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FOR TERM I
NOV-DEC 2021
EXAM

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Strictly as per the BOARD SAMPLE QUESTION PAPER 2021-22 released on 2 September 2021

CBSE 15 SAMPLE QUESTION PAPERS

(Strictly based on the MCQs Exam pattern)

CLASS 12 PHYSICS

Strictly as per the Latest Term-wise Syllabus released on 22 July 2021 (CBSE Cir. No. Acad-53/2021)

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- On Tips Notes
- Revision Notes
- Mind Maps
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OMR Sheets & Answers with Explanations

- Stand Alone MCQs
- Assertion-reason based MCQs
- Case-based MCQs

Design of the Question Paper

Typology of Questions	Section-A 25	Section-B 24	Section-C 6	Total No. of Questions 55
Stand Alone	25	19	2	46
Assertion & Reason	—	5	—	5
Case-based	—	—	4	4
Questions to be attempted	**20**	**20**	**5**	**45**

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Benefits

- Exam-Targeted,5 solved & 10 Self-Assessment Papers
- All Types of MCQs–Stand Alone, Assertion-Reason & Case-based Questions
- Answers with Explanations & OMR Sheets after each Sample Question Paper
- Academically important (AI) Questions for Board Exam
- Learn more with 'Mind Maps'
- On-Tips Notes for Quick Revision

1st EDITION **YEAR 2021**

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SYLLABUS COVERED

CENTRAL BOARD OF SECONDARY EDUCATION DELHI

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HELP US STOP PIRACY TODAY!

OSWAAL TIPS & TRICKS
TO SUCCEED AT ANY MCQs EXAM

FRETTING ABOUT AN ALL MCQs EXAM?

Till now, school exams in India had only a few Multiple-Choice Questions (MCQs) in theory papers. Though this year, the whole Term-I question paper will be MCQ-based. This means that students need to be a lot more comfortable with this question format- guess-work will hardly help now. On the bright side, MCQs can be highly scoring if approached strategically. For sure, the more concept clarity you have, the easier it will be. Other than that, let us discuss how you can better deal with MCQs.



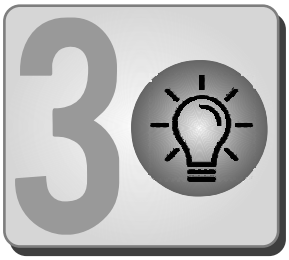
ELIMINATION TECHNIQUE

Narrow down your choices. If you are not sure about the answer, you can start by getting rid of all possibly wrong options. Look for options that just won't work. This will help figure out the high probability options and simplify your decision making process.



WORK WITH THE CLOCK

To score more in the MCQ-based, time management will also be crucial. Every paper has easy, intermediate and difficult questions. Spare 10 minutes at the start of the exam to find the easy questions and answer them first. This will boost your confidence and ensure that you have enough time left for the comparatively difficult questions. Do not give more than a couple of minutes to any question. Skip lengthy questions and come back to them at the end.



TOO UNIQUE TO BE TRUE

A choice that is very different from other options is unlikely to be the correct answer most of the time. You can easily eliminate alien concepts or terms. Many times, you will also come across out of context options, just eliminate them.



ALMOST IDENTICAL OPTIONS

Sometimes it happens that if your History question has the options- 1945, 1900, 1954 and 1923; then you can narrow down your choices to 1945 and 1954. So you instantly know what you don't need to dwell upon. The examiner has created a confusing situation and wants to test your alertness. Now if you are not sure of even these two options, try remembering where you studied this topic, was it an online lecture, was it a friend's place. This will make it easier to recollect the correct answer.

CBSE/DIR (ACAD)/2021 **Date: 02-09-2021**

Circular No: Acad 75/2021

All the Heads of Schools Affiliated to CBSE

Subject: Sample Question Papers of Classes X and XII for Term-I Exams 2021-22

Dear Principal,

The Sample Question Papers for classes X and XII Term-I Exams 2021-22 are now available at CBSE website www.cbseacademic.nic.in at the link given below:

Sample Papers Class X:

http://cbseacademic.nic.in/SQP_CLASSX_2021-22.html

Sample Papers Class XII:

http://cbseacademic.nic.in/SQP_CLASSXII_2021-22.html

(Dr. Joseph Emmanuel)
Director (Academics)

NOTICE

Important Points for Sample Question Papers

The following points are to be noted while studying/referring to the Sample Papers for Classes X & XII Term 1 for the academic session 2021-22:

1 The Multiple Choice Questions given in the sample papers are not of one mark each for all papers.

2. In the SQPs of Mathematics and all languages except English, each question carries one mark.

3. For other subjects, each question carries equal marks viz.-a-viz. the total marks given *i.e.* 40 or 35 or 25 or 15 and the weight age of marks per question will be as follows:-

Max. Marks	No. of Questions to be attempted	Marks per Question
40	50	0.80
35	50	0.70
40	45	0.88
35	45	0.77
25	40	0.625
15	25	0.60

4. If total marks scored by a candidate is in fraction, then the same will be rounded off to the next higher numerical number, for example, if the child gets 16.1 marks then the total marks will be rounded off to 17 and so on.

SYLLABUS

Latest Syllabus for Academic Year (2021-22)

PHYSICS (Code No. 042)

CLASS–XII

Physics Theory and Practical course will be done in two terms. Each term will be assessed individually.
Syllabus assigned for Term I (Theory)

Time : 90 Minutes **Max Marks: 35**

		No. of Periods	Marks
Unit I	**Electrostatics**	23	17
	Chapter–1: Electric Charges and Fields		
	Chapter–2: Electrostatic Potential and Capacitance		
Unit II	**Current Electricity**	15	
	Chapter–3: Current Electricity		
Unit III	**Magnetic Effects of Current and Magnetism**	16	18
	Chapter–4: Moving Charges and Magnetism		
	Chapter–5: Magnetism and Matter		
Unit IV	**Electromagnetic Induction and Alternating Currents**	19	
	Chapter–6: Electromagnetic Induction		
	Chapter–7: Alternating Current		
	Total	73	35

Unit I : Electrostatics **(23 Periods)**

Chapter–1 : Electric Charges and Fields

Electric Charges; Conservation of charge, Coulomb's law-force between two-point charges, forces between multiple charges; superposition principle and continuous charge distribution. Electric field, electric field due to a point charge, electric field lines, electric dipole, electric field due to a dipole, torque on a dipole in uniform electric field. Electric flux, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet

Chapter–2 : Electrostatic Potential and Capacitance

Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges; equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipole in an electrostatic field. Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarisation, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor.

Unit II : Current Electricity **15 Periods**

Chapter–3 : Current Electricity

Electric current, flow of electric charges in a metallic conductor, drift velocity, mobility and their relation with electric current; Ohm's law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity; temperature dependence of resistance. Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in

...Contd. Syllabus

parallel, Kirchhoff's laws and simple applications, Wheatstone bridge, metre bridge **(qualitative ideas only)**. Potentiometer - principle and its applications to measure potential difference and for comparing EMF of two cells; measurement of internal resistance of a cell **(qualitative ideas only)**

Unit III : Magnetic Effects of Current and Magnetism 16 Periods

Chapter–4 : Moving Charges and Magnetism

Concept of magnetic field, Oersted's experiment. Biot - Savart law and its application to current carrying circular loop. Ampere's law and its applications to infinitely long straight wire. Straight and toroidal solenoids (only qualitative treatment), force on a moving charge in uniform magnetic and electric fields. Force on a current-carrying conductor in a uniform magnetic field, force between two parallel current-carrying conductors-definition of ampere, torque experienced by a current loop in uniform magnetic field; moving coil galvanometer-its current sensitivity and conversion to ammeter and voltmeter.

Chapter–5 : Magnetism and Matter

Current loop as a magnetic dipole and its magnetic dipole moment, magnetic dipole moment of a revolving electron, bar magnet as an equivalent solenoid, magnetic field lines; earth's magnetic field and magnetic elements.

Unit IV : Electromagnetic Induction and Alternating Currents 19 Periods

Chapter–6 : Electromagnetic Induction

Electromagnetic induction; Faraday's laws, induced EMF and current; Lenz's Law, Eddy currents. Self and mutual induction.

Chapter–7 : Alternating Current

Alternating currents, peak and RMS value of alternating current/voltage; reactance and impedance; LC oscillations (qualitative treatment only), LCR series circuit, resonance; power in AC circuits. AC generator and transformer.

Syllabus assigned for Practical for Term I

Total Periods:16

First term practical examination will be organised by schools as per the directions of CBSE The record to be submitted by the students at the time of first term examination has to include a record of at least 4 Experiments and 3 Activities to be demonstrated by teacher.

Time Allowed: one and half hours **Max. Marks: 15**

Two experiments to be performed by students at time of examination	**8 Marks**
Practical record [experiments and activities]	**2 Marks**
Viva on experiments, and activities	**5 Marks**
Total	**15 Marks**

Experiments assigned for Term I

1. To determine resistivity of two / three wires by plotting a graph between potential difference versus current.
2. To find resistance of a given wire / standard resistor using metre bridge.

OR

To verify the laws of combination (series) of resistances using a metre bridge.

OR

To verify the laws of combination (parallel) of resistances using a metre bridge.

3. To compare the EMF of two given primary cells using potentiometer.

OR

To determine the internal resistance of given primary cell using potentiometer.

4. To determine resistance of a galvanometer by half-deflection method and to find its figure of merit.
5. To convert the given galvanometer (of known resistance and figure of merit) into a voltmeter of desired range and to verify the same.

OR

To convert the given galvanometer (of known resistance and figure of merit) into an ammeter of desired range and to verify the same.

6. To find the frequency of AC mains with a sonometer.

...Contd. Syllabus

Activities assigned for Term I

1. To measure the resistance and impedance of an inductor with or without iron core.
2. To measure resistance, voltage (AC/DC), current (AC) and check continuity of a given circuit using multimeter.
3. To assemble a household circuit comprising three bulbs, three (on/off) switches, a fuse and a power source.
4. To assemble the components of a given electrical circuit.
5. To study the variation in potential drop with length of a wire for a steady current.
6. To draw the diagram of a given open circuit comprising at least a battery, resistor/rheostat, key,

Practical Examination for Visually Impaired Students of XII Evaluation Scheme (Term I)

Time Allowed: one hour **Max. Marks: 15**

Identification/Familiarity with the apparatus	**3 Marks**
Written test (based on given/prescribed practicals)	**5 Marks**
Practical Record	**2 Marks**
Viva	**5 Marks**
Total	**15 Marks**

General Guidelines

- The practical examination will be of one hour duration.
- A separate list of ten experiments is included here.
- The written examination in practicals for these students will be conducted at the time of practical examination of all other students.
- The written test will be of 10 minutes duration.
- The question paper given to the students should be legibly typed. It should contain a total of 8 practical skill based very short answer type questions. A student would be required to answer any 5 questions.
- A writer may be allowed to such students as per CBSE examination rules.
- All questions included in the question papers should be related to the listed practicals. Every question should require about two minutes to be answered.
- These students are also required to maintain a practical file. A student is expected to record at least five of the listed experiments as per the specific instructions for each subject. These practicals should be duly checked and signed by the internal examiner.
- The format of writing any experiment in the practical file should include aim, apparatus required, simple theory, procedure, related practical skills, precautions etc.
- Questions may be generated jointly by the external/internal examiners and used for assessment.
- The viva questions may include questions based on basic theory/principle/concept, apparatus/ materials/ chemicals required, procedure, precautions, sources of error

Class XII

A. Items for Identification/ familiarity with the apparatus for assessment in practicals (All experiments)

Meter scale, general shape of the voltmeter/ammeter, battery/power supply, connecting wires, standard resistances, connecting wires, voltmeter/ammeter, meter bridge, screw gauge, jockey Galvanometer, Resistance Box, standard Resistance, connecting wires, Potentiometer, jockey, Galvanometer, Lechlanche cell, Daniell cell [simple distinction between the two vis-à-vis their outer (glass and copper) containers], rheostat connecting wires, Galvanometer, resistance box, Plug-in and tapping keys, connecting wires battery/power supply, Diode, Resistor (Wire-wound or carbon ones with two wires connected to two ends), capacitors (one or two types), Inductors, Simple electric/electronic bell, battery/power supply, Plug-in and tapping keys, Convex lens, concave lens, convex mirror, concave mirror, Core/hollow wooden cylinder, insulated wire, ferromagnetic rod, Transformer core, insulated wire.

...Contd. Syllabus

Experiments assigned for Term-I

1. To determine the resistance per cm of a given wire by plotting a graph between voltage and current.
2. To verify the laws of combination (series/parallel combination) of resistances by Ohm's law.
3. To find the resistance of a given wire / standard resistor using a meterbridge.
4. To compare the e.m.f of two given primary cells using a potentiometer.
5. To determine the resistance of a galvanometer by half deflection method.

❑❑

30 DAYS OF ONLY GRATITUDE!

Take it as a challenge; practice gratitude every day.

When you'll look around yourself, you'll find umpteen number of things to be grateful for. Practicing gratitude everyday will only multiply those things in your life & will ignite positive emotions in you. Here are a few things you could be grateful for. **So, get started today!**

#1 About your body.	#2 What you find beautiful.	#3 A song you love.	#4 An accomplish-ment of yours.	#5 A friend.
#6 A Smell you love.	#7 Something that makes you smile.	#8 A happy memory.	#9 Something you like about where you live.	#10 A person in your family.
#11 A food you love.	#12 An ability of yours.	#13 A person.	#14 You're looking forward to.	#15 A life lesson.
#16 A person you look up to.	#17 A personality trait of yours.	#18 An item you use every day.	#19 A freedom you are grateful for.	#20 A holiday you love.
#21 A technology.	#22 Something made you laugh.	#23 Something nice.	#24 A book magazine or podcast.	#25 Another person.
#26 Something in nature.	#27 A gift you received.	#28 Something that brings hope.	#29 A compliment you have received.	#30 Something you are passionate about.

POSITIVE AFFIRMATIONS



"Affirmations are like a seed planted in soil. Poor soil, poor growth. Rich soil, abundant growth. The more you choose to think thoughts that make you feel good, the quicker the affirmations work."

- Louise Hay





- I am confident.
- I love who I am.
- I am compassionate.
- I am responsible.
- I am a leader.
- I believe in my dreams.
- I am brave.
- I choose a positive attitude.
- I am enough.
- I am great just the way I am.
- I work hard.
- I radiate joy and love.
- I am honest.
- I ampatient.
- I help my family.
- I am strong.
- I can achieve my goals.
- I make good decisions.
- I am diligent.
- I am thoughtful.
- I am talented.
- I am loved.
- I am generous.
- I accept and love myself.
- I am unique.
- I am wonderfully made.
- I am creative.
- Good things happen to me.
- I am loving.
- I am kind.
- I am joyful.
- I care about others.
- I am important.
- I like myself.
- It's going to be a great day.
- I learn from my mistakes.
- I make friends easily.
- I am worthy.
- I am open to new experiences.
- I am beautiful.
- I am deserving of good things.
- I am grateful.
- I believe in me.
- I respect myself and I respect others.

Our mind starts believing what we repeatedly think or say. We, at Oswaal Books, resonate with this belief. So, we want all our readers to create their own positive affirmations! A positive affirmation is something spoken aloud that you want to believe or want to be true. Repeating positive affirmations daily can help shift your internal dialogue from negative to positive.

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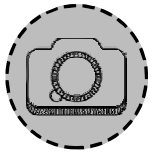
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DHULE	Navjeevan Book Stall, 7020525561
BHUSAWAL	Anil Book Depot, 9403942906
	ODISHA
CUTTACK	A. K. Mishra Agencies, 9437025991, 9437081319
BHUBANESHWAR	M/s Pragnya, 8847888616, 9437943777, Bharati Book House, 9438420527
BARIPADA	Trimurthi Book World, (0679) 2253336 9437034735
BALASORE	Sri Maa Store, 9668822246
	PUNJAB
LUDHIANA	Amit Book Depot., 9815807871, Ravi Book Shop, 9815200925
JALANDHAR	Cheap Book Store, 9872223458, 9878258592,
	Gaurav the Book World, 9478821183, Subhash Book Depot, 9876453625
	City Book Shop, 9417440753
PATIALA	Adarsh Enterprises, 9814347613
	RAJASTHAN
KOTA	Raj Traders, (0744) 2429090, 9309232829, 8005529594,
	Radhe Traders, 8769802001, Perfect Stationers & Gen. Shoppe, 9829863904
	Vardhman Book Depot, 9571365020
BHILWARA	Nakoda Book Depot, (01482) 243653, 9214983594
JAIPUR	J K Enterprises, 9460983939, 9414782130
	Saraswati Book House, (0141) 2610823, 9829811155
	Ravi Entreprises (0141) 2602517, 9828944479
	TAMIL NADU
COIMBATORE	Majestic Book House, (0422) 2384333
CHENNAI	Arraba Book Traders, (044) 25387868, 9841459105, M.R. Book Store (044)
	25364596, Indian Book House, (044) 24327784, 9094129595,
	Kalaimagal Store, (044) 5544072, 9940619404, Vijaya Stores, 9381037417
	Bookmark It-Books & Stat. Store, 7305151653, M.K. Store, 9840030099
	Tiger Books Pvt. Ltd., 9710447000
PUDUCHERRY	Sri Saraswathi Book Stall, (04132) 222283, 9092626287
OOTY	Bharat & Co., 9095552155
	TRIPURA
AGARTALA	Book Corner, 9856358594, Book Emporium, (0381) 2391509, 9436460399
	UTTAR PRADESH
AGRA	Sparsh Book Agency, 9412257817
	Om Pustak Mandir, (0562) 2464014, 9319117771,
	Panchsheel Books, 9412257961, 9412257962,
	Ajay Book Depot, 9411205449
ALIGARH	Shaligram Agencies (0571) 2421887, 9412317800
ALLAHABAD	Mehrotra, (0532) 2266865, 9415636890
AZAMGARH	Sasta Sahitya Sadan, 9450029674
GORAKHPUR	Atul Pustak Bhandar, 9935210622
LUCKNOW	Rama Book Depot, (0522) 4080133, 9956922433 (Retail), Vyapar Sadan, 7607102462
	Azad Book Depot Pvt. Ltd., 7317000250
MORENA	Shri Ram Book Store, 9424603124
MEERUT	Ideal Book Depot, (0121) 4059252, 9837066307, Garg Book Depot, 9458553028
VARANASI	Bokaro Student Friends, (0542) 2401250, 8299344607
	Gupta Books, 9918155500, 8707225564
	UTTARAKHAND
RUDRAPUR	Vinod Pustak Bhandar, 9927866188
DEHRADUN	Brothers Pustak Bhandar, 9897833882
KASHIPUR	Neelam Book Depot, 9927305987
	WEST BENGAL
KOLKATA	Oriental Publishers & Distributor (033) 40628367,
	Katha 'O' Kahani, (033) 22196313, 22419071,
	Saha Book House, (033) 22193671, 9333416484,
	New National Book Store, 8697601392, United Book House, 9831344622
SILIGURI	Agarwal Book House, (0353) 2535274, 9832038727

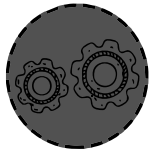
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WRITING NOTES

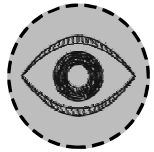
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MIND MAPS
Learning Made Simple





anytime, as frequency as you like till it becomes a habit!



When?

What?

Presenting words and concepts as pictures!!

MIND MAP
AN INTERACTIVE MAGICAL TOOL

Why?

- To Unlock the imagination and come up with ideas
- To Remember facts and figures easily
- To Make clearer and better notes
- To Concentrate and save time
- To Plan with ease and ace exams

Result



Learning made simple
'a winning combination'

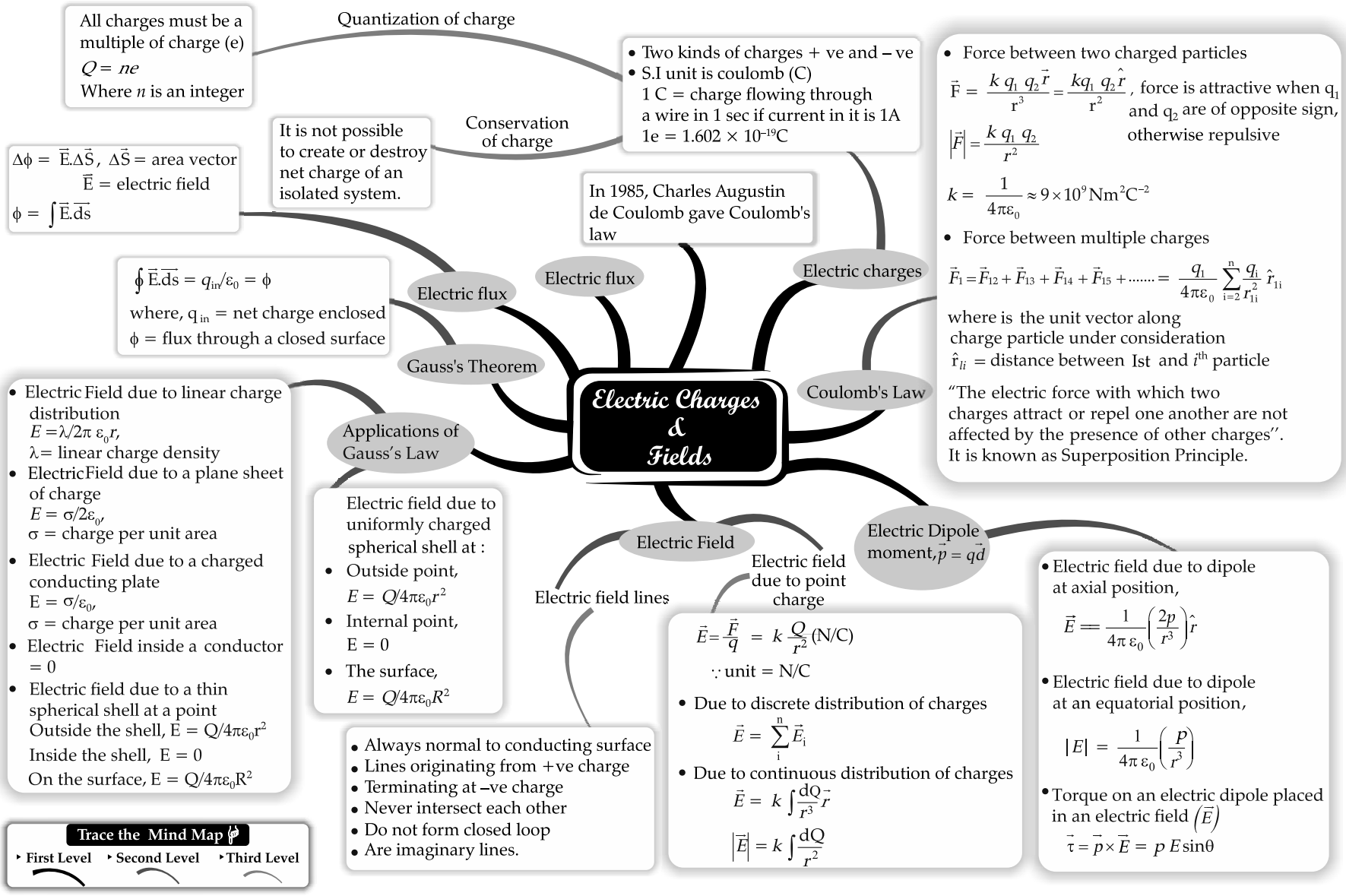
How?



With a blank sheet of paper coloured pens and your creative imagination!

What are Associations?

It's a technique connecting the core concept at the Centre to related concepts or ideas. Associations spreading out straight from the core concept are the First Level of Association. Then we have a Second Level of Association emitting from the first level and the chronology continues. The thickest line is the First Level of Association and the lines keep getting thinner as we move to the subsequent levels of association. This is exactly how the brain functions, therefore these Mind Maps. Associations are one powerful memory aid connecting seemingly unrelated concepts, hence strengthening memory.


Electric Charges & Fields
Quantization of charge
All charges must be a multiple of charge (e)
$Q = ne$
Where n is an integer
Conservation of charge
It is not possible to create or destroy net charge of an isolated system.
• Two kinds of charges + ve and – ve
• S.I unit is coulomb (C)
1 C = charge flowing through a wire in 1 sec if current in it is 1A
1e = 1.602×10^{-19}C
In 1985, Charles Augustin de Coulomb gave Coulomb's law
Electric charges
• Force between two charged particles
$\vec{F} = \frac{k\, q_1\, q_2 \vec{r}}{r^3} = \frac{k q_1\, q_2 \hat{r}}{r^2}$, force is attractive when q_1 and q_2 are of opposite sign, otherwise repulsive
$|\vec{F}| = \frac{k\, q_1\, q_2}{r^2}$
$k = \frac{1}{4\pi\varepsilon_0} \approx 9 \times 10^9 \text{Nm}^2\text{C}^{-2}$
• Force between multiple charges
$\vec{F}_1 = \vec{F}_{12} + \vec{F}_{13} + \vec{F}_{14} + \vec{F}_{15} + \ldots\ldots = \frac{q_1}{4\pi\varepsilon_0} \sum_{i=2}^{n} \frac{q_i}{r_{1i}^2} \hat{r}_{1i}$
where is the unit vector along charge particle under consideration
$\hat{r}_{li}$ = distance between Ist and i^{th} particle
"The electric force with which two charges attract or repel one another are not affected by the presence of other charges''. It is known as Superposition Principle.
Coulomb's Law
Electric Flux
$\Delta\phi = \vec{E}.\Delta\vec{S}$, $\Delta\vec{S}$ = area vector
$\vec{E}$ = electric field
$\phi = \int \vec{E}.\overrightarrow{ds}$
Electric flux
$\oint \vec{E}.\overrightarrow{ds} = q_{in}/\varepsilon_0 = \phi$
where, q_{in} = net charge enclosed
ϕ = flux through a closed surface
Gauss's Theorem
Applications of Gauss's Law
• Electric Field due to linear charge distribution
$E = \lambda/2\pi\varepsilon_0 r$,
λ = linear charge density
• Electric Field due to a plane sheet of charge
$E = \sigma/2\varepsilon_0$,
σ = charge per unit area
• Electric Field due to a charged conducting plate
$E = \sigma/\varepsilon_0$,
σ = charge per unit area
• Electric Field inside a conductor = 0
• Electric field due to a thin spherical shell at a point
Outside the shell, $E = Q/4\pi\varepsilon_0 r^2$
Inside the shell, E = 0
On the surface, $E = Q/4\pi\varepsilon_0 R^2$
Electric Field
Electric field due to uniformly charged spherical shell at :
• Outside point,
$E = Q/4\pi\varepsilon_0 r^2$
• Internal point,
E = 0
• The surface,
$E = Q/4\pi\varepsilon_0 R^2$
Electric field lines
• Always normal to conducting surface
• Lines originating from +ve charge
• Terminating at –ve charge
• Never intersect each other
• Do not form closed loop
• Are imaginary lines.
Electric field due to point charge
$\vec{E} = \frac{\vec{F}}{q} = k\frac{Q}{r^2}$ (N/C)
$\because$ unit = N/C
• Due to discrete distribution of charges
$\vec{E} = \sum_i^n \vec{E}_i$
• Due to continuous distribution of charges
$\vec{E} = k\int \frac{dQ\vec{r}}{r^3}$
$|\vec{E}| = k\int \frac{dQ}{r^2}$
Electric Dipole moment, $\vec{p} = \vec{qd}$
• Electric field due to dipole at axial position,
$\vec{E} = \frac{1}{4\pi\varepsilon_0}\left(\frac{2p}{r^3}\right)\hat{r}$
• Electric field due to dipole at an equatorial position,
$|E| = \frac{1}{4\pi\varepsilon_0}\left(\frac{P}{r^3}\right)$
• Torque on an electric dipole placed in an electric field $(\vec{E})$
$\vec{\tau} = \vec{p} \times \vec{E} = pE\sin\theta$
Trace the Mind Map
First Level
Second Level
Third Level

Electrostatic Potential and Capacitance

Electric potential

- Work done per unit test charge by an external agent in moving the test charge from reference point to the desired point. Its SI unit is J/C
  $V_0 = W/q_0$.

Electric potential due to a point charge

$V_P = Q/4\pi\varepsilon_0 r$

Potential due to a system of charges

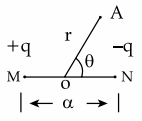
$V = \frac{1}{4\pi\varepsilon_0}\sum\frac{Q_i}{r_i}$

Potential due to a dipole

$V = \frac{1}{4\pi\varepsilon_0}\frac{p\cos\theta}{r^2}$

Where, $p = qd$

$\theta = \angle AON$



At $\theta = 0^\circ, V = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^2}$ [axial position]

At $\theta = 90^\circ$, $V = 0$ [equitorial position]

In 1774, Alessandro Volta wrote treatise"on the forces of attraction of electric fire".

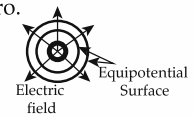
Conductors & Insulators

Conductors	Insulators
A material which when placed in an electric field, the free electrons move in a direction opposite to the field.	material in which electrons are tightly bound, and when exposed in an electric field, electrons do not move *i.e.* having no free electrons.

- Electric field inside a conductor is always zero.
- Electric field is always perpendicular to the charged surface.
- In static state, there will be no additional charge in a conductor.

Equipotential surface

- Potential is same at all the points of the surface.
- Component of electric field parallel to an equipotential surface is zero.



Dielectric

- Force $F = \frac{q_1\ q_2}{4\pi K\varepsilon_0 r^2}$, K = dielectric constant of medium
- A dielectric is an electrical insulator that can be polarized by "application of" electric field.

Capacitance, $C = \frac{Q}{V}$

Capacitance of a parallel plate capacitor,
$C = K\varepsilon_0 A/d$, K = dielectric constant

Capacitance when material slab is inserted between the plates
$C = K\varepsilon_0 A/[Kd - x(K-1)]$
where, x = thickness of the slab inserted

Energy stored in a capacitor,
$U = \frac{1}{2}CV^2 = \frac{Q^2}{2C} = 1/2\ QV$

Series grouping of capacitors,
$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + ---+ \frac{1}{C_n}$
For two, $C = \frac{C_1C_2}{C_1 + C_2}$

Parallel grouping of capacitors,
$C = C_1 + C_2 + C_3 + ---- + C_n$
for two capacitors, $C = C_1 + C_2$

Capacitance of a spherical capacitor,
$C = 4\pi\varepsilon_0/\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$
For isolated sphere,
$C = 4\pi\varepsilon_0 R$

Electric potential energy

- It is negative count of work done by the electric force as the configuration of the system changes.
- $Ur_2 - Ur_1 = -W = \frac{q_1 \cdot q_2}{4\pi\varepsilon_0}\left(\frac{1}{r_2} - \frac{1}{r_1}\right)$
- If the separation between charges is 'r', then $U_{(r)} = \frac{q_1 \cdot q_2}{4\pi\varepsilon_0 r}$
- Potential Difference,
  $V_B - V_A = \frac{U_B - U_A}{q}$
  $U_B - U_A$ = Change in Potential energy
  q = Test charge

Potential energy of a dipole

$dU = pE\sin\theta d\theta$
If we choose P.E. of dipole to be zero when $\theta = 90^\circ$, then

$U_\theta - U_{90^\circ} = \int_{90^\circ}^{\theta} pE\sin\theta\, d\theta$

If it is rotated through angle θ against the torque,

$U_\theta = -pE\cos\theta = -\vec{p}\cdot\vec{E}$

Trace the Mind Map

First Level · Second Level · Third Level

Current Electricity

Electric Current

Rate of flow of charge through an area,

$i = \frac{Q}{t}$

$i = \int \vec{J}.\vec{ds}$

Current density

$\vec{J} = \frac{\Delta i}{\Delta s \cos\theta} = \sigma E$

Δs = Area of cross-section

θ = Angle between Area vector and current flow

σ = Conductivity

Drift velocity

$V_d = \frac{i}{neA} = \frac{J}{ne}$

Mobility

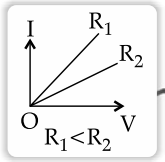
$\mu = \frac{V_d}{E} = \frac{e\tau}{m}$

τ = Average collision time

Ohm's Law

$J = \sigma E$ or $V = IR$

Characteristics



Resistance

$R = \rho \frac{l}{A} \tau$

Resistivity

$\rho = \frac{1}{\sigma} \Omega$ m

Conductivity

$\sigma = J/E$

Grouping of Resistors

Series grouping

$R = R_1 + R_2 + R_3 + - - - + R_n$

For two resistors, $R = R_1 + R_2$

Parallel grouping

$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + - - + \frac{1}{R_n}$

For two resistors

$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$

Temperature Dependence of Resistance

$R = R_0 [1 + \alpha (T - T_0)]$

$\rho = \rho_0 \quad [1 + \alpha (T - T_0)]$

R = Resistance at temperature T

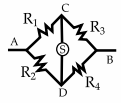
R_0 = Resistance at temperature T_0

α = Coefficient of resistivity

Wheatstone Bridge

- Condition for balanced wheatstone bridge

If $\frac{R_1}{R_2} = \frac{R_3}{R_4}$



- $V_c = V_D$

No current through G

Meter Bridge

Unknown resistance

$S = \frac{R(100-l)}{l}$

l = Balancing length

R = Known resistance

Potentiometer

$P = \frac{V_A - V_B}{l} = \frac{\text{Potential difference}}{\text{Length of wire}}$

Comparison of emf, $\frac{E_1}{E_2} = \frac{l_1}{l_2}$

Internal Resistance (r) = $R\left(\frac{l_1}{l_2} - 1\right)$

l_1 and l_2 are lengths of null point

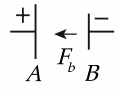
Electric cell

It is a device which maintains a potential difference between its two terminals.

EMF

emf = $E = \frac{W}{q} = \frac{F_b}{d}$

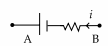
It is equal to the potential difference between the terminals when the they are not connected externally.



Internal Resistance

$V_A - V_B = E - ir$

r = Internal resistance of the cell



Grouping of Cell

Parallel grouping

$E_{eq} = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2}$, $i = \frac{E_{eq}}{R + \frac{r_1 r_2}{r_1 + r_2}}$

Series grouping

$i = \frac{E_1 + E_2}{R_1 + (r_1 + r_2)} = \frac{E_0}{R_1 + R_2}$

$E_0 = E_1 + E_2$, $R_2 = r_1 + r_2$

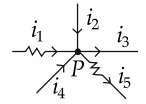
Kirchhoff's Law

Junction Law

$i_1 + i_2 + i_4 = i_3 + i_5$

The algebraic sum of all currents directed towards a point (junction) is zero.

$\Sigma I_p = 0$



Loop Law

The algebraic sum of all the potential difference along a closed loop is zero.

$\Sigma E = 0$

Trace the Mind Map

First Level ▸ Second Level ▸ Third Level

Moving Charges & Magnetism

- It is a region around a magnet or current carrying conductor or a moving charge in which its magnetic effect can be felt
- SI unit is Tesla(T) = weber/m^2
- 1 Gauss = 10^{-4} Tesla where gauss is the CGS unit

Magnetic Field $(\vec{B})$

$\vec{F} = q(\vec{v} \times \vec{B})$

$= qvB \sin\theta$

- For $\theta = 0, \vec{F} = 0$ along the magnetic field
- For $\theta = 90°$, *i.e.* if charge's velocity is perpendicular to field direction, force is perpendicular to both field and velocity

$F = qvB = \dfrac{mv^2}{r}$

$r = \dfrac{mv}{qB}$ = Radius of the circle in which charge rotates

Time period $(T) = \dfrac{2\pi m}{qB}$

ν(frequency) $= \dfrac{1}{T} = \dfrac{qB}{2\pi m}$

If $\theta \neq 0, 180°, 90°$

Then, $F = qvB \sin\theta$

And the charge particle will follow helical path whose

$r = \dfrac{mv_\perp}{qB}$ and pitch $= V_\parallel \times T = V_\parallel \times \dfrac{2\pi m}{qB}$

Cyclotron

To accelerate a charged particle (except electron)

Max. energy gained $= \left(\dfrac{q^2B^2}{2m}\right)p^2$

Oersted's Law

In April 1820, Hans Christian Oersted discovered that flow of current in a wire can deflect a nearby magnetic compass needle.

Ampere's Law

$\oint \vec{B}.\vec{dl} = \mu_0 i$

where i = Total current crossing the area bounded by closed curve.

Solenoid

- Magnetic field at a point inside due to a long solenoid, $B = \mu_0 ni$
- At a point on one end $B = \dfrac{\mu_0 ni}{2}$

where n = number of turns per unit length along the length of solenoid.

Magnetic field due to Toroid

$B = \dfrac{\mu_0 Ni}{2\pi r}$, N = Total Number of turns

i = Current in toroid

Force on a current carrying conductor

$d\vec{F} = i(d\vec{l} \times \vec{B})F = ilB$

Force between parallel current carrying wires

$F = \dfrac{\mu_0 i_1 i_2}{2\pi d}$

Torque experienced by a loop in uniform magnetic field

$\vec{\tau} = \vec{M} \times \vec{B}$

$\vec{\tau} = NBiA$

Definition of Ampere

If two parallel wire kept 1 m apart, if and $F = 2 \times 10^{-7}$ N, then current = 1A in each wire.

Sensitivity

Voltage sensitivity = NBA/CG current sensitivity = NBA/C

Galvanometer

Ammeter

$S = \dfrac{Ig}{I_T - Ig}G$

Voltmeter

$R = \dfrac{V}{Ig} - G$

Magnetic Force on a moving charge

biot-Savart Law

$d\vec{B} = \dfrac{\mu_0}{4\pi}\dfrac{id\vec{l} \times \vec{r}}{r^3}$ [θ = angle between $d\vec{l}$ and $\vec{r}$]

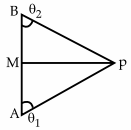
$dB = \dfrac{\mu_0}{4\pi}\dfrac{idl\sin\theta}{r^2}$ [Direction of field will be perpendicular to the plane containing current element and the point of observation]

where $\mu_0 = \dfrac{1}{\varepsilon_0 c^2}$

Magnetic field due to straight current carrying wire

$B = \dfrac{\mu_0 i}{4\pi d}(\sin\theta_1 + \sin\theta_2)$

where θ_1 and θ_2 are the angles corresponding to the lower and upper ends respectively



i.e $\theta_1 = 0$

$\theta_2 = \pi$

$B = \dfrac{\mu_0 i}{2\pi d}$

Field due to a current carrying circular ring

Field at the centre

$B = \dfrac{\mu_0 i}{2a}$

Field at a point far away from the centre

$B = \dfrac{\mu_0 i a^2}{2(a^2 + d^2)^{3/2}}$

Field at an axial point

i.e. for $d >>> a$

$B = \dfrac{\mu_0 i a^2}{2d^3}$

Trace the Mind Map

First Level · Second Level · Third Level

Magnetism & Matter

Trace the Mind Map
- First Level
- Second Level
- Third Level

Dipole moment

Current loop of area A = πr^2 carrying current i may be replaced by a magnetic dipole of dipole moment, $\mu = md = iA$

Circular Loop

Revolving electron

$$|\vec{\mu}| = iA = \frac{ev}{2\pi r} \times \pi r^2$$
$$= evr/2$$
$$\vec{\mu} = \frac{-e}{2m_e}\vec{L}$$

$\mu = md$

m = Magnetic charge or pole strength

d = Separation between poles

r = Radius of circular orbit

e = Charge on electron

v = Speed of electron;

L = Angular momentum

m_e = Mass of electron

Solenoid

$\mu = NIA$,

N = Number of turns

I = Current

A = Area

Earth's magnetic field

Earth is a natural source of magnetic field having geometric north and geometric south pole

Declination

Angle between magnetic meridian and geographical meridian.

Inclination or dip (δ)

Angle made by Earth's magnetic field with horizontal in the magnetic direction,
$\delta_{equator} = 0$, $\delta_{pole} = 90°$

Horizontal component

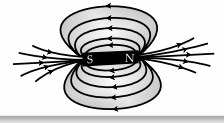
$B_H = B\cos\theta$

B_H (at pole) = 0

B_H (at equator) is maximum

Magnetic field lines

Continuous imaginary lines which represent the direction of magnetic field.



Bar magnet

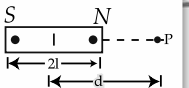
Magnetic field intensity

- End–on–position

$$= \frac{\mu_0}{4\pi}\frac{2M}{d^3}$$

$M = 2ml$

$d >>> l$

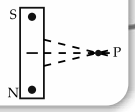


- Broadside Position,

$$B = \frac{\mu_0}{4\pi}\frac{M}{(d^2+l^2)^{3/2}}$$

For $d >>> l$,

$B = \mu_0 M/4\pi d^3$



Potential energy of a Field-Magnet System

$U_0 = U_0 - U_{90°} = -MB\cos\theta = -\vec{M}.\vec{B}$

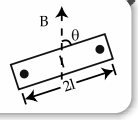
we take P.E. at $\theta = 90°$ to be zero

Torque

$\vec{\tau} = \vec{M} \times \vec{B} = MB\sin\theta$

$M = 2ml$

B = Magnetic field



Magnetic terms

Magnetic intensity

$H = \frac{B_0}{\mu}$

Magnetic permeability

$\mu = \mu_0(1 + c_m)$

Magnetic Susceptibility

$\chi = \frac{I}{H}$

Intensity of magnetization

$I = \frac{M}{V}$

Time period oscillating bar magnet

$T = 2\pi\sqrt{\frac{I}{MB}}$

Magnetic substance

Para-magnetism

Tendency to increase the magnetic field due to magnetization,
e.g. Al, Mn (c_m low and –*ve*, $\mu_r > 1$)

Diamagnetism

Tendency of strong magnetization in the direction of magnetic field.
e.g. Fe, Co, Ni, ($\mu_r, x_m >> 1$)

Ferromagnetism

Tendency to magnetise in a direction opposite to direction of magnetic field
e.g. Bi, Cu, Hg, Ni.
($\mu_r, x_m < 1$)

Electromagnets

Magnet in which the magnetic field is produced by an electric current. Magnetic field disappears when current is turned off.

Trace the Mind Map
- First Level
- Second Level
- Third Level

Electromagnetic Induction

In 1831, Michael Faraday discovered electromagnetic induction and James Clerk Maxwell mathematically described it.

Faraday's law of electromagnetic induction

1. Whenever magnetic flux through an area bounded by a closed conducting loop changes, an emf is produced in the loop.
2. The emf is given by $E = -d\phi/dt$ where $\phi = \int \vec{B}.\vec{ds}$ is the magnetic flux through the area.

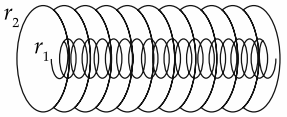
Mutual induction

$\phi = Mi$

$\frac{d\phi}{dt} = -M\frac{di}{dt}$

$M_{12} = \mu_0 n_1 n_2 \pi r_1^2 l$

$M_{21} = \mu_0 n_1 n_2 \pi r_2^2 l$



Emf induced in an AC generator, $E = NBA\omega \sin \omega t$

Lenz's law

The direction of the induced current is such that it opposes the change that has induced it.

Induced current

$I = \frac{E}{R} = -\frac{1}{R}\frac{d\phi}{dt}$

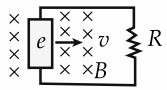
Induced EMF

Motional EMF

$E = \left|\frac{d\phi}{dt}\right| = \left|Bl\frac{dx}{dt}\right|$

$= Blv$

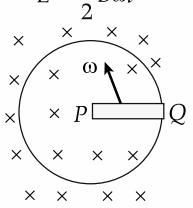
$i = Blv/(R+r)$



r = Resistance of rod moving with velocity v in uniform magnetic field $\vec{B}$

EMF induced in a rotating conductor

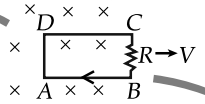
$E = \frac{-d\phi}{dt}$



$E = \frac{1}{2}B\omega l^2$

Where l = Length of rod

Rectangular loop



EMF induced

$E = vBl$

$i = \frac{vBl}{R}$

Magnetic force on the loop

$F = B^2l^2v/R$

= Force required to move the loop with constant velocity (v)

Thermal power developed in the loop is

$P = \frac{v^2B^2l^2}{R}$

Eddy current

It is induced when magnetic flux linked with the conductor changes.

Self induction

If we consider a solenoid of N turns, the flux through each turn, $\phi = \int \vec{B}.\vec{ds}$.

EMF induced between the ends of coil, $E = -N\frac{d}{dt}\int \vec{B}.\vec{ds}$

Self inductance of long solenoid

$L = \mu_0 n^2 \pi r^2 l$

n = Number of turns per unit length

ϕ = Flux = $(\mu_0 ni)\,\pi r^2$

r = Radius of each loop of solenoid

- **Growth of current in LR Circuit**

  $i = \frac{E}{R}(1 - e^{tR/L}) = i_0(1 - e^{-t/r})$

- **Decay of current**

  $i = i_0 e^{-t/r}$

- **Energy stored in an Inductor**

  $U = \frac{1}{2}Li^2$

Alternating Current

AC Current

Direction of current changes alternatively
$i = i_0 \sin\omega t$
$v = v_0 \sin\omega t$

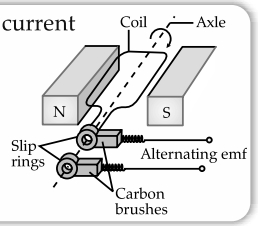
- RMS value or root mean square value
  - $i_{rms} = i_0/\sqrt{2}$
  - $v_{rms} = v_0/\sqrt{2}$
- Mean value or Average value
  - $i_{mean} = 2i_0/\pi$
  - $v_{rms} = 2v_0/\pi$
- Peak value or Maxm value
  - $i_0 = \sqrt{2}\, i_{rms}$
  - $v_0 = \sqrt{2}\, v_{rms}$

Contribution

In 1883, Nikola Tesla inverted AC motor, AC generator and AC transmission technology.

A C Generator

A device generating alternating current having elements magnet, Armature and graphite Brushes
emf induced through coil
$E = NBA\,\omega \sin\omega t$
$i = E/R = NBA\,\omega \sin\,\omega t/R$



Transformer

It is used to obtain a high AC voltage from a Low–voltage AC source or vice–versa

- Efficiency of a transformer
  - η = output power/Input power
  - 99% efficiency can easily achieved
- Turns ratio
  - $\frac{E_s}{E_p} = \frac{I_p}{I_s} = \frac{N_s}{N_p} = K$

Power in AC Circuit

$P = E_{rms} i_{rms} \cos\phi = \frac{E_0}{\sqrt{2}} \times \frac{i_0}{\sqrt{2}} \cos\phi = \frac{1}{2} E_0 i_0 \cos\phi$

Impedance

The ratio of emf applied and the current produced in an AC circuit
$Z = E_0/i_0$ Ohm

Reactance

The hindrance offered by inductor or capacitor or both to the flow of AC (X_L or X_C)

A C Circuits

- Inductive (L) circuit
  - $i = i_0 \sin\left(\omega t - \frac{\pi}{2}\right)$
  - Phase difference b/w V&I, $\phi = \pi/2$
  - Power factor $\cos(\phi) = 0$
  - Voltage leads current by $\pi/2$
  - $P = 0$
- Capacitive (C) circuit
  - $i = i_0 \sin\left(\omega t + \frac{\pi}{2}\right)$
  - $\phi = \pi/2$ or $-\pi/2$
  - Power factor $\cos\phi = 0$
  - Power $(P) = 0$
  - Current leads the voltage by $\pi/2$
- Resistive (R) circuit
  - $i = i_0 \sin(\omega t)$
  - $\phi = 0°$
  - $\cos\phi = 1$
  - $P = V_0 I_0/2$
  - Current & voltage both are in same phase
- R–C circuit
  - $i = i_0 \sin(\omega t + \phi)$
  - $Z = \sqrt{R^2 + X_c^2}$
  - $X_c = 1/\omega C$
  - $\tan\phi = 1/\omega CR$
  - $i_0 = E_0/Z$
  - Power factor $\cos\phi = \frac{R^2}{\sqrt{R^2 + X_c^2}}$
  - current leading.
- L–C circuit
  - $i = i_0 \sin\left(\omega t \pm \frac{\pi}{2}\right)$
  - $X = X_L - X_C$
  - $\phi = \pi/2$
  - Power factor = 0, Either voltage or current leading
- L–R circuit
  - $i = i_0 \sin(\omega t + \phi)$
  - $Z = \sqrt{R^2 + X_L^2}$
  - $X_L = \omega L$
  - $\tan\phi = \omega L/R$
  - $i_0 = E_0/Z$
  - power factor = R/Z
  - voltage is leading
- L–C–R circuit
  - $i = i_0 \sin(\omega t \pm \phi)$
  - $Z = \sqrt{R^2 + (X_c - X_L)^2}$
  - $X = X_c - X_L = \left(\frac{1}{\omega c} - \omega L\right)$
  - $\tan\phi = \left(\frac{1}{\omega c} - \omega L\right)/R$, $i_0 = \frac{E_0}{Z}$

Trace the Mind Map
First Level · Second Level · Third Level

OSWAAL EXAM TOOLS

ON TIPS NOTES

Note making is a skill that we use in many walks of life : at school, university and in the world of work. However, accurate note making requires a thorough understanding of concepts. We, at Oswaal, have tried to encapsulate all the chapters from the given syllabus into the following **ON TIPS NOTES**. These notes will not only facilitate a better understanding of concepts, but will also ensure that each and every concept is taken up and every chapter, is covered in totality. So go ahead and use these to your advantage... go get the **OSWAAL ADVANTAGE !!**

Unit-I : Electrostatics

CHAPTER 1 : Electric Charges and Fields

UNITS AND DIMENSIONS

Physical Quantity	Symbol	Dimension	Unit
Vector area elements	$\vec{\Delta s}$	$[L^2]$	m^2
Electric field	$\vec{E}$	$[MLT^{-3}A^{-1}]$	V/m Or NC^{-1}
Electric flux	ϕ	$[ML^3T^{-3}A^{-1}]$	Vm
Dipole moment	$\vec{p}$	[LTA]	Cm
Linear Charge density	λ	$[L^{-1}TA]$	Cm^{-1}
Surface Charge density	σ	$[L^{-2}TA]$	Cm^{-2}
Volume Charge density	ρ	$[L^{-3}TA]$	Cm^{-3}

IMPORTANT RESULTS AND FORMULAE

1. Charges developed on bodies, when they are rubbed against each other are called as frictional charges.
2. The charge on a body is expressed as $q = \pm ne$, where n is an integer (*i.e.*, no. of electrons present on the body) and e is the charge on the electron. Charge is additive in nature & always conserved. The charge on electron is $e^- = -1.6 \times 10^{-19}$ C and charge on proton is $e^+ = +1.6 \times 10^{-19}$ C.
3. Total positive or negative charge on an object of mass m having mass number A and atomic number Z, is given as :

   $$q = \frac{m\mathrm{N}}{\mathrm{A}} \times \mathrm{Z}$$

   Here, $\mathrm{N} = 6.02 \times 10^{23}$, Avogadro number.
4. When two charges q and q_0 separated by a distance r, the electrostatic force experienced by them is given as : $\mathrm{F} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{qq_0}{r^2}$. This is Coulomb's law.

5. $\frac{1}{4\pi\varepsilon_0} \cong 9 \times 10^9\ \text{Nm}^2\ \text{C}^{-2}$, ε_0 has a value of $8.85 \times 10^{-12}\ \text{C}^2/\text{Nm}^2$ and is a natural constant known as permittivity of free space.

6. The electric field strength due to a point source charge q at an observation point A at a distance r from the source charge is given by :

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{r^2} \hat{r}\ .$$

The unit of electric field is NC^{-1}.

7. If a test charge q_0 is placed at a point where electric field is $\vec{E}$, then force on the test charge is $\vec{F} = q_0 \vec{E}$.

8. The product of the magnitude of the either charge (q) of the dipole and the separation (l) between the charges is called electric dipole moment (p_e), *i.e.*, $p_e = ql$, l = distance (from $-q$ to $+q$).

9. Electric field due to a short dipole at any point, making angle θ with the axial line is given by :

$$\vec{E} = \frac{1}{4\pi\varepsilon_0} \times \frac{\vec{p}_e}{r^3} (1 + 3\cos^2\theta)^{1/2} = \frac{\vec{p}_e}{4\pi\varepsilon_o r^3} \sqrt{1 + 3\cos^2\theta}$$

10. For a short dipole, we have $r >> l$, the electric field on the axial line is $\vec{E}_a = \frac{1}{4\pi\varepsilon_0} \cdot \frac{2\vec{p}_e}{r^3}$.

11. For a short dipole, we have $r >> l$, the electric field on the equatorial line is $\vec{E}_e = \frac{1}{4\pi\varepsilon_0} \cdot \frac{\vec{p}_e}{r^3}$

12. Electric field due to circular loop of charge,

$$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{qx}{(a^2 + x^2)^{3/2}}$$

if $x >> a$ then, $\quad E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{x^2}$

13. **(a)** A dipole of moment $\vec{p}_e$ in electric field $\vec{E}$, experiences a torque given by : $\vec{\tau} = \vec{p}_e \times \vec{E}$ or $\tau = p_e E \sin\theta$.

(b) The torque is minimum for $\theta = 0°$ or $180°$. *i.e*, $\tau_{min} = 0$, when $\theta = 0°$ or $180°$. In this position, the dipole is said to be in equilibrium.

(c) The equilibrium of the dipole is stable for $\theta = 0°$ and it is unstable for $\theta = 180°$.

(d) The torque is maximum for $\theta = 90°$, *i.e.*, we find $\tau_{max} = p_e E$, when $\theta = 90°$.

(e) As θ increases from 0° to 180°, τ first increases, becomes maximum and then decreases to zero.

14. The electrostatic potential energy of a dipole of moment $\vec{p}_e$ in uniform electric field $\vec{E}$ is :

$U_p = -\vec{p}_e \cdot \vec{E} = -p_e E \cos\theta$

(i) For $\theta = 0°$ we have $U_p = -p_e E$.
It is the minimum value of the potential energy and the dipole is in stable equilibrium.

(ii) For $\theta = 90°$, we have $U_p = 0$.
The dipole is in unstable equilibrium.

(iii) For $\theta = 180°$, we have $U_p = p_e E$. (Max)

15. The flux ϕ of electric field E through a small area element Δs is given by $\Delta\phi = \vec{E} \cdot \Delta\vec{s}$,

where $\Delta\vec{s}$ is vector area element. S.I. unit of flux is $Nm^2\ C^{-1}$.

16. **Gauss's Theorem :** The total electric flux through a closed surface enclosing a charge is equal to $1/\varepsilon_0$ times the charge enclosed.

Mathematically, $\phi_E = \oint \vec{E}.\vec{ds} = \frac{q}{\varepsilon_0}$.

17. **Applications of Gauss's Theorem**

Electric field :

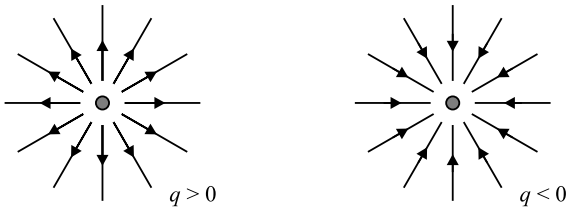
(a) Due to an infinitely long straight uniformly charged wire ; $\vec{E} = \frac{\lambda}{2\pi\varepsilon_0 r}\hat{n}$.

(b) Due to uniformly charged infinite plane sheet ; $\vec{E} = \frac{\sigma}{2\varepsilon_0}\hat{n}$.

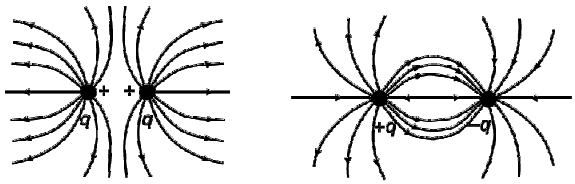
IMPORTANT FIGURES

Electric Field Lines :

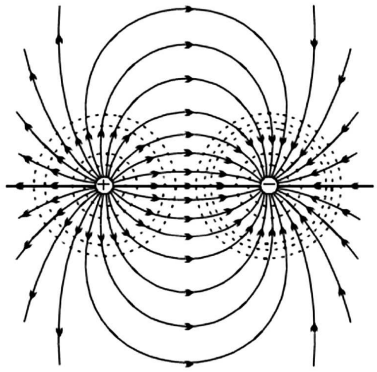
1. In case of Isolated point charges :



2. In case of a system of two charges :



Equipotential Surfaces due to a Dipole :



CHAPTER 2 : Electrostatic Potential and Capacitance

UNITS AND DIMENSIONS

Physical quantity	Symbol	Dimension	Unit
Electrical Potential	V	$[ML^2T^{-3}A^{-1}]$	V
Capacitance	C	$[M^{-1}L^{-2}T^4A^2]$	F
Polarisation density	P	$[L^{-2}AT]$	Cm^{-2}
Dielectric constant	K	[Dimensionless]	

IMPORTANT RESULTS AND FORMULAE

1. Electric potential due to a point source charge q at a distance r from it is given by :

$$V = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{r}$$

Unit : $1\ V = 1\ JC^{-1}$

2. The electric field at a point is related to the negative potential gradient as follows :

$$\vec{E} = -\left(\frac{dV}{dr}\right)$$

Unit : Vm^{-1}

(i) Electric potential due to a dipole at a point at distance r and making angle θ with the dipole moment p_e is given by :

$$V = \frac{1}{4\pi\varepsilon_0} \cdot \frac{p_e \cos\theta}{r^2}$$

(ii) On the axial line, the electric potential is given by :

$$V_a = \frac{1}{4\pi\varepsilon_0} \cdot \frac{p_e}{r^2}$$

(iii) On the equatorial line, the electric potential is : $V_e = 0$

3. Electric potential due to an isolated conducting charged sphere of radius R carrying charge Q :

(a) The electric potential at the surface of the sphere and at every point inside the sphere is :

$$V = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{R}$$

(b) The electric potential at a point outside the sphere is

$$V = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{r}$$

where $r > R$ is the distance of the point from the centre of the sphere.

4. Potential energy of system of two point charges : $U = \frac{1}{4\pi\varepsilon_0} \cdot \frac{q_1 q_2}{r_{12}}$.

5. The ratio of the charge q and potential V of a conductor is called capacitance (C).

$$C = \frac{q}{V}$$

Unit : 1 Farad = 1 coulomb/volt

6. (a) Electrostatic potential energy of a conductor carrying charge q, capacitance C and potential V, is given by :

$$U_p = \int_0^q V dq = \int_0^q \frac{q}{C} dq = \frac{1}{2}\frac{q^2}{C}$$

(b) Since, $q = VC$,

$$\therefore \quad U_p = \frac{1}{2}V^2 C \Rightarrow U_p = \frac{1}{2}qV.$$

7. If a number of capacitors of capacitances C_1, C_2, C_3 ..... are connected in series, their equivalent capacitance is given by :

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + ...$$

8. If a number of capacitors of capacitances C_1, C_2, C_3 ..... C_n are connected in parallel, then their equivalent capacitance is given by :

$$C_p = C_1 + C_2 + C_3 + ... + C_n$$

9. Let a parallel plate capacitor consists of two plates of area 'A', separated by distance '*d*', having slab of same thickness and area with dielectric constant 'K' between the plates. Then the capacitance of the capacitor is given by :

$$C = \frac{K\varepsilon_0 A}{d}$$

10. **(i)** If we have a number of slabs of same area as the plates of the capacitor with thickness t_1, t_2, t_3,.... and dielectric constants K_1, K_2, K_3 ..... inserted between the plates, the capacitance of the capacitor is given by :

$$C = \frac{\varepsilon_0 A}{\frac{t_1}{K_1} + \frac{t_2}{K_2} + \frac{t_3}{K_3} + ...}$$

(ii) If a single slab of thickness '*t*' and dielectric constant 'K' is introduced between the plates having separation '*d*' then the capacitance of the capacitor is given by :

$$C = \frac{\varepsilon_0 A}{\frac{t}{K} + \frac{(d-t)}{1}} = \frac{K\varepsilon_0 A}{K(d-t)+t}$$

(iii) If a single slab of conductor of thickness '*t*' is introduced between the plates, having separation '*d*' then the capacitance of the capacitors is given by :

$$C = \frac{\varepsilon_0 A}{\frac{t}{\infty} + \frac{(d-t)}{1}} = \frac{\varepsilon_0 A}{d-t}$$

Unit-II : Current Electricity

CHAPTER 3 : Current Electricity

UNITS AND DIMENSIONS

Physical Quantity	Symbol	Dimension	Unit
Electric current	I	[A]	A
Charge	Q, *q*	[TA]	C
Electric voltage	V	$[ML^2T^{-3}A^{-1}]$	V
Potential difference	V	$[ML^2T^{-3}A^{-1}]$	V
Electromotive force	E	$[ML^2T^{-3}A^{-1}]$	V
Resistance	R	$[ML^2T^{-3}A^{-2}]$	Ω
Resistivity	ρ	$[ML^3T^{-3}A^{-2}]$	Ωm
Electrical conductivity	σ	$[M^{-1}L^{-3}T^3A^2]$	$(ohm^{-1}m^{-1})$ or, Sm^{-1}

Electric field	E	$[MLT^{-3}A^{-1}]$	s
Drift velocity	v_α	$[LT^{-1}]$	Am^{-2}
Relaxation time	τ	[T]	$m^2V^{-1}s^{-1}$
Current density	$\vec{J}$	$[L^{-2}A]$	Vm^{-1}
Mobility	μ	$[M^{-1}T^2A]$	ms^{-1}

IMPORTANT RESULTS AND FORMULAE

1. **Electric current :** Electric current is defined as the rate of flow of charge, *i.e.*,

$$I = \frac{dq}{dt}$$

When charge flows at a constant rate, the corresponding electric current can be written as :

$$I = \frac{q}{t}$$

Unit : 1 Ampere = 1 coulomb $second^{-1}$

2. When electric current is set up in a conductor, the electrons drift through the conductor with velocity v_d, which is drift velocity and is given by :

$$v_d = \frac{I}{neA}$$

3. **Ohm's law :** Current I in a conductor is directly proportional to the potential difference V applied across the ends of the conductor provided the physical conditions such as the temperature, mechanical strain, etc. remain unchanged.

$$I \propto V$$

or $$V = RI$$

where, R is a constant called resistance of the conductor.

4. **Resistance :**

$$R = \rho\frac{l}{A}$$

5. **Resistivity :** $\rho = \dfrac{m}{ne^2\tau}$

6. **Conductivity :** Reciprocal of resistivity

$$\sigma = \frac{1}{\rho}$$

Unit = ohm^{-1}, or siemens m^{-1}

7. The temperature coefficient for conductors is positive *i.e.*, resistance increases as the temperature rises.

The temperature coefficient for the insulators and semiconductors is negative *i.e.*, their resistance decreases as the temperature increases.

8. The internal resistance of a cell is

$$r = \left(\frac{E - V}{V}\right)R$$

9. **Electrical power :**

$$P = \frac{V^2}{R} = I^2R$$

Unit : Watt

10. **The emf and terminal potential difference of a cell :** Let the emf of a cell is 'E' and its internal resistance is *r*. If an external resistance R is connected across the cell through a key, then IR = V = potential difference across the external resistance R. This is equal to the terminal potential difference across the cell.

$$E = V + Ir$$

$$\Rightarrow \quad I = \frac{E - V}{r}$$

So, $V = E - Ir$

$\therefore \quad V < E.$

When current is drawn from a cell, its terminal potential difference is less than the emf.

11. **Series Combination of Cells :**

In *n* cells having internal resistance *r* and emf E for each.

$$I_S = \frac{nE}{R + nr}$$

12. **Parallel Combination of Cells :**

If *n* cells having internal resistances $r_1, r_2, r_3 \ldots\ldots r_n$ & of emf $E_1, E_2, E_3 \ldots\ldots E_n$ respectively.

$$I_P = \frac{\frac{E_1}{r_1} + \frac{E_2}{r_2} + \frac{E_3}{r_3} + \ldots\ldots \frac{E_n}{r_n}}{1 + R\left(\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \ldots\ldots \frac{1}{r_n}\right)}$$

13. **Mixed Combination of Cells :**

Here *nm* cells are combined in *m* rows, each row having *n* cells such that

$$I_m = \frac{nE}{R + \frac{nr}{m}} = \frac{mnE}{mR + nr}$$

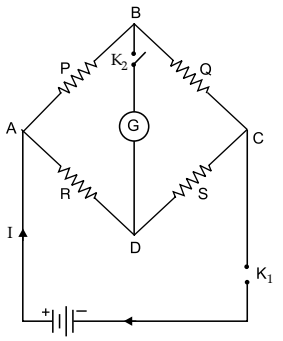
14. **Kirchhoff's Laws :**

First law : The algebraic sum of current at a junction is zero *i.e.*, $\Sigma I = 0$. This implies that the total current entering a junction is equal to the total current leaving the junction.

Second law : In a closed loop, the algebraic sum of the emf's is equal to the algebraic sum of the product of resistance and the respective current flowing through them *i.e.*,

$$\Sigma E = \Sigma IR.$$

15. **Wheatstone Bridge :** This is a circuit consisting of four resistances P, Q, R and S, a galvanometer and a battery connected as follows :



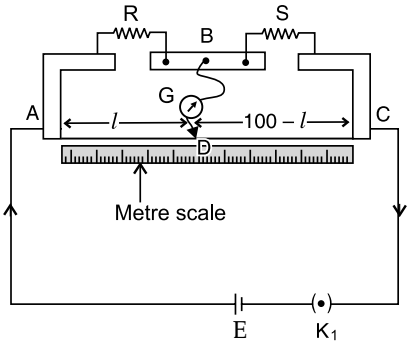
The Wheatstone bridge is balanced when there is no current flow through the galvanometer. It means potential at B is equal to that at D. In such a case

$$\frac{P}{Q} = \frac{R}{S}$$

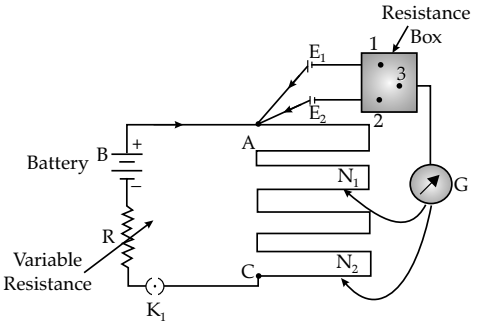
16. **Slide Wire Bridge or Meter Bridge :** It measures unknown resistance. It works on principle of Wheatstone bridge.

IMPORTANT FIGURES

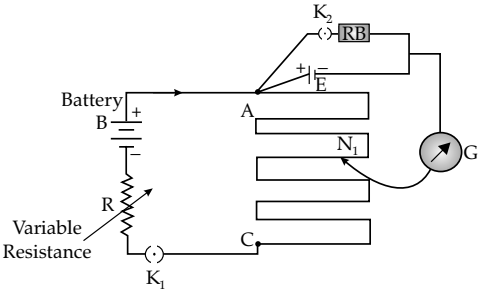
Meter Bridge :



Potentiometer Setup for Comparison of emf's of two cells :



Potentiometer Setup for Evaluation of Internal Resistance of a cell :



Unit-III : Magnetic effects of current and magnetism

CHAPTER 4 : Moving Charges and Magnetism

UNITS AND DIMENSIONS

Physical Quantity	Symbol	Nature	Dimension	Units
Permeability of free space	μ_0	Scalar	$[MLT^{-2}A^{-2}]$	TmA^{-1}
Magnetic field	$\vec{B}$	Vector	$[MT^{-2}A^{-1}]$	T(tesla)
Magnetic moment	$\vec{m}$	Vector	$[L^2A]$	Am^2 or J/T
Torsion constant	k	Scalar	$[ML^2T^{-2}]$	$Nmrad^{-1}$

IMPORTANT RESULTS AND FORMULAE

1. **Force :** When a test charge q_0 enters a magnetic field $\vec{B}$ directed along the negative Z-axis with a velocity $\vec{v}$ making an angle ϕ with the Z-axis, then

$$\vec{F}_m = q_0(\vec{v}\times\vec{B})$$

$F_{mx} = q_0 v_y B$, $F_{my} = q_0 v_x B$ and $F_{mz} = 0$

2. Force on a current carrying conductor in a magnetic field $\vec{B}$ is $\vec{F}_m = I(\vec{l}\times\vec{B})$, where I is the current, l is the length of conductor and $\vec{l}$ is along the direction of current.

3. Force between current elements :

$$d\vec{F}_{m_{12}} = \frac{\mu_0}{4\pi}\cdot\frac{I_2 d\vec{l}_2\times(I_1 d\vec{l}_1\times\vec{r}_{12})}{r_{12}^3}$$

here, force is on $I_2 d\vec{l}_2$ due to $I_1 d\vec{l}_1$.

4. Force per unit length between infinitely long straight current carrying conductor is :

$$F_m/l = \frac{\mu_0}{4\pi}\cdot\frac{2I_1I_2}{r}$$

where, F_m/l is the force per unit length.

5. **Lorentz force :** $\vec{F} = q(\vec{E} + \vec{v}\times\vec{B})$

6. Torque on a magnetic dipole moment $\vec{p}_m$ due to a magnetic field $\vec{B}$ is $\vec{\tau} = \vec{p}_m\times\vec{B}$.

7. Magnetic field due to a straight conductor carrying current I and at a distance 'a' from the conductor is

$$B = \frac{\mu_0}{4\pi}\cdot\frac{I}{a}[\sin\phi_2 + \sin\phi_1]$$

8. Magnetic field due to infinite straight conductor at a distance a from it,

$$B = \frac{\mu_0}{4\pi}\times\frac{2I}{a}$$

9. Magnetic field on the axis of a current (I) carrying coil of turns n, radius R and at a distance x from the centre of the coil is

$$B = \frac{\mu_0}{4\pi} \cdot \frac{In.2\pi R^2}{(R^2 + x^2)^{3/2}}$$

and $B_{(centre)} = \frac{\mu_0}{4\pi} \cdot \frac{n.2\pi I}{R}$

$$B_{(far\ away)} = \frac{\mu_0}{4\pi} \cdot \frac{n.2\pi IR^2}{x^3}$$

10. Ampere's Circuital law : The line integral of the magnetic field around a closed path is μ_0 times the total current enclosed by the path and is given as :

$$\oint \vec{B}.d\vec{l} = \mu_0 I.$$

11. The magnetic field due to a straight solenoid well within it and on the axis is given by :

$$B = \mu_0 nI,$$

where, n = number of turns per unit length and I is the current in the coil.

12. Maximum energy by positive ions :

$$E_{max} = \frac{1}{2} \cdot \frac{B^2 q^2 R^2}{m}$$

13. Biot Savart's law : The magnetic field due to a current element is given by the following relation :

$$\vec{B} = \frac{\mu_0}{4\pi} \cdot \frac{I\vec{dl} \times \hat{r}}{r^2}$$

(a) If θ be the angle between $I\vec{dl}$ and $\hat{r}$, then :

$$B = \frac{\mu_0}{4\pi} \cdot \frac{Idl}{r^2} \sin\theta$$

(b) The unit of magnetic field B is called tesla (T).

(c) $\mu_0 = 4\pi \times 10^{-7}\ TmA^{-1}$

(d) B is perpendicular to both $I\vec{dl}$ and $\hat{r}$.

14. (i) Voltage sensitivity :

$$\frac{\theta}{V} = \frac{nBA}{kR}\ (rad\ V^{-1})$$

(ii) Current sensitivity :

$$\frac{\theta}{I} = \frac{nBA}{k}\ (rad\ A^{-1})$$

(iii) Conversion of galvanometer into ammeter

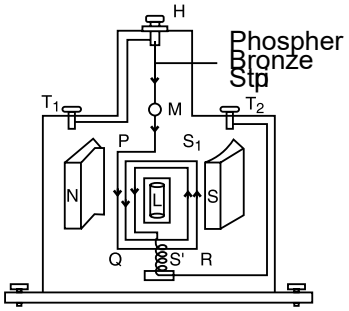
$$S = \frac{I_g}{(I - I_g)} \times G$$

(iv) Conversion of galvanometor into voltmeter

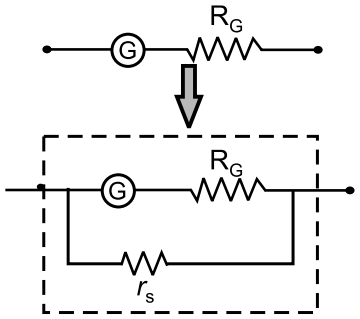
$$R = \frac{V}{I_g} - G$$

IMPORTANT FIGURES

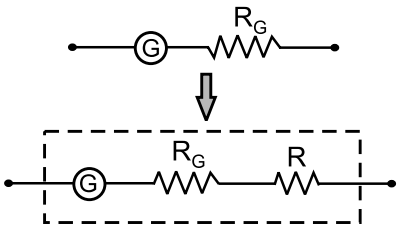
Moving Coil Galvanometer :



Galvanometer to Ammeter Conversion :



Galvanometer to Voltmeter Conversion :



CHAPTER 5 : Magnetism and Matter

UNITS AND DIMENSIONS

Physical quantity	Symbol	Nature	Dimension	Unit
Permeability of free space	μ_0	Scalar	$[MLT^{-2}A^{-2}]$	TmA^{-1}, NA^{-2}
Magnetic field, Magnetic induction, Magnetic flux density	$\vec{B}$	Vector	$[MT^{-2}A^{-1}]$	T (tesla)
Magnetic moment	$\vec{m}$	Vector	$[L^2A]$	Am^2
Magnetic flux	ϕ_B	Scalar	$[ML^2T^{-2}A^{-1}]$	Wb (weber)
Magnetization	$\vec{M}$	Vector	$[L^{-1}A]$	Am^{-1}
Magnetic intensity, Magnetic field strength	$\vec{H}$	Vector	$[L^{-1}A]$	Am^{-1}
Magnetic susceptibility	χ	Scalar	—	—
Relative magnetic permeability	μ_r	Scalar	—	—
Magnetic permeability	μ	Scalar	$[MLT^{-2}A^{-2}]$	TmA^{-1}, NA^{-2}

IMPORTANT RESULTS AND FORMULAE

1. **Magnetic dipole moment :** $\vec{M} = m(2\vec{l})$
2. **(i)** Angle between geographic meridian and the magnetic meridian is called Angle of declination.
   (ii) Angle between horizontal component and total magnetic field of the earth is called dip Angle.
   (iii) Dip is zero at the equator and 90° at the magnetic poles.
3. $\mu = \mu_0\mu_r$.
   where, μ = permeability of medium, μ_0 = permeability of vacuum and μ_r = relative permeability.
4. Magnetic induction B and magnetic intensity H are related as $B = \mu H$.
5. **Curie's law in magnetism :** The intensity of magnetization I of a paramagnetic material is directly proportional to the strength of the external magnetic field H, called the magnetising field and is inversely proportional to the absolute temperature of the material.

$$I \propto \frac{H}{T}$$

$$\therefore \quad I = \frac{CH}{T}$$

$$\therefore \quad \frac{I}{H} = \frac{C}{T}$$

or $$\chi = \frac{C}{T}$$

where, C is known as Curie constant.

6. Magnetic intensity : $H = \frac{B_0}{\alpha_0}$
7. Magnetic susceptibility : $\chi = \frac{I}{H}$
8. Magnetic permeability : $\mu = \frac{B}{H}$
9. The force between two magnetic poles of strength q_m and $q'_{m'}$ separated by r is given by

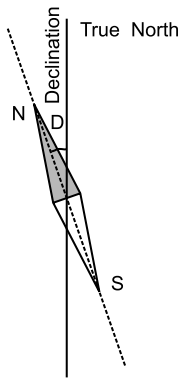
$$F = \frac{\mu_0}{4\pi} \cdot \frac{q_m q'_m}{r^2}$$

10. **Tangent law :** When a short bar magnet is suspended freely under the combined action of two uniform magnetic fields of intensities B and B_H acting at 90° to each other, the magnet comes to rest making an angle θ with the direction of the magnetic field B_H.

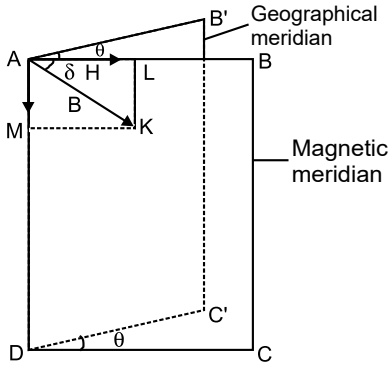
$$B = B_H \tan\theta$$

IMPORTANT GRAPHS AND FIGURES

Angle of declination :

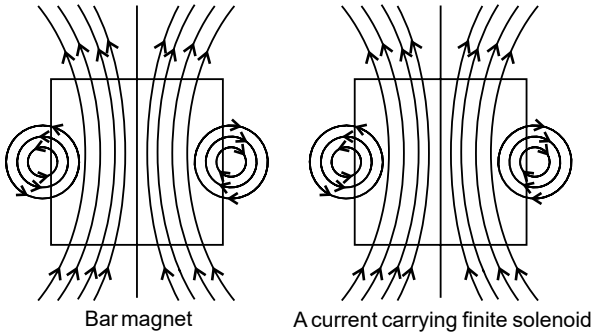


Magnetic elements of earth :

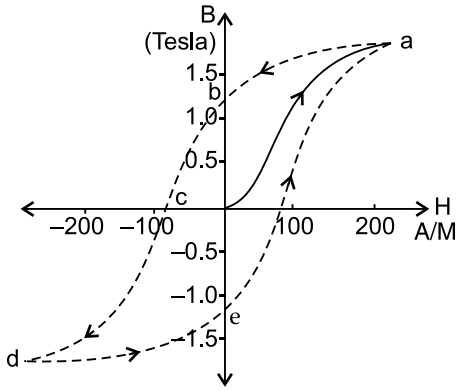


where, θ = Magnetic declination, δ = Magnetic inclination or Magnetic dip and H = Horizontal component

Magnetic field lines :



Hysteresis loop :



Unit-IV : Electromagnetic Industion and Alternating Currents

CHAPTER 6 Electromagnetic Induction

UNITS AND DIMENSIONS

Quantity	Symbol	Dimension	Unit
Magnetic flux	ϕ	$[ML^2T^{-2}A^{-1}]$	Wb (weber)
EMF	E	$[ML^2T^{-3}A^{-1}]$	V (volt)

Mutual inductance	M	$[ML^2T^{-2}A^{-2}]$	H (henry)
Self inductance	L	$[ML^2T^{-2}A^{-2}]$	H (henry)

IMPORTANT RESULTS AND FORMULAE

1. The inductance of a coil depends on the following factors :

(a) area of cross-section

(b) number of turns

(c) permeability of the core.

2. Self induction

$$\phi \propto I \text{ or } \phi = LI$$

$$E = -\frac{d\phi}{dt} = -L\frac{dI}{dt}$$

$$L = \frac{-E}{dI/dt}$$

The inductance of a circular coil is given by :

$$L = \frac{\phi}{I} = \frac{BAN}{I} = \frac{\mu}{4\pi}\cdot\frac{(2\pi NI)}{rI}\times AN \qquad \left[\because B = \frac{\mu}{4\pi}\cdot\frac{2\pi NI}{r}\right]$$

$$= \frac{\mu N^2}{2r}A = \frac{\mu N^2}{2r}\times\pi r^2$$

or $$L = \frac{\mu N^2 \pi r}{2}$$

here, ϕ = magnetic flux from the coil, I = current through the coil, A = area of coil, r = radius of coil, N = total number of turns of the coil, μ = permeability of the medium.

3. The inductance of a solenoid of length l, is given by :

$$L = \frac{\phi}{I} = \frac{BAN}{I} = \left(\frac{\mu NI}{l}\right)\frac{AN}{I} \qquad \left[\because B = \frac{\mu NI}{l}\right]$$

or $$L = \frac{\mu N^2 A}{l} = \mu n^2 Al = \mu n^2 V \qquad \left[\because n = \frac{N}{l}\right]$$

here, $n = N/l$ = number of turns per unit length and $V = Al$ = volume of the solenoid.

4. The inductance in series combination is given by :

$$L_s = L_1 + L_2 + L_3 + ...$$

The inductance in parallel combination is given by :

$$\frac{1}{L_p} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} + ...$$

5. If two coils of inductance L_1 and L_2 are coupled together, then their mutual inductance is given by :

$$M = k\sqrt{L_1 L_2}$$

6. Mutual inductance :

$$\phi \propto I \text{ or } \phi = MI$$

$$E = -\frac{d\phi}{dt} = -M\frac{dI}{dt}$$

$$M = -E/(dI/dt)$$

$$M = \frac{-E}{dI/dt}$$

The mutual inductance of two coils is given by :

$$M = \frac{\mu N_p N_s A_p}{l} = \frac{\mu_0 N_p N_s A_s}{l}$$

7. Magnetic flux is number of magnetic field lines crossing a surface normally.

The magnetic flux is denoted by ϕ. If $\vec{B}$ be the magnetic field through the area element $d\vec{A}$. Then, the flux through the area is given by :

$$d\phi = \vec{B} \cdot d\vec{A}.$$

8. Faraday's laws of electromagnetic induction :

(a) Whenever, the magnetic flux linked with a circuit changes, an emf is induced.

(b) The induced emf lasts as long as the change in magnetic flux continues.

(c) The magnitude of induced emf (E) is directly proportional to the rate of change in magnetic flux.

Thus, if $d\phi$ be the change in magnetic flux during the time dt, then :

$$E \propto \frac{d\phi}{dt} \text{ or } E = k\frac{d\phi}{dt}$$

where, k is the constant of proportionality. In SI, $k = -1$, hence, $E = -\frac{d\phi}{dt}$

9. Lenz's law :

It states that induced current produced in a circuit always flows in such a direction that it opposes the change or the cause that produces it.

The Lenz's law explains the negative sign in the Faraday's flux rule, $E = -\frac{d\phi}{dt}$

10. If a rod of length l moves perpendicular to a magnetic field B with a velocity v, then the induced emf produced across it is given by :

$$E = vBl$$

In general, we have $E = \vec{B}.(\vec{v} \times \vec{l})$

11. If a current I is set up in a coil of inductance L, then the magnetic field energy stored in it is given by

$$U_p = \frac{1}{2}LI^2$$

12. Instantaneous value of emf produced by AC generator, $e = NBA\omega \sin \omega t$

CHAPTER 7 : Alternating Current

UNITS AND DIMENSIONS

Physical quantity	Symbol	Dimension	Unit
rms voltage	V_{rms}	$[ML^2T^{-3}A^{-1}]$	V
rms current	I_{rms}	[A]	A
Inductive reactance	X_L	$[ML^2T^{-3}A^{-2}]$	Ω
Capacitive reactance	X_C	$[ML^2T^{-3}A^{-2}]$	Ω
Impedance	Z	$[ML^2T^{-3}A^{-2}]$	Ω
Resonant frequency	ω_r or ω_0	$[T^{-1}]$	Hz
Quality factor	Q	Dimensionless	
Power factor	cos ϕ	Dimensionless	

IMPORTANT RESULTS AND FORMULAE

1. **(a)** Instantaneous value of alternating current

$I = I_0 \sin \omega t$ or $I = I_0 \cos \omega t$

(b) Peak value of a.c. $= I_0$

(c) Alternating emf, $E = E_0 \sin \omega t$

or $E = E_0 \cos \omega t$

(d) Mean or average value of a.c.

I_m or $I_a = \dfrac{2I_0}{p} = 0.636\, I_0$.

(e) r.m.s. value of a.c. $I_{rms} = I_0/\sqrt{2} = 0.707\, I_0$.

2. The part of the impedance in which the phase difference between the current and emf is $\pi/2$, is called reactance.

If the emf leads the current by $\pi/2$, the reactance is called purely inductive.

If the emf lags behind the current by $\pi/2$, the reactance is called purely capacitive.

If the emf is in phase with the current, the circuit is called purely resistive.

3. **Sign for phase difference (ϕ) between I and E for series LCR circuit :**

ϕ is positive, when $X_L > X_C$.

ϕ is negative, when $X_L < X_C$.

ϕ is zero, when $X_L = X_C$.

4. The LCR circuit is said to be resonance when :

$X_L = X_C$. *i.e.*, when $\omega L = \dfrac{1}{\omega C}$

and $\omega = \omega_0 = \dfrac{1}{\sqrt{LC}}$ is called resonant frequency.

5. At series resonant frequency, $\omega_0 = \dfrac{1}{\sqrt{LC}}$, we have :

(i) $Z = R$ = minimum value of impedance.

(ii) $I_0 = E_0/R$ = maximum value of peak current.

(iii) $\phi = 0$, *i.e.*, I and E are in phase with each other.

(iv) V_L is equal and opposite to V_C.

(v) Potential drop across C and L together is zero.

(vi) $E = V_R$.

6. **Energy stored in an inductor :**

$$U = \frac{1}{2} L I_0^2$$

7. **Energy stored in a capacitor :**

$$U = \frac{1}{2} CV^2 = \frac{1}{2} \frac{q_0^2}{C} = \frac{1}{2} q_0 V$$

8. **Power in a.c. circuit :** The power in LCR circuit is given by

$$P = EI = E_0 I_0 \sin \omega t \sin (\omega t - \phi).$$

Power in LCR circuit consists of two components :

(i) Virtual power component

$= \frac{1}{2} E_0 I_0 \cos(2\omega t - \phi)$.

It has frequency twice as that of a.c. Its value over the complete cycle is zero.

(ii) Real power component $= \frac{1}{2} E_0 I_0 \cos\phi$. It dissipates power.

$\cos\phi$ is called power factor.

9. Inductive reactance : $X_L = \omega L$

Inductive susceptance : $B_L = \frac{1}{\omega L}$

Capacitive reactance : $X_C = \frac{1}{\omega C}$

Capacitive susceptance : $B_C = \omega C$

Reactance : $X = X_L - X_C = \omega L - \frac{1}{\omega C}$

Susceptance : $B = B_C - B_L = \omega C - \frac{1}{\omega L}$

10. Impedance of LCR circuit :

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$= \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

$$\tan\phi = \frac{V_L - V_C}{V_R}$$

$$= \frac{IX_L - IX_C}{IR}$$

$$= \frac{X_L - X_C}{R}$$

$$= \frac{\omega L - \frac{1}{\omega C}}{R}$$

Power, $P = E_{rms} \times i_{rms} \times \frac{R}{Z}$

11. Band width $= \omega_2 - \omega_1 = 2\Delta\omega$

12. Sharpness of resonance $= \frac{\omega_r}{2\Delta\omega}$

or $\frac{\omega_r}{2\Delta\omega} = \frac{\omega_r L}{R}$

13. Q factor : $Q = \frac{\text{Voltage across L or C}}{\text{Applied voltage}}$

$$Q = \frac{\omega_0 L}{R} = \frac{1}{R}\sqrt{\frac{L}{C}}$$

14. Transformer :

(i) $\frac{E_s}{E_p} = \frac{N_s}{N_p} = k$ (say) (transformer ratio)

(ii) $\frac{N_s}{N_p} = k$ is called transformer ratio.

(iii) For step up transformer, $k > 1$ and for step down transformer, $k < 1$.

(iv) For step up transformer, $N_s > N_p$, therefore $E_s > E_p$. And for the step down transformer, $N_s < N_p$ therefore $E_s < E_p$.

(v) The efficiency of the transformer is given by :

$$\eta = \frac{\text{Output power}}{\text{Input power}}$$

If I_p and I_s be the currents in the primary and secondary circuits, then

$$\eta = \frac{E_s I_s}{E_p I_p}$$

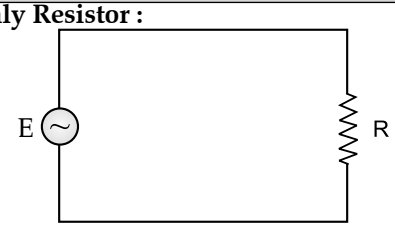
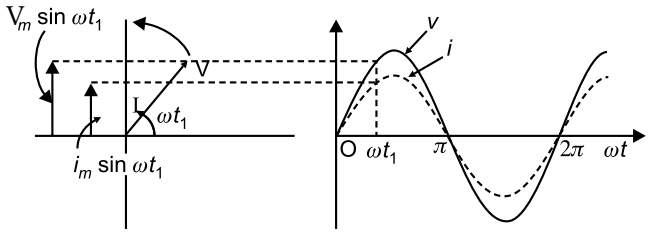
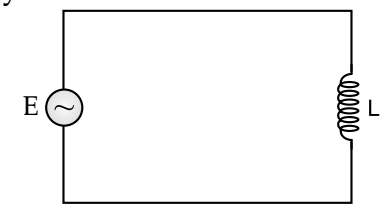
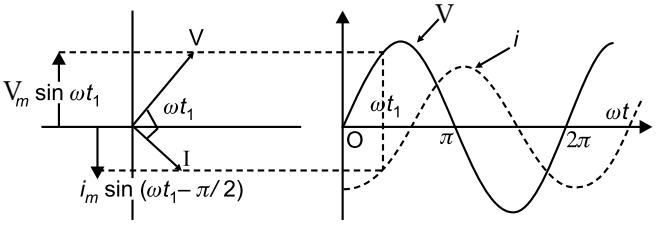
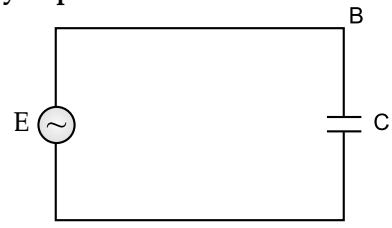
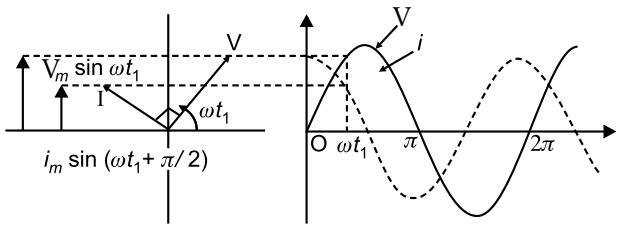
For ideal transformer $\eta = 1 = 100\%$. Therefore,

$$E_s I_s = E_p I_p$$

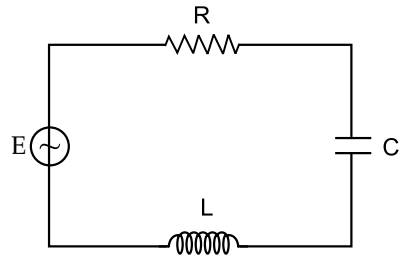
or $$\frac{I_s}{I_p} = \frac{N_p}{N_s} = \frac{1}{k}$$

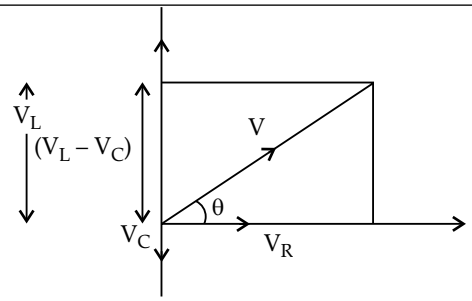
Hence for step-up transformer, current in the secondary is less than that in the primary ($I_s < I_p$) and in a step down transformer, we have $I_s > I_p$.

IMPORTANT FIGURES

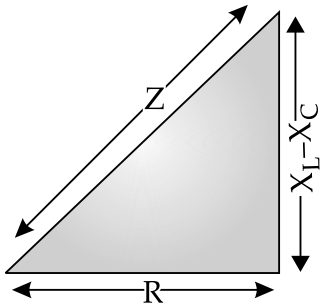
Type of circuit	Phasor diagram & wave diagram
Only Resistor : 	
Only Inductor : 	
Only Capacitor : 	

LCR circuit :





Impedance triangle :



Transformer :

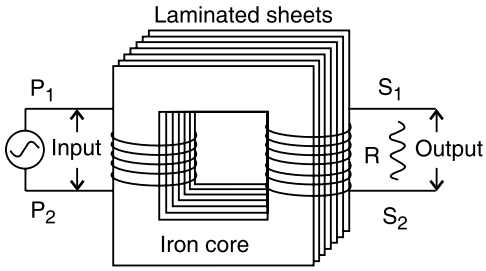
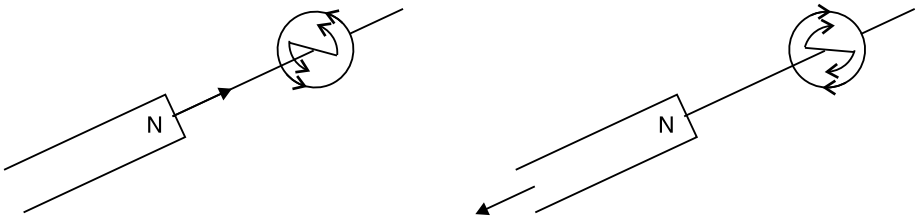
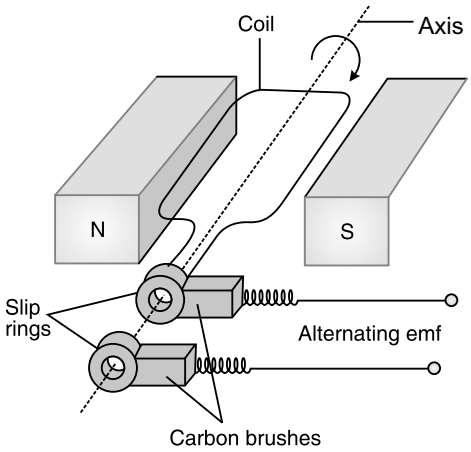


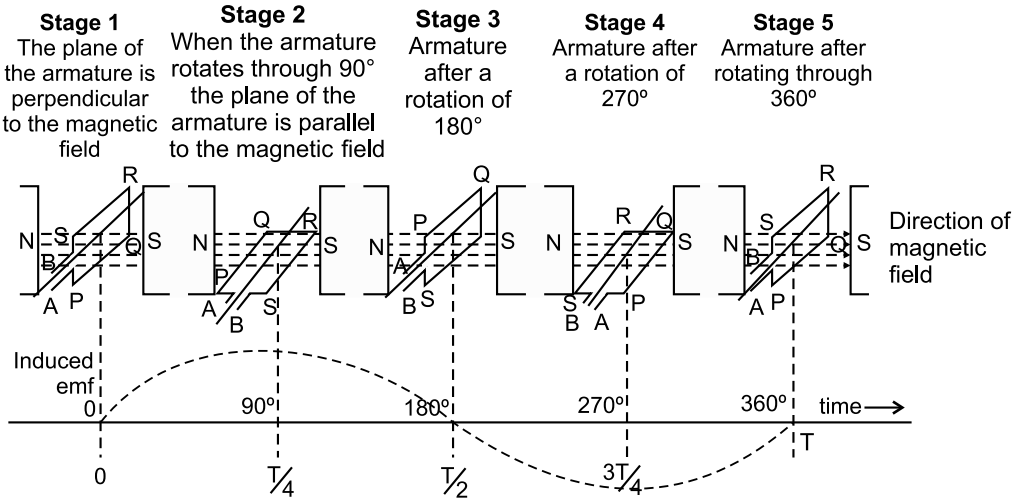
Illustration of Lenz's law :



AC generator :



Working of AC generator :



❑❑❑



Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Sample Question Paper 2021-22
(Issued by Board 02nd September, 2021)

Sample Question Paper 1

Solved _____

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. Which of the following is NOT the property of equipotential surface?

(A) They do not cross each other.

(B) The rate of change of potential with distance on them is zero.

(C) For a uniform electric field, they are concentric spheres.

(D) They can be imaginary spheres.

Q. 2. Two point charges + 8q and –2q are located at $x = 0$ and $x = L$ respectively.

The point on x axis at which net electric field is zero due to these charges is

(A) 8L **(B)** 4L

(C) 2L **(D)** L

Q. 3. An electric dipole of moment p is placed parallel to the uniform electric field. The amount of work done in rotating the dipole by 90° is

(A) 2pE **(B)** pE

(C) pE/2 **(D)** Zero

Q. 4. Three capacitors 2 μF, 3 μF and 6 μF are joined in series with each other.
The equivalent capacitance is:
(A) 1/2 μF **(B)** 1 μF
(C) 2 μF **(D)** 11 μF

Q. 5. Two point charges placed in a medium of dielectric constant 5 are at a distance ***r*** between them, experience an electrostatic force 'F'. The electrostatic force between them in vacuum at the same distance *r* will be:
(A) 5F **(B)** F
(C) F/2 **(D)** F/5

Q. 6. Which statement is true for Gauss law?
(A) All the charges whether inside or outside the gaussian surface contribute to the electric flux.
(B) Electric flux depends upon the geometry of the gaussian surface.
(C) Gauss theorem can be applied to non-uniform electric field.
(D) The electric field over the gaussian surface remains continuous and uniform at every point.

Q. 7. A capacitor plates are charged by a battery with 'V' volts. After charging, battery is disconnected and a dielectric slab with dielectric constant 'K' is inserted between its plates, the potential across the plates of a capacitor will become:
(A) Zero **(B)** V/2
(C) V/K **(D)** KV

Q. 8. The best instrument for accurate measurement of EMF of a cell is-
(A) Potentiometer **(B)** metre bridge
(C) Voltmeter **(D)** ammeter and voltmeter

Q. 9. An electric current is passed through a circuit containing two wires of same material, connected in parallel. If the lengths and radii of the wires are in the ratio of 3 : 2 and 2 : 3, then the ratio of the current passing through the wire will be-
(A) 2 : 3 **(B)** 3 : 2
(C) 8 : 27 **(D)** 27 : 8

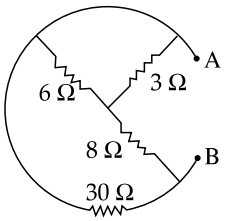
Q. 10. By increasing the temperature, the specific resistance of a conductor and a semiconductor:
(A) increases for both.
(B) decreases for both.
(C) increases for a conductor and decreases for a semiconductor.
(D) decreases for a conductor and increases for a semiconductor.

Q. 11. We use alloys for making standard resistors because they have:
(A) low temperature coefficient of resistivity and high specific resistance.
(B) high temperature coefficient of resistivity and low specific resistance.
(C) low temperature coefficient of resistivity and low specific resistance.
(D) high temperature coefficient of resistivity and high specific resistance.

Q. 12. A constant voltage is applied between the two ends of a uniform metallic wire, heat 'H' is developed in it. If another wire of the same material, double the radius and twice the length as compared to original wire is used, then the heat developed in it will be:
(A) H/2 **(B)** H
(C) 2H **(D)** 4H

Q. 13. If the potential difference V applied across a conductor is increased to 2V with its temperature kept constant, the drift velocity of the free electrons in a conductor will:
(A) remain the same. **(B)** become half of its previous value.
(C) be double of its initial value. **(D)** become zero.

Q. 14. The equivalent resistance between A and B is:



(A) 3 ohms
(B) 5.5 ohms
(C) 7.5 ohms
(D) 9.5 ohms

Q. 15. The SI unit of magnetic field intensity is:

(A) AmN^{-1} **(B)** $NA^{-1}m^{-1}$
(C) $NA^{-2}m^{-2}$ **(D)** $NA^{-1}m^{-2}$

Q. 16. The coil of a moving coil galvanometer is wound over a metal frame in order to:

(A) reduce hysteresis **(B)** increase sensitivity
(C) increase moment of inertia **(D)** provide electromagnetic damping

Q. 17. Two wires of the same length are shaped into a square of side '*a*' and a circle with radius '*r*'. If they carry same current, the ratio of their magnetic moment is:

(A) 2 : π **(B)** π : 2
(C) π : 4 **(D)** 4 : π

Q. 18. The horizontal component of earth's magnetic field at a place is $\sqrt{3}$ times the vertical component. The angle of dip at that place is:

(A) π/6 **(B)** π/3
(C) π/4 **(D)** 0

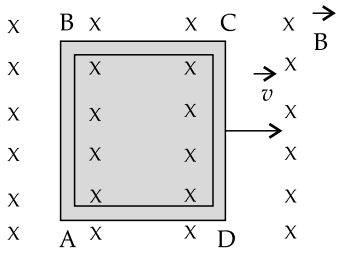
Q. 19. The small angle between magnetic axis and geographic axis at a place is:

(A) Magnetic meridian **(B)** Geographic meridian
(C) Magnetic inclination **(D)** Magnetic Declination

Q. 20. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon the:

(A) rate at which current change in the two coils
(B) relative position and orientation of the coils
(C) rate at which voltage induced across two coils
(D) currents in the two coils

Q. 21. A conducting square loop of side 'L' and resistance 'R' moves in its plane with the uniform velocity '*v*' perpendicular to one of its sides. A magnetic induction 'B' constant in time and space pointing perpendicular and into the plane of the loop exists everywhere as shown in the figure. The current induced in the loop is:



(A) BLv/R Clockwise
(B) BLv/R Anticlockwise
(C) 2BLv/R Anticlockwise
(D) Zero

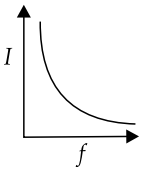
Q. 22. The magnetic flux linked with the coil (in Weber) is given by the equation:

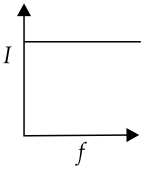
$$\phi = 5t^2 + 3t + 16$$

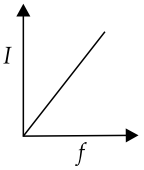
The induced EMF in the coil at time, $t = 4$ will be:

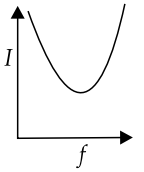
(A) – 27 V **(B)** – 43 V
(C) – 108 V **(D)** 210 V

Q. 23. Which of the following graphs represent the variation of current(I) with frequency (f) in an AC circuit containing a pure capacitor?

(A) 

(B) 

(C) 

(D) 

Q. 24. A 20 volt AC is applied to a circuit consisting of a resistance and a coil with negligible resistance. If the voltage across the resistance is 12 volt, the voltage across the coil is:

(A) 16 V **(B)** 10 V

(C) 8 V **(D)** 6 V

Q. 25. The instantaneous values of emf and the current in a series ac circuit are:

$E = E_o \sin \omega t$ and $I = I_o \sin (\omega t + \pi/3)$ respectively, then it is

(A) Necessarily a RL circuit **(B)** Necessarily a RC circuit

(C) Necessarily a LCR circuit **(D)** Can be RC or LCR circuit

Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. A cylinder of radius r and length l is placed in an uniform electric field parallel to the axis of the cylinder. The total flux for the surface of the cylinder is given by:

(A) zero **(B)** πr^2

(C) $E \pi r^2$ **(D)** $2 E \pi r^2$

Q. 27. Two parallel large thin metal sheets have equal surface densities 26.4×10^{-12} C/m^2 of opposite signs. The electric field between these sheets is:

(A) 1.5 N/C **(B)** 1.5×10^{-16} N/C

(C) 3×10^{-10} N/C **(D)** 3 N/C

Q. 28. Consider an uncharged conducting sphere. A positive point charge is placed outside the sphere. The net charge on the sphere is then:

(A) negative and uniformly distributed over the surface of sphere.

(B) positive and uniformly distributed over the surface of sphere.

(C) negative and appears at a point the surface of sphere closest to point charge.

(D) zero.

Q. 29. Three Charges $2q$, $-q$ and $-q$ lie at vertices of a triangle. The value of E and V at centroid of triangle will be:

(A) $E \neq 0$ and $V \neq 0$ **(B)** $E = 0$ and $V = 0$

(C) $E \neq 0$ and $V = 0$ **(D)** $E = 0$ and $V \neq 0$

Q. 30. Two parallel plate capacitors X and Y, have the same area of plates and same separation between plates. X has air and Y with dielectric of constant 2 , between its plates. They are connected in series to a battery of 12 V. The ratio of electrostatic energy stored in X and Y is:

(A) 4 : 1 **(B)** 1 : 4

(C) 2 : 1 **(D)** 1 : 2

Q. 31. Which among the following, is not a cause for power loss in a transformer:

(A) Eddy currents are produced in the soft iron core of a transformer.

(B) Electric flux sharing is not properly done in primary and secondary coils.

(C) Humming sound produced in transform due to magnetostriction.

(D) Primary coil is made up of a very thick copper wire.

Q. 32. An alternating voltage source of variable angular frequency '*w*' and fixed amplitude 'V' is connected in series with a capacitance C and electric bulb of resistance R (inductance zero). When '*w*' is increased:

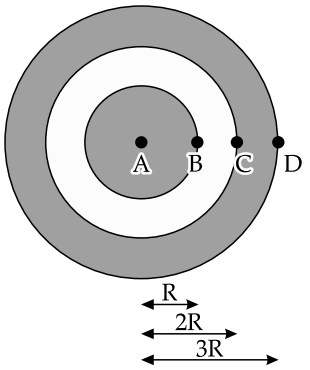
(A) The bulb glows dimmer.

(B) The bulb glows brighter.

(C) Net impedance of the circuit remains unchanged.

(D) Total impedance of the circuit increases.

Q. 33. A solid spherical conductor has charge +Q and radius R. It is surrounded by a solid spherical shell with charge -Q, inner radius 2R, and outer radius 3R. Which of the following statements is true?



(A) The electric potential has a maximum magnitude at C and the electric field has a maximum magnitude at A.

(B) The electric potential has a maximum magnitude at D and the electric field has a maximum magnitude at B.

(C) The electric potential at A is zero and the electric field has a maximum magnitude at D.

(D) Both the electric potential and electric field achieve a maximum magnitude at B.

Q. 34. A battery is connected to the conductor of non-uniform cross section area. The quantities or quantity which remains constant is:

(A) electric field only.

(B) drift speed and electric field.

(C) electric field and current.

(D) current only.

Q. 35. Three resistors having values R_1, R_2 and R_3 are connected in series to a battery. Suppose R_1 carries a current of 2.0 A, R_2 has a resistance of 3.0 ohms and R_3 dissipates 6.0 watts of power. Then the voltage across R_3 is:

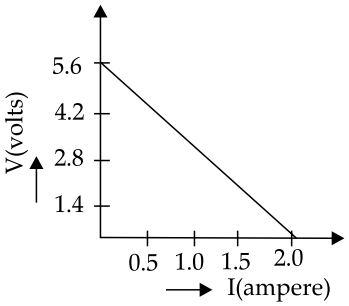
(A) 1 V

(B) 2 V

(C) 3 V

(D) 4 V

Q. 36. A straight line plot showing the terminal potential difference (V) of a cell as a function of current (I) drawn from it, is shown in the figure. The internal resistance of the cell would be then:



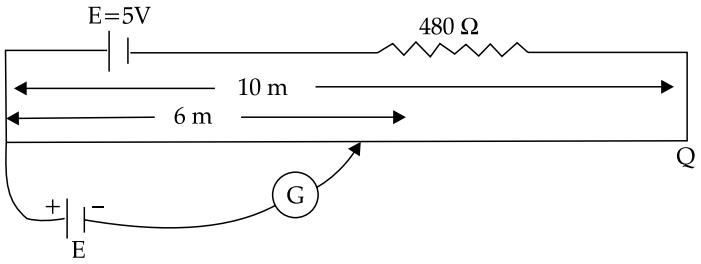
(A) 2.8 ohms

(B) 1.4 ohms

(C) 1.2 ohms

(D) zero

Q. 37. A 10 m long wire of uniform cross-section and 20 Ω resistance is used in a potentiometer. The wire is connected in series with a battery of 5 V along with an external resistance of 480 Ω. If an unknown emf E is balanced at 6.0 m length of the wire, then the value of unknown emf is:



(A) 1.2 V

(B) 1.02 V

(C) 0.2 V

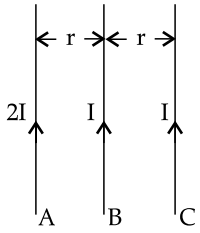
(D) 0.12 V

Q. 38. The current sensitivity of a galvanometer increases by 20%. If its resistance also increases by 25%, the voltage sensitivity will:

(A) decrease by 1% **(B)** increased by 5%

(C) increased by 10% **(D)** decrease by 4%

Q. 39. Three infinitely long parallel straight current carrying wires A, B and C are kept at equal distance from each other as shown in the figure. The wire C experiences net force F .The net force on wire C, when the current in wire A is reversed will be:



(A) Zero **(B)** F/2

(C) F **(D)** 2F

Q. 40. In a hydrogen atom, the electron moves in an orbit of radius 0.5 A^o making 10 revolutions per second, the magnetic moment associated with the orbital motion of the electron will be:

(A) 2.512×10^{-38} Am^2 **(B)** 1.256×10^{-38} Am^2

(C) 0.628×10^{-38} Am^2 **(D)** zero

Q. 41. An air-cored solenoid with length 30 cm, area of cross-section 25 cm^2 and number of turns 800, carries a current of 2.5 A. The current is suddenly switched off in a brief time of 10^{-3} s. Ignoring the variation in magnetic field near the ends of the solenoid, the average back emf induced across the ends of the open switch in the circuit would be:

(A) zero **(B)** 3.125 volts

(C) 6.54 volts **(D)** 16.74 volts

Q. 42. A sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to a series LCR circuit in which R = 3 Ω, L = 25.48 mH and C = 796 μF, then the power dissipated at the resonant condition will be:

(A) 39.70 kW **(B)** 26.70 kW

(C) 13.35 kW **(D)** Zero

Q. 43. A circular loop of radius 0.3 cm lies parallel to much bigger circular of radius 20 cm. The centre of the small loop is on the axis of the bigger loop. The distance between their centres is 15 cm. If a current of 2.0 A flows through the smaller loop, then the flux linked with the bigger loop is:

(A) 3.3×10^{-11} weber **(B)** 6×10^{-11} weber

(C) 6.6×10^{-9} weber **(D)** 9.1×10^{-11} weber

Q. 44. If both the number of turns and core length of an inductor is doubled keeping other factors constant, then its self-inductance will be:

(A) unaffected **(B)** doubled

(C) halved **(D)** quadrupled

Q. 45. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): To increase the range of an ammeter, we must connect a suitable high resistance in series to it.

Reason (R): The ammeter with increased range should have high resistance.

Select the most appropriate answer from the options given below:

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false and R is also false.

Q. 46. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): An electron has a high potential energy when it is at a location associated with a more negative value of potential and a low potential energy when at a location associated with a more positive potential.

Reason (R): Electrons move from a region of higher potential to region of lower potential.

Select the most appropriate answer from the options given below:

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false and R is also false.

Q. 47. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): A magnetic needle free to rotate in a vertical plane, orients itself (with its axis) vertical at the poles of the earth.

Reason (R): At the poles of the earth, the horizontal component of earth's magnetic field will be zero.

Select the most appropriate answer from the options given below:

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false and R is also false.

Q. 48. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): A proton and an electron, with same momenta, enter in a magnetic field in a direction at right angles to the lines of the force. The radius of the paths followed by them will be same.

Reason (R): Electron has less mass than the proton.

Select the most appropriate answer from the options given below:

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

(C) A is true but R is false.

(D) A is false and R is also false.

Q. 49. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): On Increasing the current sensitivity of a galvanometer by increasing the number of turns, may not necessarily increase its voltage sensitivity.

Reason (R): The resistance of the coil of the galvanometer increases on increasing the number of turns.

Select the most appropriate answer from the options given below:

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not the correct explanation of A.

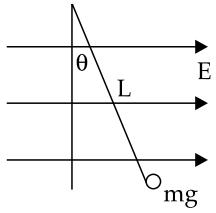
(C) A is true but R is false.

(D) A is false and R is also false.

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

Q. 50. A small object with charge q and weight mg is attached to one end of a string of length 'L' attached to a stationary support. The system is placed in a uniform horizontal electric field 'E', as shown in the accompanying figure. In the presence of the field, the string makes a constant angle θ with the vertical. The sign and magnitude of q:



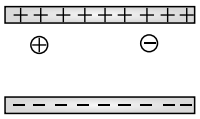
(A) positive with magnitude mg/E

(B) positive with magnitude (mg/E)tan θ

(C) negative with magnitude mg/E tan θ

(D) positive with magnitude E tan θ/mg

Q. 51. A free electron and a free proton are placed between two oppositely charged parallel plates. Both are closer to the positive plate than the negative plate.



Which of the following statements is true?

I. The force on the proton is greater than the force on the electron.

II. The potential energy of the proton is greater than that of the electron.

III. The potential energy of the proton and the electron is the same.

(A) I only **(B)** II only

(C) III and I only **(D)** II and I only

CASE STUDY

Read the following paragraph and answers the questions:

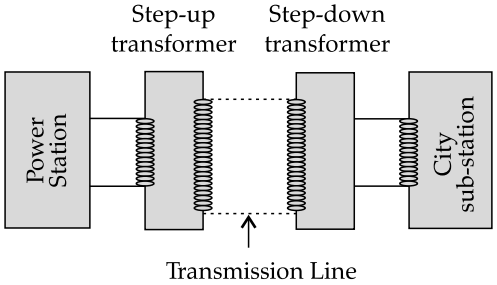


Fig. Long distance power transmission

The large-scale transmission and distribution of electrical energy over long distances is done with the use of transformers. The voltage output of the generator is stepped-up. It is then transmitted over long distances to an area sub-station near the consumers. There the voltage is stepped down. It is further stepped down at distributing sub-stations and utility poles before a power supply of 240 V reaches our homes.

Q. 52. Which of the following statement is true?

(A) Energy is created when a transformer steps up the voltage

(B) A transformer is designed to convert an AC voltage to DC voltage

(C) Step–up transformer increases the power for transmission

(D) Step–down transformer decreases the AC voltage

Q. 53. If the secondary coil has a greater number of turns than the primary,

(A) the voltage is stepped-up ($V_s > V_p$) and arrangement is called a step-up transformer

(B) the voltage is stepped-down ($V_s < V_p$) and arrangement is called a step-down transformer

(C) the current is stepped-up ($I_s > I_p$) and arrangement is called a step-up transformer

(D) the current is stepped-down ($I_s < I_p$) and arrangement is called a step-down transformer

Q. 54. We need to step-up the voltage for power transmission, so that

(A) the current is reduced and consequently, the I^2R loss is cut down

(B) the voltage is increased, the power losses are also increased

(C) the power is increased before transmission is done

(D) the voltage is decreased so V^2/R losses are reduced

Q. 55. A power transmission line feeds input power at 2300 V to a step down transformer with its primary windings having 4000 turns. The number of turns in the secondary in order to get output power at 230 V are-

(A) 4 **(B)** 40

(C) 400 **(D)** 4000

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: A

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: ⒶⒷⒸⒹ

Roll Number: ⓪①②③④⑤⑥⑦⑧⑨

Name

Test Date

Invigilator's Signature

Student's Signature

Certified that all the entries In this section have been properly filled by the student

Subject

Proper Marking
The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪⓪ ①① ②② ③③ ④④ ⑤⑤ ⑥⑥ ⑦⑦ ⑧⑧ ⑨⑨

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Marking Scheme 2021-22 (Term-I)
(Issued by Board)

Solutions of Question Paper 1

Section-A

Ans. 1. Option (C) is correct.

Explanation : As all other statements are correct. In uniform electric field, equipotential surfaces are never concentric spheres but are planes ⊥ to electric field lines.

Ans. 2. Option (C) is correct.

Explanation : Let P be the observation point at a distance r from $-2q$ and at $(L + r)$ from $+ 8q$.
Given Now, Net EFI at P = 0
$\therefore \vec{E_1}$ = EFI (Electric Field Intensity) at P due to $+ 8q$
$\vec{E_2}$ = EFI (Electric Field Intensity) at P due to $- 2q$

$$\left|\vec{E_1}\right| = \left|\vec{E_2}\right|$$

$$\therefore \quad \frac{k(8q)}{(L + r)^2} = \frac{k(2q)}{r^2}$$

$$\therefore \quad \frac{4}{(L + r)^2} = \frac{1}{(r)^2}$$

$$4r^2 = (L + r)^2$$
$$2r = L + r$$
$$r = L$$

$\therefore$ P is at $x = L + L = 2L$ from origin
$\therefore$ Correct option is (C) 2L.

Ans. 3. Option (B) is correct.

Explanation :

$$W = pE (\cos \theta_1 - \cos \theta_2)$$
$$\theta_1 = 0°$$
$$\theta_2 = 90°$$
$$W = pE (\cos 0° - \cos 90°)$$
$$= pE (1 - 0)$$
$$= PE$$

Ans. 4. Option (B) is correct.

Explanation :

$$\frac{1}{C_{series}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$\frac{1}{C_{series}} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6}$$

$$\frac{3 + 2 + 1}{6} = \frac{6}{6}$$

$$C_{series} = 1 \ \mu F$$

Ans. 5. Option (A) is correct.

Explanation :

$$\frac{Q_1 \quad Q_2}{r} K = 5$$

$$F = \frac{1}{4\pi\varepsilon o k} \frac{Q_1 Q_2}{r^2}$$

Q_1 _____ Q_2

Force in the charges in the air is

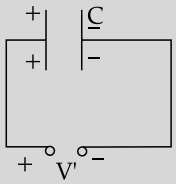
$$F^- = \frac{1}{4\pi\varepsilon o} \frac{Q_1 Q_2}{r^2}$$
$$= K F$$
$$= 5 F$$

Ans. 6. Option (D) is correct.

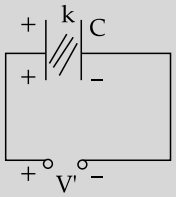
Explanation : All other statements except (iv) are incorrect.
The electric field over the Gaussian surface remains continuous and uniform at every point.

Ans. 7. Option (C) is correct.

Explanation:



Battery is disconnected.



Q = Charge remains context

$C' = KC$

$Q' = C'V'$

$Q = C'V'$

$Q = K\,C\,V'$

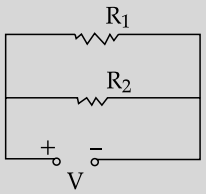
$$V' = \frac{Q}{KC} = \frac{V}{K}$$

Ans. 8. Option (A) is correct.

Explanation : Potentiometer.

Ans. 9. Option (C) is correct.

Explanation :



$I_1 : I_2 = 3 : 2$

$r_1 : r_2 = 2 : 3$

$I_1 : I_2 = ?$

$$R_1 = \rho\frac{l_1}{\pi r_1^2}$$

$$R_2 = \rho\frac{l_2}{\pi r_2^2}$$

$$\frac{R_1}{R_2} = \frac{l_1}{l_2}\frac{\pi r_2^2}{\pi r_1^2} = \frac{l_1}{l_2}\times\frac{r_2^2}{r_1^2}$$

$$= \frac{3}{2}\times\left(\frac{3}{2}\right)^2 = \frac{(3)^3}{(2)^3} = \frac{27}{8}$$

$$\therefore \quad \frac{I_1}{I_2} = \frac{V/R_1}{V/R_2} = \frac{R_2}{R_1} = 8/27$$

Ans. 10. Option (C) is correct.

Explanation : Specific resistance of a conductor increases and for a semiconductor decreases with increase in temperature because for a conductor, a temperature:
coefficient of resistivity, α = + ve
and for a semiconductor, α = – ve

Ans. 11. Option (A) is correct.

Explanation : Alloys have low temperature coefficient of resistivity and high specific resistance. If α = low, the value of 'R' with temperature will not change much and specific resistance is high, then required length of the wire will be less.

Ans. 12. Option (C) is correct.

Explanation :

$$R = \rho\frac{l}{A}$$

$$R = \rho\frac{l}{\pi r^2}$$

$$R' = \rho\frac{2l}{\pi(2r)^2}$$

$$R' = \rho\frac{2l}{\pi 4r^2}$$

$$H = \frac{V^2}{R}t \;\&\; H' = \frac{V^2}{R'}t$$

$\because$ V = constant

$$\frac{H'}{H} = \frac{V^2}{R'}\frac{R}{V^2}\frac{t}{t}$$

$$= \frac{R}{R'} = \rho\frac{l}{\pi r^2}\frac{2\pi r^2}{\rho l}$$

$$\frac{H'}{H} = \frac{2}{1}$$

$$H' = 2H$$

Ans. 13. Option (C) is correct.

Explanation :
We know

$$V_d = \frac{eE}{ml}\bar{\tau}$$

$$= e\frac{V}{ml}\bar{\tau}$$

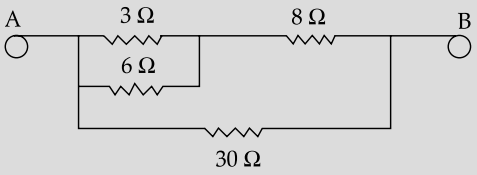
If temperature is kept constant, relaxation time $\bar{\tau}$ - will remain constant and e, m are also constants.

$$V_d \propto V$$

$$V_d \propto 2V$$

Ans. 14. Option (C) is correct.

Explanation : Redrawing the circuit, we get



3 Ω & 6 Ω are in parallel.

$$\therefore\ R_1 = \frac{3\times 6}{3+6} = \frac{18}{9} = 2\ \Omega$$

Now R_1 and 8Ω in series

$$\therefore\ R_2 = R_1 + 8 = 2 + 8 = 10\ \Omega$$

Now R_2 and 30 Ω in parallel

$$R_{eq} = \frac{R_2 \times 30}{R_2 + 30} = \frac{10\times 30}{10+30}$$

$$= \frac{300}{40} = \frac{30}{4} = \frac{15}{2}$$

$$= 7.5\ \Omega$$

Ans. 15. Option (B) is correct.

Explanation : We know

$$B = \frac{F}{Il\sin\theta}$$

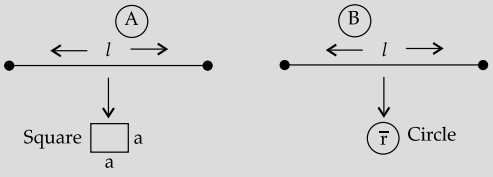
$$\text{SI Unit of B} = \frac{N}{Am} = NA^{-1}m^{-1}$$

Ans. 16. Option (D) is correct.

Explanation : The coil of a moving coil galvanometer is wound over metallic frame to provide electromagnetic damping so it becomes dead beat galvanometer.

Ans. 17. Option (C) is correct.

Explanation : l = length of wire



Area of a Square

$$= a^2$$

Also here $l = 4a$

$$a = \frac{l}{4}$$

$$\therefore\ \text{Area} = \frac{l^2}{16}$$

$$A_1 = \frac{l^2}{16}$$

Area of a circle

$$= \pi r^2$$

Also here, $2\pi r = l$

$$r = \frac{l}{2\pi}$$

Now area $= \pi\left(\frac{1}{2\pi}\right)^2$

$$A_2 = \frac{1^2}{4\pi}$$

Now Magnetic moment = IA

$\therefore\ M_1 = IA$, & $M_2 = I A_2$

Since I (current) is same in both

$$\therefore\ \frac{M_1}{M_2} = \frac{A_1}{A_2} = \frac{l^2}{16} = \frac{4\pi}{l^2} = \frac{\pi}{4}$$

$M_1M_2 = \pi : 4$

Ans. 18. Option (A) is correct.

Explanation : Target law, $B_V = B_H \tan\delta$

$$\tan\delta = \frac{B_V}{B_H}$$

Given $B_H = \sqrt{3}\ B_V$

$$\tan\delta = \frac{B_V}{\sqrt{3}\,B_V} = \frac{1}{\sqrt{3}}$$

$\delta = 30°$ or $\frac{\pi}{6}$ radians.

Ans. 19. Option (D) is correct.

Explanation : Correct option is Magnetic declination or Angle of declination. It is the small angle between geographic axis and magnetic axis.

Ans. 20. Option (B) is correct.

Explanation : Mutual inductance of a pair of two coils depends on the relative position and orientation of two coils.

Ans. 21. Option (D) is correct.

Explanation : Current induced is $I = \frac{|e|}{R}$

Now $|e| = \frac{d\phi}{dt}$

But there is no change of flux with time, as $\vec{B}$, $\vec{A}$ and θ all remain constant with time.

$\therefore$ No current is induced.

Ans. 22. Option (B) is correct.

Explanation : $\phi = 5t^2 + 3t + 16$

$$|e| = \frac{d\phi}{dt}$$

$$= \frac{d}{dt}\left[5t^2 + 3t + 16\right]$$

$$= 10t + 3$$

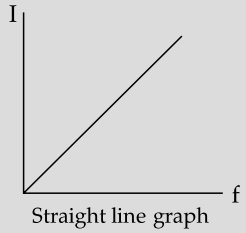
$$|e|_{t=4} = 10\,(4) + 3 = 43 \text{ V}$$

$$e = -43 \text{ Volts}$$

Ans. 23. Option (C) is correct.

Explanation :

$I = \frac{V}{X_C}$ in pure capacitor



Straight line graph

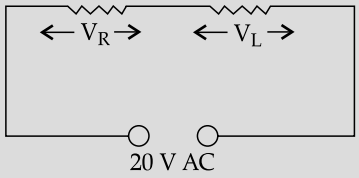
$$= \frac{V}{\frac{1}{2\pi fc}} = V\,2\pi fc$$

$\Rightarrow \quad 1 \propto f$

other parameters kept constant

Ans. 24. Option (A) is correct.

Explanation :



V_R = Effective voltage across R

$\therefore V_R = I_{eff}\,R$

V_L = Effective voltage across L

$V_L = I_{eff} \times L$

$$\text{Net } V = \sqrt{V_R^2 + V_L^2}$$

$$= \sqrt{I_{eff}^{\,2}R^2 + I_{eff}^{\,2} \times L^2}$$

$$20 = \sqrt{(12)^2 + V_L^{\,2}}$$

$$(20)^2 = (12)^2 + V_L^{\,2}$$

$$400 = 144 + V_L^{\,2}$$

$$V_L = \sqrt{400 - 144} = \sqrt{256} = 16 \text{ Volts}$$

Ans. 25. Option (D) is correct.

Explanation : $E = E_0 \sin \omega t$

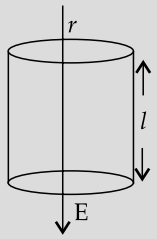
$$I = I_0 \sin\left(\omega t + \frac{\pi}{3}\right)$$

as I can lead the voltage in RC and LCR circuit, so it can be RC or LCR circuit.

Section-B

Ans. 26. Option (A) is correct.

Explanation :



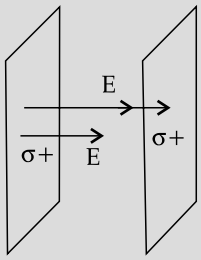
Since – ve electric flux.

= +ve flux electric flux enclosed with a cylinder here

$\therefore$ Total electric flux = 0.

Ans. 27. Option (D) is correct.

Explanation :



Surface charge density,

$$\sigma = 26.4 \times 10^{-12} \frac{C}{m^2}$$

$$E = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0}$$

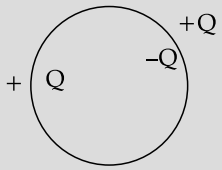
$$= \frac{2\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$$

$$= \frac{26.4 \times 10^{-12}}{8.85 \times 10^{-12}} \frac{N}{C}$$

$$= 3 \frac{N}{C}$$

Ans. 28. Option (D) is correct.

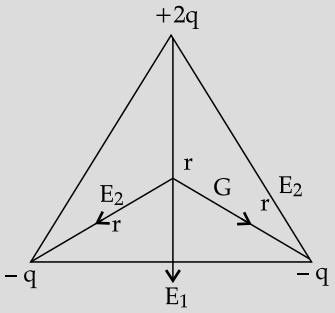
Explanation :



Equal and opposite charges appear on the nearby conductor due to induction, but still net charge on the conductor is zero. Correct option (D).

Ans. 29. Option (C) is correct.

Explanation :



Net Electric field intensity at G ≠ O

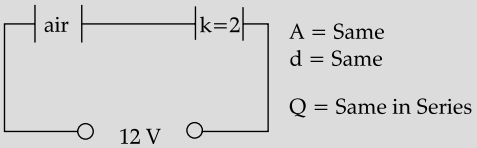
Net Potential at G,

$$V = \frac{K2Q}{r} - \frac{KQ}{r} - \frac{KQ}{r}$$

$$= 0$$

Ans. 30. Option (C) is correct.

Explanation :



$$C_x = \frac{\varepsilon_0 A}{d}, \; C_y = \frac{2\varepsilon_0 A}{d}$$

$$U_x = \frac{Q^2}{2C_x}, \; U_y = \frac{Q^2}{2C_y}$$

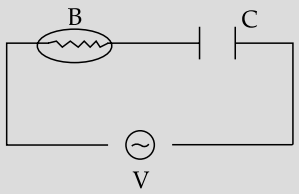
$$\therefore \frac{U_x}{U_y} = \frac{C_y}{C_x} = \frac{2C_x}{C_x} = \frac{2}{1}$$

Ans. 31. Option (D) is correct.

Explanation : Correct statement is option (D) as primary coil made of thick copper wire has very less R. Therefore negligible power loss. Rest all options are reasons for power losses in a transformer.

Ans. 32. Option (B) is correct.

Explanation :



$\omega \uparrow$

$$X_c = \frac{1}{2\pi fc} = \frac{1}{\omega c} \downarrow \; i.e. \; X_c \downarrow$$

$I \uparrow \; \therefore$ Brightness of the bulb will $\uparrow$.

Ans. 33. Option (D) is correct.

Explanation : As all other statements seem incorrect in context with the given figure.

Ans. 34. Option (D) is correct.

Explanation :

- Current is defined as charges flow per unit time: it should be constant throughout any cross-section as there is no accumulation of charge in conductor.

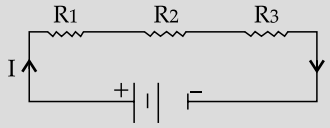
  The resistance is given by $R = \frac{\rho L}{A}$,

  ρ is constant for a material. Given that cross-sectional area varies. Therefore resistance varies.
- From ohm's law V = IR as I constant and R varies, therefore V varies and corresponding electric field will also vary.
- Draft velocity $V_d = \frac{I}{neA}$ will also vary as I constant and A is changed.

Hence option (D) is correct.

Ans. 35. Option (C) is correct.

Explanation :



Given

$I = 2\ A, R_2 = 3\ \Omega, P_3 = 6\ W$

Power across $R_3 = V_3 I$

$6 = I^2 R_3$

$\frac{6}{4} = R_3 = \frac{3}{2} = 1.5\ \Omega$

$V_3 = IR_3 = 2\ (1.5) = 3\ V$

Ans. 36. Option (A) is correct.

Explanation : I = O, V = E, $\therefore$ E = 5.6 V

$$r = \frac{E}{I} = \frac{5.6}{2.0} = 2.8\ \Omega$$

Ans. 37. Option (D) is correct.

Explanation : Let PQ is a potentiometer wore of length 10 m,

$$I = \frac{E}{R + R'} = \frac{5}{480 + 20} = \frac{5}{500}$$

$$= \frac{1}{100} = 0.01\,A$$

$V_{PQ} = I R_{PQ} = 0.01 \times 20$

$= 0.2\ V$

If 10 m potentiometer wire balances

$\Rightarrow 0.2\ V$

Then 1 m potentiometer wire balances

$\Rightarrow \frac{0.2}{10} V$

Then 6 m potentiometer wire balances

$= \frac{0.2}{10} \times 6\ V$

$= \frac{1.2}{10} = 0.12\ V$

Ans. 38. Option (D) is correct.

Explanation : Given,

$$I'_g = I_g + \frac{20}{100} I_g$$

$$= \frac{120}{100} I_g = 1.2 I_g$$

$$R' = R + \frac{25}{100} R = \frac{125}{100} R$$

$$= 1.25\ R$$

$V'_g = ?$

$$V'_g = \frac{I'_g}{R'} = \frac{1.2 I_g}{1.25\,R}$$

$$= \frac{120}{125} V_g = \frac{25}{25} V_g$$

$$\%\ \text{change} = \frac{V'_g - V_g}{V_g} \times 100$$

$$= \frac{\left(\frac{24}{25} V_g - V_g\right)}{V_g} \times 100$$

$$= \frac{(24 - 25)}{25} \times 100$$

$$= \frac{-1}{25} \times 100 = 4\%$$

Decrease by 4%.

Ans. 39. Option (A) is correct.

Explanation : Let F_1 is force per unit, length between A & C

$\therefore$ *i.e.* $F_1 = \frac{\mu_0}{4\pi} \frac{2I \times I}{2r}$

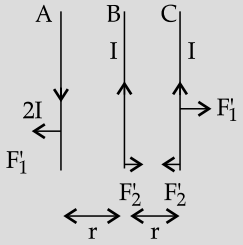
And F_2 is force per unit, length between B & C

$\therefore$ $F_2 = \frac{\mu_0}{4\pi} \frac{I \times I}{r}$

Now net force on 'C' is per unit length

$$F_1 + F_2 = \frac{\mu}{4\pi} \frac{I^2}{r} (1 + 1)$$

$$= \frac{2\mu_0}{4\pi}\frac{I^2}{r} = F \text{ (given)}$$



Now

F'_1 = Repulsive force between A & C

$$= \frac{\mu_0}{4\pi}\frac{2I^2}{2r}$$

$F'_2 = F_2$ = A reactive force between B and C

$\therefore$ Net force on 'C' $F'_1 - F'_2 = 0$

$\because \quad F'_1 = F'_2 = \frac{\mu}{4\pi}\frac{2I^2}{2r}$

$\therefore$ Net Force on 'C' is zero.

Ans. 40. Option (B) is correct.

Explanation :

$R = 0.5\ A°$

$\omega = 10$ rps $= 10 \times 2\pi$ rad/s

$\nu = 10$ Hz

$M = IA = e\,\nu\,\pi\,r^2$

$= 1.6 \times 10^{-19} \times 10 \times 3.14 \times 0.5 \times 0.5 \times 10^{-10} \times 10^{-10}$

$= 1.256 \times 10^{-38}\ Am^2$

Ans. 41. Option (C) is correct.

Explanation : Magnetic field inside a solenoid

$$B = \mu_0 \frac{N}{l} I'$$

Flux linked with 'N' turns

Initial flux $\phi_1 = NBA = N\mu_0 \frac{N}{l} IA$

$$= \mu_0 \frac{N^2}{l} IA$$

$$= \frac{4\pi \times 10^{-7} \times 800 \times 800 \times 2.5 \times 2.5 \times 10^{-4}}{0.30}$$

$= 16.74 \times 10^{-3}$ Wb

Final flux $\phi_2 = 0$

Average back emf $|e|$

$$= \frac{d\phi}{dt} = \frac{16.74 \times 10^{-3} - 0}{10^{-3}}$$

$= 16.74$ V

Ans. 42. Option (D) is correct.

Explanation :

$V_o = 283$ V, $f = 50$ Hz

$R = 3\ \Omega$, $L = 25.48$ mH

$C = 796\ \mu F$

$P|_{\text{at resonance}} = ?$

Power dissipated

$P = I^2R$

$$I = \frac{I_0}{\sqrt{2}} = \frac{1}{\sqrt{2}}\left(\frac{283}{3}\right)$$

$= 66.7$ A

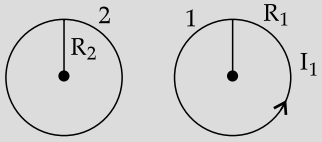
$P = I^2 R$

$= (66.7)^2\, 3$

$= 13.35$ kW

Ans. 43. Option (D) is correct.

Explanation : Let flux linked with smaller loop be ϕ_1 and with bigger loop be ϕ_2.



Given

$R_2 = 0.2$ m

$R_1 = 0.003$ m

$x = 15$ cm $= 0.15$ m

Now $\phi_1 = B_2A_1$

$$= \frac{\mu_0}{4\pi}\left[\frac{2\pi R_2^2 I_2}{\left(R_2^2 + x^2\right)^{3/2}}\right]\pi\ R_1^2$$

$$M = \frac{\phi_1}{I_2} = \frac{\mu_0}{4\pi}\frac{2\pi\, R_2^2\, \pi R_1^2}{\left(R_2^2 + x^2\right)^{3/2}}$$

Now $\phi_2 = M\, I_1$

$$= \frac{\mu_0}{4\pi}\frac{2\pi R_2^2 \pi R_1^2}{\left(R_2^2 + x^2\right)^{3/2}} \cdot I_1$$

$= 9.1 \times 10^{-11}$ Weber

Ans. 44. Option (B) is correct.

Explanation :

$$L = \mu_0 \frac{N^2}{l} A$$

$$L' = \mu_0 \frac{(2N)^2}{2l} A$$

$$= 2\mu_0 \frac{N^2}{l} A = 2L$$

Ans. 45. Option (D) is correct.

Explanation : Correct option is (D) as both statements are false. To increase the range of an ammeter, suitable low R (or shunt) should be connected in parallel to it. The ammeter with increased range has low resistance.

Ans. 46. Option (C) is correct.

Explanation : Statements correct but reason is wrong because electrons move from a region of low potential to high potential.

Ans. 47. Option (A) is correct.

Explanation : The given statement is correct and reason is the correct explanation of the above statement. At poles, magnetic needle orients itself vertically because horizontal components of earth's field is zero there.

Ans. 48. Option (B) is correct.

Explanation : we know

$$\frac{mv^2}{r} = Bqv \sin\theta = Bqv \sin\theta$$

Centripetal force = magnetic Lorentz force

$\sin\theta = \sin 90° = 1$

($\angle$between $\vec{V}$ & $\vec{B} = 90°$)

$$\frac{mv^2}{r} = Bqv$$

$$\frac{mv}{r} = Bq$$

$$r = \frac{mv}{Bq} = \frac{p}{Bq} = \frac{\text{linear momentum}}{Bq}$$

Since $r = \frac{p}{Bq}$

Given p, B are same

Also q for proton & electron is same except its sign.

$\therefore$ Radius is same. So statement is correct but reason is not the correct explanation of the given assertion.

Ans. 49. Option (A) is correct.

Explanation : When we increase current sensitivity by increasing number of turns, then resistance of coil also increases. So increasing current sensitivity does not necessarily imply that voltage sensitivity will increase because

$$V_g = \frac{I_g}{R}$$

$\therefore$ if $I_g \uparrow$ & $R \uparrow$ by different amounts, then V_g may increase or decrease.

Section-C

Ans. 50. Option (B) is correct.

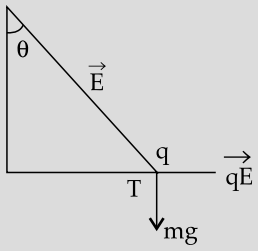
Explanation : $F_e = mg \tan\theta$

$$qE = mg \tan\theta$$

$$qE = mg \tan\theta$$

$$q = \left(\frac{mg}{E}\right) \tan\theta$$

$$\tan\theta = \frac{F_e}{mg}$$



Ans. 51. Option (B) is correct.

Explanation :

$\because \quad F_p = F_e$

$\because \quad F = qE$

$E = \text{same}$

$'q' = \text{same}$

Now, $P\varepsilon = q\,V(r)$

$(P \cdot \varepsilon)_p > (P \cdot \varepsilon)_e$

Ans. 52. Option (D) is correct.

Explanation : Correct answer is (D) *i.e.* step down transformer decreases the ac voltage.

Ans. 53. Option (A) is correct.

Explanation :

i.e. $\dfrac{N_s}{N_p} = \dfrac{E_s}{E_p}$

i.e. if number of turns in secondary coil are more than number of turns in primary, then voltage is increased or stepped up in secondary, so called step-up transformer.

Ans. 54. Option (D) is correct.

Explanation : *i.e.* Current is reduced if voltage is stepped-up, so corresponding I^2R losses are cut down.

Ans. 55. Option (C) is correct.

Explanation :

Given $E_i = 2300\ V$

$E_0 = 230\ V$

$N_p = 4000$

$N_s = ?$

$$\frac{E_i}{E_o} = \frac{N_p}{N_s}$$

$$\frac{2300}{230} = \frac{4000}{x}$$

$x = 400 = N_s$ = number of turns is secondary coil.

■■■

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Sample Question Paper

Sample Question Paper 2

Solved

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. Plastic rod rubbed with fur and glass rod rubbed with silk

(A) repel each other **(B)** mix up with each other

(C) attract each other **(D)** None of these

Q. 2. Number of electrons present in a negative charge of 10 Coulomb is:

(A) 1.61×10^{19} **(B)** 5.25×10^{19}

(C) 6.25×10^{19} **(D)** 2.50×10^{19}

AI **Q.3.** If there is only one type of charge in the universe, then

(A) $\oint E.ds \neq 0$ on any surface

(B) $\oint E.ds = \varepsilon_0/q$ if the charge is outside the surface.

(C) $\oint E.ds$ cannot be defined

(D) $\oint E.ds = q/\varepsilon_0$ if charges of magnitude q is inside the surface.

Q.4. Two identical metallic spheres having charge + 6Q and – 2Q are placed r distance apart from their centres. Force of attraction between them is F. After that if they are brought in contact and then placed at the same distance r. New force acting on them is

(A) $\frac{F}{2}$ **(B)** $\frac{F}{3}$

(C) $\frac{F}{6}$ **(D)** $\frac{F}{4}$

Q. 5. Which is not the unit of electric potential

(A) joule/coulomb **(B)** newton/coulomb

(C) newton-meter/coulomb **(D)** Volt

Q. 6. Consider a current carrying wire (current I) in the shape of a circle. Note that as the current progresses along the wire, the direction of J (current density) changes in an exact manner, while the current I remain unaffected. The agent that is essentially responsible for is

(A) source of emf

(B) electric field produced by charges accumulated on the surface of wire.

(C) the charges just behind a given segment of wire which push them just the right way by repulsion.

(D) the charges ahead.

Q. 7. Which of the following characteristics of electrons determines the current in a conductor?

(A) Drift velocity alone **(B)** Thermal velocity alone

(C) Both drift velocity and thermal velocity **(D)** Neither drift nor thermal velocity.

Q. 8. On decreasing the electric field E, the drift velocity v_d

(A) increases **(B)** decreases

(C) remain same **(D)** zero

Q. 9. Energy in 100-watt electric bulb in 1 minute

(A) 100 J **(B)** 6000 J

(C) 1600 J **(D)** 5000 J

AI Q. 10. In a metre bridge, what is the effect on null deflection of galvanometer, when the radius of the meter bridge wire is doubled?

(A) There will be no change **(B)** Null point will shift to $L_1/2$ point

(C) Null point will shift to $2L_1$ point **(D)** Null point will not be available

Q. 11. Which one of the following statements is correct?

(A) Potentiometer is used to measure the current in a circuit.

(B) Potentiometer is used to measure the internal resistance of a cell.

(C) Potentiometer is used to measure the resistance of a circuit.

(D) Potentiometer is used to measure the potential difference across a resistor.

Q. 12. Which wire is not used in potentiometer?

(A) copper **(B)** constantan

(C) manganin **(D)** All of these

Q. 13. Kirchhoff's current law is based on the law of conservation of

(A) Charge **(B)** Energy

(C) Mass **(D)** Both (B) and (C)

Q.14. A current carrying circular loop of radius R is placed in the $x - y$ plane with centre at the origin. Half of the loop with $x > 0$ is now bent so that it now lies in the $y - z$ plane.

(A) The magnitude of magnetic moment now diminishes.

(B) The magnetic moment does not change.

(C) The magnitude of B at (0.0.z), $z >> R$ increases.
(D) The magnitude of B at (0.0.z), $z >> R$ is unchanged.

Q. 15. Two charged particles traverse identical helical paths in a completely opposite sense in a uniform magnetic field $B = B_0\hat{k}$.
(A) They have equal z-components of momenta.
(B) They must have equal charges.
(C) They necessarily represent a particle antiparticle pair.
(D) The charge to mass ratio satisfy:

$$\left(\frac{e}{m}\right)_1 + \left(\frac{e}{m}\right)_2 = 0$$

Q. 16. To convert a galvanometer to ammeter a shunt S is to be connected with the galvanometer. The effective resistance of the ammeter then is
(A) GS/(G + S) **(B)** (G + S)/GS
(C) G + S **(D)** None of these

Q. 17. An ammeter gives full scale deflection when current of 1.0 A is passed in it. It is converted into a 100 A range ammeter, what will be the ratio of the shunt resistance and its resistance?
(A) 1 : 9 **(B)** 9 : 1
(C) 1 : 11 **(D)** 11 : 1

Q. 18. An iron-cored solenoid has self-inductance 2.4 H. When the core is removed, the self-inductance becomes 6 mH. The relative permeability of the material of the core is
(A) 400 **(B)** 200
(C) 800 **(D)** 600

Q. 19. If two coils of self-inductance L_1 and L_2 are coupled together, their mutual inductance becomes
(A) $M = k\sqrt{L_1L_2}$ **(B)** $M = k\sqrt{\frac{L_1}{L_2}}$
(C) $M = k\sqrt{L_1 + L_2}$ **(D)** None of these

Q. 20. Lenz's law is consequence of the law of conservation of
(A) Charge **(B)** Mass
(C) Energy **(D)** Momentum

Q. 21. Magnetic field energy stored in a coil is
(A) Li^2 **(B)** $\frac{1}{2}Li$
(C) Li **(D)** $\frac{1}{2}Li^2$

AI Q.22. If the rms current in a 50 Hz AC circuit is 5 A, the value of the current $\frac{1}{300}$ s after its value becomes zero is
(A) $5\sqrt{2}$A **(B)** $5\sqrt{\frac{3}{2}}$A
(C) $\frac{5}{6}$A **(D)** $\frac{5}{\sqrt{2}}$A

Q. 23. When frequency of applied alternating voltage very high then
(A) A capacitor will tend to become SHORT **(B)** An inductor will tend to become SHORT
(C) Both (A) and (B) **(D)** No one will become short

Q. 24. Which of the following combinations should be selected for better tuning of an LCR circuit used for communication?

(A) $R = 20\Omega, L = 1.5H, C = 35\mu F$ **(B)** $R = 25\Omega, L = 2.5H, C = 45\mu F$

(C) $R = 15\Omega, L = 3.5H, C = 30\mu F$ **(D)** $R = 25\Omega, L = 1.5H, C = 45\mu F$

Q. 25. The sharpness of tuning of a series LCR circuit at resonance is measured by Q factor of the circuit which is given by

(A) $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$ **(B)** $Q = \frac{1}{R}\sqrt{\frac{C}{L}}$

(C) $Q = \frac{1}{L}\sqrt{\frac{R}{C}}$ **(D)** $Q = \frac{1}{C}\sqrt{\frac{R}{L}}$

Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. If distance between two charged particles is halved. How the force be affected?

(A) Half **(B)** four times

(C) same **(D)** twice

Q. 27. Radius of the hydrogen atom is 10^{-15} m. The electric field at the surface of the atom is

(A) $14.4 \times 10^{-20}\,NC^{-1}$ **(B)** $14.4 \times 10^{20}\,NC^{-1}$

(C) $14.4 \times 10^{-19}\,NC^{-1}$ **(D)** $14.4 \times 10^{19}\,NC^{-1}$

Q. 28. 8 small drops of equal size having radius of 2 mm are charged to 220 volt. Together they make a bigger drop. Calculate the potential of bigger drop.

(A) 220 V **(B)** 1760 V

(C) 880 V **(D)** 27.5 V

Q. 29. The maximum capacitance of three identical capacitors is obtained by connecting them

(A) in parallel **(B)** in series

(C) two in parallel and one in series **(D)** two in series and one in parallel

Q. 30. A current of 8.0 ampere is flowing in a conductor. Number of electrons flowing per second is:

(A) 8 **(B)** 8×10^{19}

(C) 20×10^{8} **(D)** 5×10^{19}

Q. 31. A wire has resistance 15 Ω. It is bent in the form of equilateral triangle. The effective resistance between any two vertices will be:

(A) 6.66 Ω **(B)** 15 Ω

(C) 5 Ω **(D)** 3.33 Ω

Q. 32. If a copper is shaped such that its resistance is minimum, then its length L and diameter d will be

(A) L, $3d$ **(B)** $\frac{L}{3}$, $3d$

(C) 3L, $3d$ **(D)** $\frac{L}{3}$, d

Q. 33. Two bulb of 60 W and 80 W are connected to 220 V line. The ratio of their resistances:

(A) 4:3 **(B)** 3:4

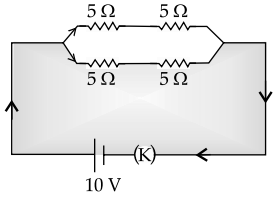
(C) 16:9 **(D)** 9:16

Q. 34. The current density (number of free electrons per m^3) in metallic conductor is of the order of

(A) 10^{28} **(B)** 10^{23}

(C) 10^{20} **(D)** 10^{15}

Q. 35. What is the potential difference between points A and B in the following circuit?



(A) 10 V **(B)** 5 V

(C) 2.5 V **(D)** 20 V

Q. 36. A solenoid of 1.5 metre length and 4.0 cm diameter has 10 turn per cm. A current of 5 A is flowing through it. The magnetic field at axis inside the solenoid is

(A) $2\pi \times 10^{-3}$ T **(B)** $2\pi \times 10^{-3}$ G

(C) $2\pi \times 10^{-7}$ T **(D)** $2\pi \times 10^{-7}$ G

Q. 37. A galvanometer of 100 Ω resistance gives full scale deflection for 10 mA current. To use it as an ammeter of 10 A range, the resistance of the shunt required is

(A) 10 Ω **(B)** 0.10 Ω

(C) 0.01 Ω **(D)** 0.001 Ω

Q. 38. The magnetic flux linked with a coil is given by an equation $\phi = 5t^2 + 2t + 3$.

The induced e.m.f. in the coil at the 3 second will be

(A) 32 units **(B)** 54 units

(C) 40 units **(D)** 65 units

Q. 39. The output of a step-down transformer is measured to be 24 V when connected to a 12 W Light bulb. The value of the peak current is

(A) $\frac{1}{\sqrt{2}}$ A **(B)** $\sqrt{2}$A

(C) 2A **(D)** $2\sqrt{2}$A

Q.40. The heat produced in a given resistance in a given time by the sinusoidal current $I_0 \sin \omega t$ will be the same as heat produced by a steady current of magnitude

(A) 0.707 I_0 **(B)** 1.412 I_0

(C) I_0 **(D)** $\sqrt{I_0}$

AI Q. 41. A coil having an area A_0 is placed in a magnetic field which changes from B_0 to $4B_0$ in time interval t. the e.m.f. induced in a coil will be

(A) $3\frac{A_0B_0}{t}$ **(B)** $4\frac{A_0B_0}{t}$

(C) $3\frac{B_0}{A_0t}$ **(D)** $4\frac{B_0}{A_0t}$

Q. 42. The time constant of an inductive coil is 2.0×10^{-3} second. When 60 Ω resistance is added in series, the time constant reduces to 9.5×10^{-3} second. If inductance of the coil is

(A) 20 mH **(B)** 40 mH

(C) 50 mH **(D)** 65 mH

Q. 43. A pure inductor of 15.0 mH is connected to a source of 220 V. Find the inductive reactance and rms current in the circuit if the frequency of the source is 50 Hz.

(A) 46.71 Ω **(B)** 10.05 Ω

(C) 16.5 Ω **(D)** 55.3 Ω

Q. 44. A current of 2 A flows in a coil when connected to a 10 V dc source. If the same coil is connected to a 10 V, $\frac{50}{\pi}$ Hz ac source a current 1 A flows in the circuit. The inductance of the coil is

(A) $\frac{\sqrt{3}}{20}$ H **(B)** $\frac{\sqrt{3}}{10}$ H

(C) $\frac{\sqrt{3}}{5}$ H **(D)** $\frac{\sqrt{3}}{2}$ H

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

Q. 45. **Assertion (A):** Electric field is always normal to equipotential surfaces and along the direction of decreasing order of potential.

Reason (R): Negative gradient of electric potential is electric field.

Q. 46. **Assertion (A):** Electrons are transferred from lower potential region to higher potential region.

Reason (R): Material which loses electron has positive charge and material which gains electrons has negative charge.

Q. 47. **Assertion (A):** Kirchhoff's junction rule is applicable for any number of lines meeting at a point in an electrical circuit.

Reason (R): When there is a flow of steady current, then there is no accumulation of charge at the junction.

Q. 48. **Assertion (A):** Magnetic field interacts with a moving charge only.

Reason (R): Moving charge produces a magnetic field. .

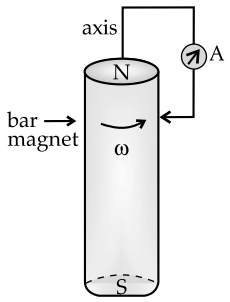
Q. 49. **Assertion (A):** An alternating current does not show any magnetic effect.

Reason (R): Alternating current changes direction with time.

Section-C

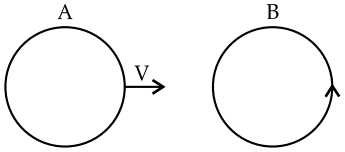
This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

Q. 50. A cylindrical bar magnet is rotated about its axis in the figure. A wire is connected from the axis and is made to touch the cylindrical surface through a contact. Then



(A) A direct current flows in the ammeter A.
(B) No current flows through the ammeter A.
(C) An alternating-sinusoidal current flows through the ammeter A with a time period $2\pi/\omega$.
(D) A time varying non-sinusoidal current flows through the ammeter A.

Q. 51. There are two coils A and B as shown in figure. A current start flowing in B as shown, when A is moved towards B and stops when A stops moving. The current in A is counter clockwise. B is kept stationary when A moves. We can infer that

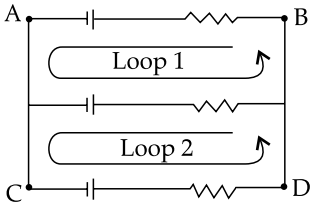


(A) there is a constant current in the clockwise direction in A.
(B) there is a varying current in A.
(C) there is no current in A.
(D) there is a constant current in the counter clockwise direction in A.

CASE STUDY

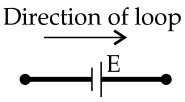
Read the following text and answer the questions

Kirchhoff's circuit laws: Kirchhoff's laws were eventually named after Gustav Robert Kirchhoff and are now known as Kirchhoff's current and Voltage Laws. Kirchhoff's current states that at the junction of the circuit, the algebraic sum of the current meeting at any node in the circuit is zero, i.e., $\sum i = 0$. Kirchhoff's voltage states that the sum of every voltage drop in a loop for any closed network of a circuit is zero. This means while adding the voltage across each circuit element in any closed loop of circuit is zero. The figure illustrates that the total voltage around a closed loop must be zero.

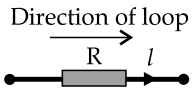


The steps of solving circuit using Kirchhoff's laws are as follows:

- The first and foremost step is to draw a closed loop to a circuit and draw the direction of the flow of current.
- Defining our sign convention is very important.
- Defining our sign convention is very important.
- Apply Kirchhoff's current law
- Apply Kirchhoff's voltage law.



Sign for E is +ve



Sign for V (or IR) is +ve

Q. 52. Which law is followed to analyse the electric circuit?

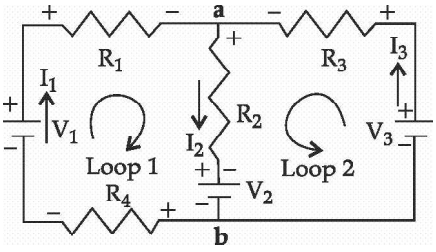
(A) Newton's law **(B)** Coulomb's law

(C) Kirchhoff's law **(D)** Gravitational law

Q. 53. **In the given figure, the relation between the currents at point** *b*

(A) $I_1 - I_2 - I_3 = 0$ **(B)** $I_1 + I_2 - I_3 = 0$

(C) $I_1 - I_2 + I_3 = 0$ **(D)** $-I_1 + I_2 - I_3 = 0$



Q. 54. On applying the Kirchhoff's voltage law in loop 1, the obtained relationship is

(A) $V_1 + I_1R_1 + I_2R_2 - V_2 + I_1R_4 = 0$ **(B)** $V_1 - I_1R_1 - I_2R_2 - V_2 + I_1R_4 = 0$

(C) $V_1 - I_1R_1 - I_2R_2 - V_2 - I_1R_4 = 0$ **(D)** $V_1 + I_1R_1 + I_2R_2 - V_2 - I_1R_4 = 0$

Q. 55. On applying the Kirchhoff's voltage law in loop 2, the obtained relationship is

(A) $V_3 - I_3R_3 - I_2R_2 - V_2 = 0$ **(B)** $V_3 - I_3R_3 + I_2R_2 - V_2 = 0$

(C) $V_3 + I_3R_3 + I_2R_2 - V_2 = 0$ **(D)** $V_3 - I_3R_3 - I_2R_2 + V_2 = 0$

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: **A**

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: ⒶⒷⒸⒹ

Roll Number: ⓪①②③④⑤⑥⑦⑧⑨

Name

Test Date

Invigilator's Signature

Student's Signature

Certified that all the entries In this section have been properly filled by the student

Subject

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪⓪ ①① ②② ③③ ④④ ⑤⑤ ⑥⑥ ⑦⑦ ⑧⑧ ⑨⑨

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Sample Question Papers

Sample Question Paper 3

Solved

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. Charging occurs due to

(A) transfer of electrons **(B)** transfer of protons

(C) transfer of neutrons **(D)** None of these

Q. 2. Torque acting on a dipole having dipole moment vector $\vec{P}$ in a uniform electric field $\vec{E}$ is

(A) $\vec{p} \cdot \vec{E}$ **(B)** $\vec{E} \times \vec{p}$

(C) $\vec{p} \times \vec{E}$ **(D)** zero

Q. 3. Along an electric line of force, electric potential

(A) increases **(B)** decreases

(C) remains same **(D)** infinite

Q. 4. The capacitance between two plates of capacitor increases with

(A) increase the plate area and decrease the distance between the plates.

(B) decrease the plate area and increase the distance between the plates.

(C) decrease the plate area and distance between the plates.

(D) increase the plate area and distance between the plates.

Q. 5. Work done by moving a charged particle from one point to another in an electrostatic field _____ upon the path chosen.

(A) depends **(B)** does not depend

(C) may or may not depend **(D)** None of these

AI Q. 6. When cell of e.m.f. E is connected with an external resistance R, the potential difference across the cell becomes V. The internal resistance of the cell is:

(A) $\frac{E - V}{V}R$ **(B)** $\frac{E - V}{E}R$

(C) $\frac{V - E}{V}R$ **(D)** $\frac{V - E}{E}R$

Q. 7. When a current drawn from a cell increase, the potential difference across the terminal of cell is

(A) lowered **(B)** more

(C) remain same **(D)** infinite

Q. 8. When the wire carrying current is charged

(A) never **(B)** Always

(C) At the time of switch on **(D)** At the time of switch off

Q. 9. In the presence of an electric field, paths of electrons in metals are _____ between two successive collisions.

(A) straight in one direction **(B)** straight in two directions

(C) curved **(D)** none of these

Q. 10. Example of a non-ohmic resistance is:

(A) copper wire **(B)** tungsten wire

(C) diode **(D)** carbon resistor

Q. 11. Kirchhoff's second law of electrical circuit is based on

(A) conservation of energy **(B)** conservation of charge

(C) conservation of momentum **(D)** none of these

Q. 12. Two parallel, long wires carry currents i_1 and i_2 with $i_1 > i_2$. When the current are in the same direction, the magnetic field at a point midway between the wire is 10 mT. If the direction of i_2 is reversed, the field becomes 30 mT. The ratio i_1/i_2 is.

(A) 4 **(B)** 3

(C) 2 **(D)** 1

Q. 13. The magnetism of a magnet is due to

(A) spin of electrons **(B)** the earth

(C) cosmic rays **(D)** pressure of big magnet inside the earth

Q. 14. The magnetic field around a long straight current carrying wire is

(A) spherical symmetry **(B)** cubical symmetry

(C) cylindrical symmetry **(D)** unsymmetrical

Q. 15. An electron moves in a circular path with a uniform speed v. It produces magnetic field at the center of the circle. The radius of the circle is proportional to

(A) $\sqrt{\frac{B}{v}}$ **(B)** $\frac{B}{v}$

(C) $\sqrt{\frac{v}{B}}$ **(D)** $\frac{v}{B}$

Q. 16. A moving coil has N number of turns in a coil of effective area A, it carries a current I. Produced magnetic field is radial. the torque acting on the coil is given by

(A) NIBA **(B)** N^2IBA

(C) NI^2BA **(D)** NIB^2A

Q. 17. In a moving coil galvanometer, the deflection of the coil θ is related to the current i

(A) $i \propto \tan\theta$ **(B)** $i \propto \sqrt{\theta}$

(C) $i \propto \theta$ **(D)** $i \propto \theta^2$

Q. 18. The instantaneous flux associated with a closed circuit of 10 W resistance is indicated by the following reaction $f = 6t^2 - 5t + 1$, then value in amperes of the induced current at t = 0.25 sec will be:

(A) 1.2 **(B)** 0.8

(C) 6 **(D)** 0.2

Q. 19. In electromagnetic induction, the induced charge is independent of

(A) time **(B)** change of flux

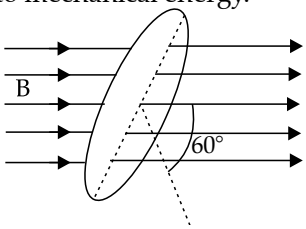
(C) resistance of coil **(D)** None of these.

Q. 20. A dynamo converts

(A) mechanical energy into thermal energy. **(B)** Thermal energy into mechanical energy.

(C) mechanical energy into electrical energy. **(D)** electrical energy into mechanical energy.

AI **Q. 21.** Figure represents an area A = 2 m^2 situated in a uniform magnetic field B = 4 weber/m^2 and making an angle of 60° with magnetic field lines. The magnetic flux through the area would be



(A) 4 weber **(B)** 8 weber

(C) $4\sqrt{3}$ weber **(D)** $2\sqrt{2}$ weber

Q. 22. A.C power is transmitted from a power house at a high voltage as

(A) the rate of transmission is faster at high voltages.

(B) the rate of transmission is faster at low voltages.

(C) power cannot be transmitted at low voltages.

(D) it is more economical due to power loss.

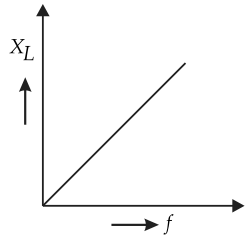
Q. 23. Power in an A.C. circuit is rated per second at which

(A) charge flows **(B)** energy spends

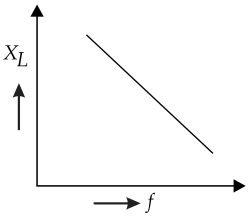
(C) current changes alternatively **(D)** work is done

Q. 24. Which of the following represents the correct graph of inductive reactance X_L and frequency f.

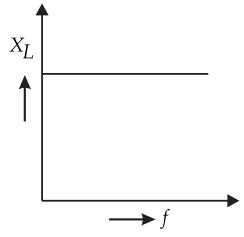
(A)



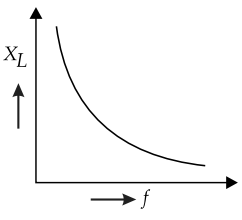
(B)



(C)



(D)



Q. 25 When an AC voltage of 220 V is applied to the capacitor C

(A) the current is in phase with the applied voltage.

(B) the charge on the plates is in phase with the applied voltage.

(C) the maximum voltage between plates is 220 V.

(D) power delivered to the capacitor is infinite.

Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. Electrostatic force between two charged particles in air is F. If charges are placed at the same distance in brass, what will be the force?

(A) zero **(B)** F

(C) infinite **(D)** None of these

Q. 27. If the electric field is $\hat{i} + 2\hat{j} + 4\hat{k}$. Electric flux through a surface area 10 units lying in X-Y plane is

(A) 10 units **(B)** 20 units

(C) 30 units **(D)** 40 units

Q. 28. Work done in moving an electron from one point to another on an equipotential surface of 10 Volt potential

(A) 10 eV **(B)** 10 V

(C) 1eV **(D)** zero

Q. 29. Electric potential at a point (*x, y, z*) in vacuum is $V = 3x^2$ volt. Find the electric field intensity at the point (1m, 2m, 3m) .

(A) 1 V/m **(B)** 3 V/m

(C) 6 V/m **(D)** 2 V/m

Q. 30. Two copper wires of same length, having different cross-sectional area in the ratio 1:3, are connected in series. The ratio of their drift velocities v_d will be

(A) 3:1 **(B)** 9:1

(C) 1:3 **(D)** 1:9

Q. 31. When A wire of resistance 12 R is bent to form a circle. The effective resistance across its diameter is

(A) 2R **(B)** 3R

(C) 4R **(D)** R

Q. 32. Two heaters A (500 W, 220 V) and B (1000 W, 220 V) are connected in parallel to 220 V. Which heater produces more heat

(A) heater A **(B)** heater B

(C) heater A and heater B produce same heat **(D)** both heaters produce no heat.

Q. 33. When two bulbs A (40 W, 220 V) and B (60 W, 220 V) are connected in series, which bulb is brighter.

(A) bulb A **(B)** bulb B

(C) both **(D)** none of these

Q. 34. The magnetic field due to a current carrying circular loop of radius 3 cm at a point on the axis at a distance of 4 cm from the center is 54 μT. What will be its value at the centre of the loop?

(A) 300 μT **(B)** 500 μT

(C) 250 μT **(D)** 150 μT

AI **Q. 35.** A current *i* ampere flows along an infinite long straight tube, then the magnetic induction at any point inside

(A) zero **(B)** infinite

(C) $\frac{\mu_0}{4\pi}\frac{2i}{r}$ T **(D)** $\frac{2i}{r}$ T

Q. 36. A long solenoid is formed by 70 turns/cm. The current to produce a magnetic field of 20 mT inside the solenoid will be

(A) 2.27 A **(B)** 1.5 A

(C) 1.8 A **(D)** 3 A

Q. 37. A charged particles enters into a magnetic field with an angle of 30° with respect to the direction of magnetic field. The path of the particle is

(A) circular **(B)** helical

(C) straight line **(D)** elliptical

Q. 38. Two bar magnets of the same mass, same length and same breadth have magnetic moments M and 3M, respectively, are joined together pole for pole and suspended by string. The time period of assembly is 3 seconds. Now, polarity of one magnet is reversed and combination is again forced to oscillate in magnetic field, the time of oscillation is

(A) 3 **(B)** 2

(C) $2\sqrt{2}$ **(D)** $3\sqrt{2}$

Q. 39. A bar magnet having magnetic moment 0.4 JT^{-1} is placed in a uniform magnetic field of 0.16 T. The magnet is in stable equilibrium when the potential energy is

(A) zero **(B)** –0.64 J

(C) –0.064 J **(D)** –6.40 J

Q. 40. Two magnets are held together and are allowed to oscillate in the earth's magnetic field with like poles together. 10 oscillations per minute are made but for unlike poles together only 4 oscillations per minutes are made. The ratio of magnetic moments is

(A) 16:21 **(B)** 21:16

(C) 29:21 **(D)** 21:29

AI Q. 41. At a certain place, the angle of dip is 60°and horizontal component of earth's magnetic field is 1 orested. The earth's total magnetic field is

(A) B = 2 **(B)** B = $\sqrt{3}$

(C) B = $2\sqrt{2}$ **(D)** B = $3\sqrt{2}$

Q. 42. The susceptibility of annealed iron at saturation is 5000. The permeability is

(A) 2.28×10^{-3} **(B)** 6.28×10^{-3}

(C) 9.28×10^{-3} **(D)** 1.28×10^{-3}

Q. 43. Two coils of self-inductances 9 mH and 4 mH are placed so close together that the effective flux in one coil is linked with other. The mutual inductance between these coils is

(A) 6mH **(B)** 36 mH

(C) 4 mH **(D)** 9 mH

Q. 44. Two solenoids of same cross-sectional area have their lengths and number of turns in the ratio of 1:3. The ratio of self-inductance of two solenoid is

(A) 1:3 **(B)** 1:9

(C) 3:1 **(D)** 9:1

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Q. 45. Assertion (A): A coulomb of charge is bigger than the charge on electron?

Reason (R): Electric charge is always quantized.

Q. 46. **Assertion (A):** Potential difference between two points is depend on path.
Reason (R): Electric field is a conservative field.

Q. 47. **Assertion (A):** Potentiometer measures the potential difference more accurately than a voltmeter.
Reason (R): There is no current drawn from external circuit in potentiometer.

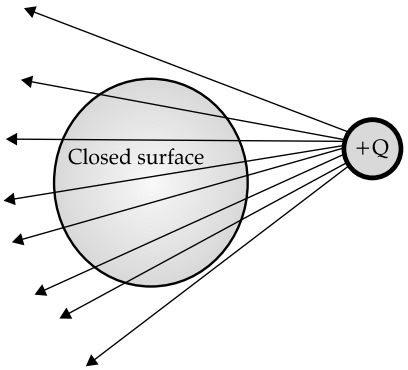
Q. 48. **Assertion (A):** Earth's magnetic field does not affect the functioning of a moving coil galvanometer.
Reason (R): Earth's magnetic field is too weak.

Q. 49. **Assertion (A):** If an electron is not deflected when moving through a certain region of space, then the only possibility is that no magnetic field is present in that region.
Reason (R): Force on electron is directly proportional to the strength of the magnetic field.

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

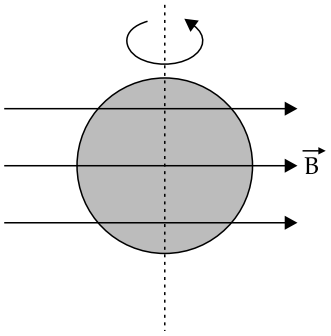
Q. 50. If a + Q charge is placed outside a closed surface. The net electric flux emerging out through the surface is



(A) $\frac{Q}{2\varepsilon_0}$ **(B)** $\frac{2Q}{\varepsilon_0}$

(C) $\frac{Q}{\varepsilon_0}$ **(D)** zero

AI Q. 51. A circular loop of area 10×10^{-2} m^2 rotates in a uniform magnetic field of 0.5 T. If the loop rotates about its diameter which is perpendicular to the magnetic field as shown in figure. The magnetic flux linked with the loop when its plane is normal to the field is



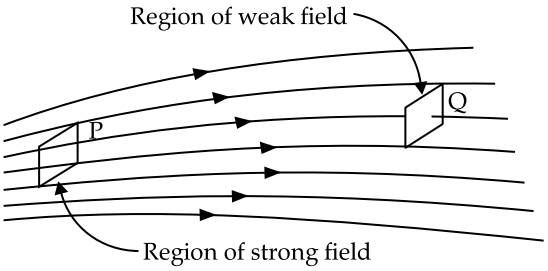
(A) 1×10^{-2} Wb **(B)** 2×10^{-2} Wb

(C) 5×10^{-2} Wb **(D)** zero

CASE STUDY

Read the following text and answer the questions

Electric Field: The electric field is defined as the space surrounding by a charge in which all other test charge would experience force. It is a vector quantity that has both magnitude and direction. The magnitude of the vector is the electric field intensity, which is defined as the force per unit charge. Additionally, electric field strength is proportional to the density of lines of force i.e., electric field strength at a point is proportional to the number of lines of force cutting a unit area element placed normal to the field at that point. The direction of the field is considered to be the same as the direction of the force, and it is expected to exert on a positive test



charge. When the electric field is radially outward, then it is considered as a positive charge, and when the electric field is radially inward, then it is considered as a negative charge. The SI unit of the electric field is volt per meter.

Q. 52. Electric lines of force of a negative point charge are

(A) radially inward **(B)** radially outward

(C) parallel lines **(D)** circular loops

Q. 53. Which of the statement is false for electric lines of force?

(A) They start from a positive charge and terminate on a negative charge.

(B) They always form closed loops.

(C) They are parallel and equally spaced in uniform electric field.

(D) electric field line curves are continuous curve.

Q. 54. Electric field lines are curved in case of

(A) single positive and negative charge **(B)** two like charges

(C) two equal and opposite charges **(D)** Both (B) and (C)

Q. 55. Electric field lines are _____ to the surface charge.

(A) perpendicular **(B)** parallel

(C) oblique **(D)** None of these

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: **A**

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: Ⓐ Ⓑ Ⓒ Ⓓ

Roll Number: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Name

Test Date

Student's Signature

Invigilator's Signature

Certified that all the entries In this section have been properly filled by the student

Subject

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

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Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Sample Question Paper 4

Solved

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. When an uncharged conducting sphere is brought near a charged conducting sphere, how the charge on conducting sphere be affected?

(A) increased **(B)** decreased

(C) remain same **(D)** zero

Q. 2. On-going away from a point charge as well as dipole, electric field due to dipole decreases with the _____ rate as compare to point charge?

(A) same **(B)** rapid

(C) slow **(D)** None of these

Q. 3. Two metallic spheres of radii 1 cm and 3 cm are given charges of -1×10^{-2} C and 5×10^{-2} C, respectively. If these are connected by a conducting wire, the final charge on the bigger sphere is :

(A) 3×10^{-2} C **(B)** 4×10^{-2} C

(C) 1×10^{-2} C **(D)** 2×10^{-2} C

Q. 4. Which one of the following does not obey inverse square law?

(A) electric field due to a point charge **(B)** electric potential due to a dipole

(C) electric potential due to a point charge **(D)** electric force between two charged particles.

Q. 5. An electron and a proton are accelerated with the same potential. Which one of them higher velocity

(A) electron **(B)** proton

(C) both have same velocity **(D)** velocity will be zero

AI Q. 6. Dielectric constant in terms of capacitance of capacitor

(A) $K = \frac{C_{medium}}{C_{air}}$ **(B)** $K = \frac{C_{air}}{C_{medium}}$

(C) $K = C_{medium} \times C_{air}$ **(D)** $K = \sqrt{C_{medium} \times C_{air}}$

Q. 7. When the plates of a charged parallel-plate capacitor are brought closer, the potential difference between the plates

(A) decreases **(B)** increases

(C) remain same **(D)** becomes zero

Q. 8. Three concentric spherical shells have radii a, b and c ($a < b < c$) and have surface charge densities σ, $-\sigma$ and σ respectively. If V_A, V_B and V_C denote the potentials of the three shells, then for $c = a + b$, we have :

(A) $V_C = V_B \neq V_A$ **(B)** $V_C \neq V_B \neq V_A$

(C) $V_C = V_B = V_A$ **(D)** $V_A = V_C \neq V_B$

Q. 9. When Ohm's law is not obeyed in a conductor

(A) if temperature changes **(B)** if conductor is under any strain

(C) both (A) and (B) **(D)** none of these.

Q. 10. Specific resistance of a wire is defined as

(A) $\frac{L}{RA}$ **(B)** $\frac{RA}{L}$

(C) $\frac{A}{RL}$ **(D)** $\frac{RL}{A}$

Q. 11. In any network of wires carrying current, the algebraic sum of all current at node is equal to

(A) sum of all incoming currents **(B)** sum of all outgoing currents

(C) zero **(D)** infinite

Q. 12. A bar magnet is cut into two equal parts by a plane parallel to the magnetic axis. Which physical quantities remain unchanged?

(A) magnetic moment **(B)** pole strength

(C) intensity of magnetization **(D)** none of these

Q. 13. Direction of magnetic dipole moment

(A) north to south **(B)** south to north

(C) east to west **(D)** west to east

Q. 14. A moving conductor coil produced an induced e.m.f., this statement is according to which law

(A) Coulomb's law **(B)** Faraday's law

(C) Lenz's law **(D)** Ampere's law

Q. 15. A cylindrical bar magnet is kept along the axis of circular coil. On rotating a magnet about its axis, the coil will have induced

(A) a current **(B)** an e.m.f.

(C) both (A) and (B) **(D)** no current

Q. 16. Production of induced e.m.f. in a coil due to the change of current in the same coil is

(A) self-induction **(B)** mutual-induction

(C) dynamo **(D)** none of these

Q. 17. Direction of induced current in a wire in a magnetic field is given by

(A) Fleming's left-hand rule **(B)** Fleming's right-hand rule

(C) right-hand clasp rule **(D)** Ampere's rule

Q. 18. There is an electric field E in X-direction. If the work done on moving a charge 0.2 C through a distance of 2 m along a line making an angle 60° with the X-axis is 4.0, what is the value of E :

(A) $\sqrt{3}$ N/C **(B)** 4 N/C

(C) 5 N/C **(D)** 20 N/C

Q. 19. Magnetic needle is kept in a non-uniform magnetic field experience

(A) a force as well as a torque **(B)** a torque but not a force

(C) a force and a torque **(D)** a force but not a torque

Q. 20. A ferromagnetic substance is heated above its curie temperature. Which of the following statements is correct?

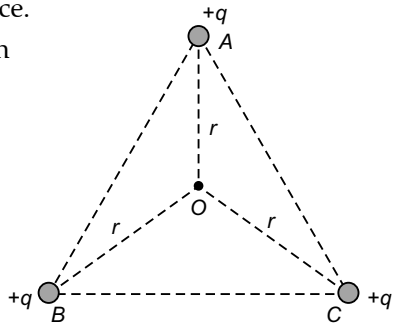
(A) Ferromagnetic domains get perfectly arranged.

(B) Ferromagnetic domains get randomly arranged.

(C) Ferromagnetic domains are not at all influenced.

(D) Ferromagnetic material transforms into diamagnetic substance.

Q. 21. ABC is an equilateral triangle. Charges $+q$ are placed at each corner. The electric intensity at O will be :



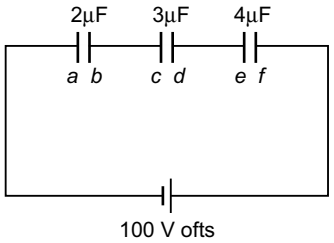
(A) $1/4\pi\varepsilon_0 \times q/r^2$

(B) $1/4\pi\varepsilon_0 \times q/r$

(C) Zero

(D) $1/4\pi\varepsilon_0 \times 3q/r^2$

Q. 22. Three capacitors are connected to D.C. source of 100 volts shown in the adjoining figure. If the charge accumulated on plates of C_1, C_2 and C_3 are q_a, q_b, q_c, q_d, q_e and q_f respectively, then :



(A) $q_b + q_d + q_f = 100/9$ C

(B) $q_b + q_d + q_f = 0$

(C) $q_a + q_c + q_e = 50$ C

(D) $q_b = q_d = q_f$

Q. 23. Power factor of the ac circuit varies between

(A) –1 and 0 **(B)** 0 to 1

(C) –1 and +1 **(D)** none of these

Q. 24. Two different wire loops are concentric and lie in the same plane. The current in the outer loop is clockwise and increase with time. The induced current in the inner loop is

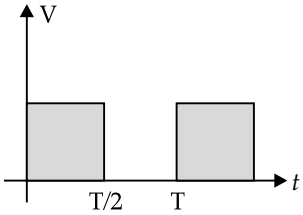
(A) anti-clockwise

(B) clockwise

(C) zero

(D) in a direction depending on the ratio of loop radii

AI Q. 25. The r.m.s.value of potential difference V in the following figure is



(A) V_0 **(B)** $\frac{V_0}{2}$

(C) $\frac{V_0}{\sqrt{2}}$ **(D)** $\frac{V_0}{4}$

Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. Number of charges in 5 coulomb?

(A) electrons 3.125×10^{19} **(B)** 1

(C) 8.0×10^{19} **(D)** infinite

Q. 27. Electric flux emerging out one face of the cube, if a charge Q is placed at the centre of cube, is

(A) $\frac{Q}{\varepsilon_0}$ **(B)** $\frac{6Q}{\varepsilon_0}$

(C) $\frac{Q}{6\varepsilon_0}$ **(D)** $\frac{Q}{4\varepsilon_0}$

Q. 28. The electric field in the free space between the sheets is

(A) $\frac{\sigma}{2\varepsilon_0}$ **(B)** $\frac{\sigma}{4\varepsilon_0}$

(C) $\frac{\sigma}{\varepsilon_0}$ **(D)** zero

Q. 29. A parallel plate capacitor is charged to a potential difference V by a DC source and then disconnected. If the distance between the plates is doubled. Capacitance will change to _____ of initial capacitance.

(A) Half **(B)** Double

(C) remain same **(D)** four times

Q. 30. Work done in moving a 10 μC between two points in an equipotential surface is

(A) zero **(B)** 10 J

(C) 9 kJ **(D)** 1 J

Q. 31. Three parallel plate capacitors of capacitance $C_1 < C_2 < C_3$ are connected in parallel, then its equivalent capacitance of parallel combination C_p is _____ the equivalent capacitance of series combinations.

(A) smaller than **(B)** greater than

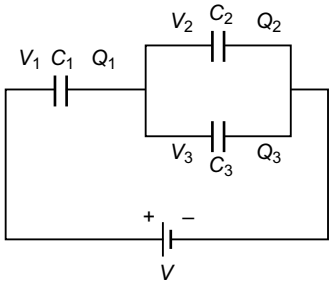
(C) equal **(D)** none of these

Q. 32. An air-filled parallel plate capacitor is charged to a potential difference 90 V and then insulated. A plastic plate is inserted between the plates covering the gap. The potential difference between the plates becomes 15 V. The dielectric constant of plastic is

(A) 2 **(B)** 3

(C) 6 **(D)** 8

AI Q. 33. In an adjoining figure are shown three capacitors C_1, C_2 and C_3 joined to a battery. The correct condition will be (Symbols have their usual meanings) :



(A) $Q_1=Q_2=Q_3$ and $V_1=V_2=V_3=V$

(B) $Q_1=Q_2+Q_3$ and $V=V_1+V_2+V_3$

(C) $Q_1=Q_2+Q_3$ and $V=V_1+V_2$

(D) $Q_2=Q_3$ and $V_2=V_3$

Q. 34. The amount of charge Q passed in time t through a cross-section of wire $Q = 2t^2 + 4t + 4$. The value of current at time $t = 2$ sec is

(A) 8 A **(B)** 10 A

(C) 6 A **(D)** 12 A

Q. 35. In a meter bridge, the balancing length from the left end is found to be 30 cm. the value of the unknown resistance is

(A) 0.67 Ω **(B)** 0.47 Ω

(C) 0.27 Ω **(D)** 0.57 Ω

Q. 36. If an unaccelerated charged particle enters in a region having electric field and magnetic field

(A) $\vec{E} \perp \vec{B}$ **(B)** $\vec{v} \perp \vec{E}$

(C) $\vec{B} \perp \vec{v}$ **(D)** None of these

Q. 37. An electron moving with the velocity of 10^6 m/s enters in a magnetic field and follow the circular path having radius of 0.1 m, then the intensity of magnetic field must be

(A) 4.7×10^{-5} T **(B)** 5.7×10^{-5} T

(C) 6.7×10^{-5} T **(D)** 7.7×10^{-5} T

Q. 38. A cell is connected between the two points of a circular conductor so that I_1 and I_2 currents are flowing in two parts of the circular conductor of radius a. The magnetic field at the center of the loop is:

(A) $\frac{\mu_0}{4\pi}(I_1 - I_2)$ **(B)** $\frac{\mu_0}{2a}(I_1 + I_2)$

(C) $\frac{\mu_0}{a}(I_1 + I_2)$ **(D)** zero

Q. 39. A bar magnet having magnetic moment 0.6 JT^{-1} is placed in a uniform magnetic field of 0.15 T. The potential energy of a magnet, when it is in stable equilibrium

(A) zero **(B)** – 0.96 J

(C) -0.096 J **(D)** – 9.60 J

Q. 40. A magnet of magnetic moment 10 C.G.S. is freely suspended in a uniform magnetic field of intensity of 0.3 units. The amount of work done in deflecting it with an angle of 60° in C.G.S. unit is

(A) 2.5 **(B)** 5.5

(C) 1.5 **(D)** 3.5

Q. 41. If relative permittivity of a medium is 2000. The absolute permeability in S.I. unit is

(A) $8\pi \times 10^{-4}$ **(B)** $2\pi \times 10^{-4}$

(C) $4\pi \times 10^{-4}$ **(D)** $\pi \times 10^{-4}$

Q. 42. A magnetic field of 5×10^3 amp/m produces a magnetic flux density of 2π Tesla. The relative permeability is

(A) 10^{-3} **(B)** 10^3

(C) 10^4 **(D)** 10^{-4}

Q. 43. Two coils have a mutual inductance of 0.002 H. The current changes in a first coil according to $I = I_0 \sin \omega t$ where, $I_0 = 5$A and $\omega = 20\pi$ radian/sec. The maximum value of e.m.f in second coil is

(A) π **(B)** 0.1π

(C) 0.2π **(D)** 0.3π

Q. 44. An AC generator of 220 V having internal resistance of 5 Ω and external resistance of 105 Ω. What is the power developed in the external resistance?

(A) 420 W **(B)** 400 W

(C) 520 W **(D)** 500 W

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Q. 45. **Assertion (A):** Coulomb force on any charged particle is the vector sum of the forces experienced on that charge due to other charges.

Reason (R): Coulomb force between two charges depends on the magnitude of two-point charges and the distance between them

Q. 46. **Assertion (A):** When conducting slab is completely filled between the space of parallel plate capacitors, its capacitance becomes infinite.

Reason (R): Electric field inside a conductor is zero resulting in a zero potential difference between the plates.

AI **Q. 47.** **Assertion (A):** Voltmeter measure the emf of a cell when it is connected across the terminal of cell.

Reason (R): Terminal potential is given by $V = E - ir$.

Q. 48. **Assertion (A):** A compass needle when placed at Earth's magnetic pole rotates in vertical plane.

Reason (R): The Earth has only vertical component of its magnetic field at the poles.

Q. 49. **Assertion (A):** At resonance, the current becomes minimum in a series LCR circuit.

Reason (R): At resonance, voltage and current are in same phase in a series LCR circuit.

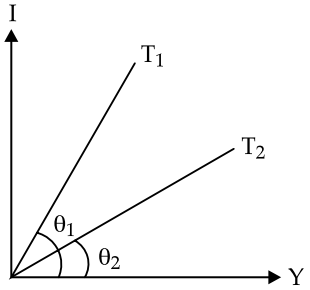
Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

AI **Q. 50.** In the V-I graph for a given metallic wire at two different temperatures T_1 and T_2 are shown in figure. The relationship between T_1 and T_2 is

(A) $T_1 = T_2$ **(B)** $T_1 \angle T_2$

(C) $T_1 \angle T_2$ **(D)** none of these



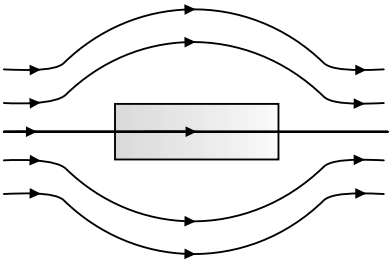
Q. 51. The given figure represents the material which is

(A) ferrimagnetic

(B) ferromagnetic

(C) diamagnetic

(D) paramagnetic



CASE STUDY

Read the following text and answer the questions

Electric potential at a point is defined as the amount of work done in bringing a unit positive charge from infinity to that point.

So, electric potential = work done divided by the amount of charge moved.

Negative charges move from lower to higher potential. Positive charges move from higher to lower potential.

Charges gain energy while moving through a potential difference. If an electron is accelerated from rest through a potential difference of 1V, it gains 1 eV energy.

Q. 52. Formula of electric potential

(A) $V = WQ$ **(B)** $V = \frac{W}{Q}$

(C) $W = VQ^2$ **(D)** $V = WQ^2$

Q. 53. An electron is accelerated through a potential difference of 7 volts. The energy gained by an electron will be

(A) 7 erg **(B)** 7 watt

(C) 7 eV **(D)** 7 volt

Q. 54. Protons move from_____ to _____ potential

(A) lower, higher **(B)** higher, lower

(C) Random motion **(D)** None of these

Q. 55. The amount of work done in bringing a charge of 10 μC from infinity to a point in an electric is 20×10^{-5} J. Electric potential at that point is

(A) 20 V **(B)** 200 V

(C) 5 V **(D)** 50 V

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: **A**

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: ⒶⒷⒸⒹ

Roll Number: ⓪①②③④⑤⑥⑦⑧⑨

Name

Test Date

Invigilator's Signature

Student's Signature

Certified that all the entries In this section have been properly filled by the student

Subject

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪①②③④⑤⑥⑦⑧⑨

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
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08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Sample Question Paper 5

Solved

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. An electric dipole has the magnitude of its charge as q and its dipole moment is p. It is placed in a uniform electric field E. If its dipole moment is along the direction of the field, the force on it and its potential energy are respectively :

(A) $2q \cdot E$ and minimum **(B)** $q \cdot E$ and $p \cdot E$

(C) Zero and minimum **(D)** $q \cdot E$ and maximum

AI **Q. 2.** If identical charges $(-q)$ are placed at each corner of a cube of side b, then electric potential energy of charge $(+q)$ which is placed at centre of the cube will be :

(A) $8\sqrt{2}q^2/4\pi\varepsilon_0 b$ **(B)** $-8\sqrt{2}q^2/\pi\varepsilon_0 b$

(C) $-4\sqrt{2}q^2/\pi\varepsilon_0 b$ **(D)** $-4q^2/\sqrt{3}\pi\varepsilon_0 b$

Q. 3. The electric intensity due to a dipole of length 10 cm and having a charge of 500 μC, at a point on the axis at a distance 20 cm from one of the charges in air, is :

(A) 6.25×10^7 N/C **(B)** 9.28×10^7 N/C

(C) 13.1×11^{11} N/C **(D)** 20.5×10^7 N/C

Q. 4. A point Q lies on the perpendicular bisector of an electrical dipole of dipole moment p. If the distance of Q from the dipole is r (much larger than the size of the dipole), then electric field at Q is proportional to :

(A) p^{-1} and r^{-2} **(B)** p and r^{-2}

(C) p^{-1} and r^{-2} **(D)** p and r^{-3}

Q. 5. A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system :

(A) decreases by a factor of 2 **(B)** remains the same

(C) increases by a factor of 2 **(D)** increases by a factor of 4

Q. 6. A parallel plate air capacitor of capacitance C is connected to a cell of emf V and then disconnected from it. A dielectric slab of dielectric constant K, which can just fill the air gap of the capacitor, is now inserted in it. Which of the following is incorrect?

(A) The change in energy stored is $1/2CV^2$ $(1/K - 1)$

(B) The charge on the capacitor is not conserved

(C) The potential difference between the plates decreases K times.

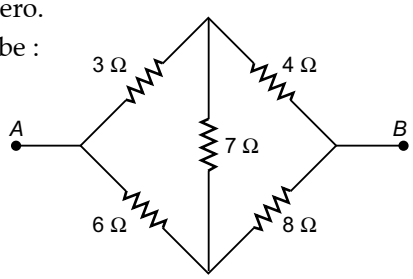
(D) The energy stored in the capacitor decreases K times.

Q. 7. A conducting sphere of radius R is given a charge Q. The electric potential and the electric field at the centre of the sphere respectively are :

(A) Zero and $Q/4\pi\varepsilon_o R^2$ **(B)** $Q/4\pi\varepsilon_o R$ and Zero

(C) $Q/4\pi\varepsilon_o R$ and $Q/4\pi\varepsilon_o R^2$ **(D)** Both are zero.

AI Q. 8. In the given figure, equivalent resistance between A and B will be :



(A) $\frac{14}{3}\Omega$ **(B)** $\frac{3}{14}\Omega$

(C) $\frac{9}{14}\Omega$ **(D)** $\frac{14}{9}\Omega$

Q. 9. An electron moving in a circular orbit of radius r makes n rotations per second. The magnetic field produced at the centre has magnitude :

(A) Zero **(B)** $\mu_0 n2e/r$

(C) $\mu_0 ne/2r$ **(D)** $\mu_0 ne/2\pi r$

Q. 10. Under the influence of a uniform magnetic field, a charged particle moves with constant speed V in a circle of radius R. The time period of rotation of the particle :

(A) depends on R and not on V **(B)** is independent of both V and R

(C) depends on both V and R **(D)** depends on V and not on R

Q. 11. A straight wire of diameter 0.5 mm carrying a current of 1A is replaced by another wire of 1 mm diameter carrying same current. The strength of magnetic field far away is :

(A) twice the earlier value **(B)** same as earlier value

(C) one-half of the earlier value **(D)** one-quarter of the earlier value

Q. 12. The average e.m.f. induced in a coil in which the current changes from 2A to 4A in 0.05 second is 8 volt. What is the self-inductance of the coil?

(A) 0.1 H **(B)** 0.2 H

(C) 0.4 H **(D)** 0.8 H

Q. 13. A step-up transformer operates on a 230 V line and supplies current of 2 A to a load. The ratio of the primary and secondary windings is 1 : 25. The current in the primary coil is :

(A) 15 A **(B)** 50 A

(C) 25 A **(D)** 12.5 A

Q. 14. An ac circuit consists of an inductor of inductance 0.5 H and a capacitor of capacitance 8 μF in series. The current in the circuit is maximum when the angular frequency of ac source is :

(A) 500 rad **(B)** 2×10^5 rad

(C) 4000 rad **(D)** 5000 rad

Q. 15. A cylindrical bar magnet of radius 0.8 cm is dropped through a metallic pipe of inner radius 1 cm. It takes more time to come down than it takes for a similar un-magnetized cylindrical iron bar dropped through the metallic pipe. This happens due to

(A) Friction

(B) Electrostatic charge developed on the inner wall of the pipe

(C) Generation of eddy current

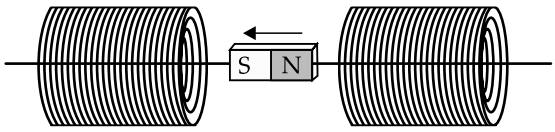
(D) Buoyancy

Q. 16. Current in a circuit falls from 5.0 A to 0.0 A in 0.1 s. If an average emf of 200 V induced, the self-inductance of the circuit is

(A) 4 H **(B)** 4 mH

(C) 40 mH **(D)** 40 H

Q. 17. The polarity developed at the right end of 1st coil will be _____ pole and the polarity developed at the left end of the 2nd coil will be _____ pole.



(A) South, North **(B)** North, South

(C) North, North **(D)** South, South

Q. 18. 1 Henry = volt-sec/ampere

(A) 10 **(B)** 1

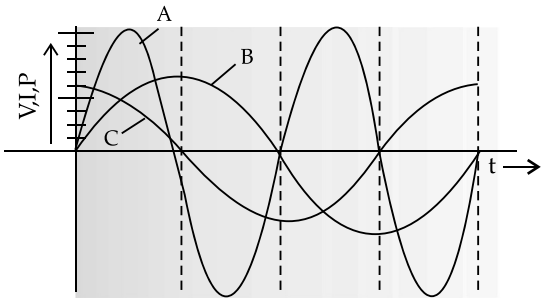
(C) 10^3 **(D)** 10^{-3}

Q. 19. The Q value of a series LCR circuit with L = 2.0 H, C = 32 μF and R = 10 Ω is

(A) 25 **(B)** 0.4×10^{-3}

(C) 25 Henry/farad **(D)** 2500

Q. 20. A device 'X' is connected to an a.c. source. The variation of voltage, current and power in one complete cycle is shown in Figure.

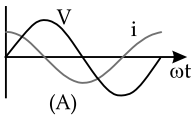


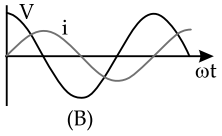
Curve _____ shows power consumption over a full cycle and the device X is a _____ .

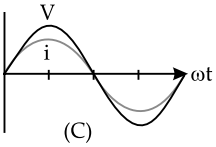
(A) A, capacitor **(B)** A, inductor

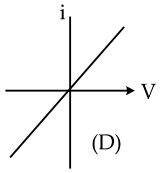
(C) Either (A) or (B) **(D)** B, capacitor

Q. 21. A device X is connected across an ac source of voltage $V = V_o \sin \omega t$. The current through X is given as $I = I_o \sin (\omega t \pm \pi/2)$. Which of the following graphs show the correct variation of voltage and current with time over one cycle of ac, for X.

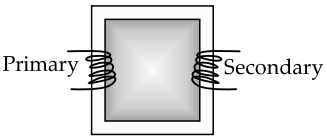
(A) 

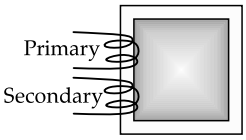
(B) 

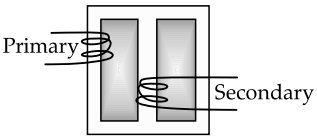
(C) 

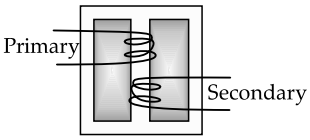
(D) 

Q. 22. Which of the following transformer winding is correct?

(A) 

(B) 

(C) 

(D) 

Q. 23. A silver wire has a resistance of 2.1 Ω at 27.5 °C, and a resistance of 2.7 Ω at 100 °C. The temperature coefficient of resistivity of silver is

(A) $0.0039°C^{-1}$ **(B)** $0.039°C^{-1}$

(C) $0.39°C^{-1}$ **(D)** None of the above

Q. 24. Given the resistances of 1 Ω, 2 Ω, 3 Ω. How will these be combined to get an equivalent resistance of $\frac{11}{3}\Omega$?

(A) 1 Ω and 2 Ω in parallel and with this combination 3 Ω in series.

(B) 3 Ω and 2 Ω in parallel and with this combination 1 Ω in series.

(C) 1 Ω and 3 Ω in parallel and with this combination 2 Ω in series.

(D) all three resistors in parallel

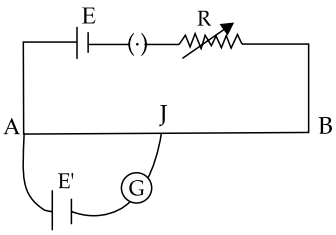
AI Q. 25. AB is a potentiometer wire (Figure). If the value of R is increased, balance point J

(A) shift towards A

(B) shift towards B

(C) Remains in same position

(D) will be missing.



Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. If a unit positive charge is taken from one point to another over an equipotential surface, then :

(A) Work is done on the charge **(B)** Work is done by the charge

(C) Work done is constant **(D)** No work is done

Q. 27. The electric field inside a spherical shell of uniform surface charge density is :

(A) Zero

(B) Constant, less than zero

(C) Directly proportional to the distance from the centre

(D) None of the above

Q. 28. The distance between the two charges $+q$ and $-q$ of a dipole is r. On the axial line at a distance d from the centre of dipole, the intensity is proportional to :

(A) q/d^2 **(B)** qr/d^2

(C) q/d^3 **(D)** qr/d^3

Q. 29. 2μF capacitance has potential difference across its two terminals 200 volts. It is disconnected from battery and then another uncharged capacitance is connected in parallel to it, then P.D. becomes 20 volts. Then the capacity of another capacitance will be :

(A) 2 μF **(B)** 4 μF

(C) 18 μF **(D)** 10 μF

Q. 30. A charge Q is placed at the corner of a cube. The electric flux through all the six faces of the cube is :

(A) $Q/3\ \varepsilon_0$ **(B)** $Q/6\ \varepsilon_0$

(C) $Q/8\ \varepsilon_0$ **(D)** Q/ε_0

Q. 31. The capacity of a parallel plate capacitor with no dielectric substance but with a separation of 0.4 cm is 2 μF. The separation is reduced to half and it is filled with a dielectric substance of value 2.8. The final capacity of the capacitor is :

(A) 11.2 μF **(B)** 15.6 μF

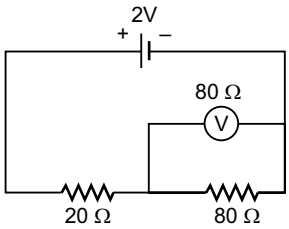
(C) 19.2 μF **(D)** 22.4 μF

Q. 32. A short bar magnet of magnetic moment 1 J/T is placed with its axis at 60° to a uniform magnetic field of 0.2 T. Calculate the magnitude of the torque experience.

(A) 3×10^{-1} Nm **(B)** $\sqrt{3} \times 10^{-2}$ Nm

(C) 3×10^{-2} Nm **(D)** $\sqrt{3} \times 10^{-1}$ Nm

Q. 33. In the adjoining circuit, the e.m.f. of the cell is 2 volt and the internal resistance is negligible. The resistance of the voltmeter is 80 ohm. The reading of the voltmeter will be :



(A) 0.80 volt

(B) 1.60 volt

(C) 1.33 volt

(D) 2.00 volt

Q. 34. Through two parallel wires A and B, 10A and 2A of currents are passed respectively in opposite directions. If the wire A is infinitely long and the length of the wire B is 2 m, the force on the conductor B, which is situated at 10 cm distance from A will be :

(A) 8×10^{-5} N **(B)** 4×10^{-7} N

(C) 4×10^{-5} N **(D)** $4\pi \times 10^{-7}$ N

Q. 35. If a long hollow copper pipe carries a current, then magnetic field is produced:

(A) inside the pipe only **(B)** outside the pipe only

(C) both inside and outside the pipe **(D)** no where

Q. 36. If the current is halved in a coil, then the energy stored is how much times the previous value?

(A) 1/2 **(B)** 1/4

(C) 2 **(D)** 4

Q. 37. In a circuit L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45°. The value of C is :

(A) $1/2\pi f(2\pi fL+R)$ **(B)** $1/\pi f(2\pi fL+R)$

(C) $1/2\pi f(2\pi fL-R)$ **(D)** $1/\pi f(2\pi fL-R)$

AI **Q. 38.** The natural frequency of a L-C circuit is equal to :

(A) $\frac{\sqrt{LC}}{2\pi}$ **(B)** $\frac{1}{2\pi\sqrt{LC}}$

(C) $\frac{1}{2\pi}\sqrt{\frac{L}{C}}$ **(D)** $\frac{1}{2\pi}\sqrt{\frac{C}{L}}$

Q. 39. An ac source is connected to a resistive circuits. Which of the following is true?

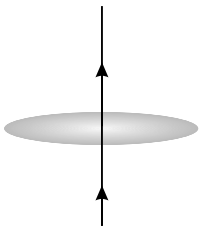
(A) Current leads the voltage and both are in same phase

(B) Current lags behind the voltage and both are in same phase

(C) Current and voltage are in same phase

(D) Any of the above may be true depending upon the value of resistance

Q. 40. What will be the direction of induced current when the current in the vertical wire is reducing at a steady rate?



(A) anti-clockwise

(B) Clockwise

(C) No current will be induced

(D) None of the above

Q. 41. Given the resistances of 1 Ω, 2 Ω, 3 Ω. How will these be combined to get an equivalent resistance of 11/5Ω?

(A) 1Ω and 2Ω in parallel and with this combination 3Ω in series.

(B) 3Ω and 2Ω in parallel and with this combination 1Ω in series.

(C) 1Ω and 3Ω in parallel and with this combination 2Ω in series.

(D) all three resistors in parallel

Q. 42. Three capacitors each of capacitance 9 pF are connected in series and then connected to a 120 V supply.

The total capacitance of the combination is _____ and the potential difference across each capacitor is _____ .

(A) 27pF, 120V **(B)** 3 pF, 40V

(C) 27pF, 40V **(D)** 3pF, 120V

Q. 43. Capacitance of a single conductor means

(A) When connected to a supply one side of the conductor will be positively charged, other side will be negatively charged.

(B) It is a parallel plate capacitor with two plates coinciding with each other

(C) It is a parallel plate capacitor. One plate is the conductor and the other plate is at infinite distance.

(D) None of the above.

Q. 44. An arbitrary surface encloses a dipole. Electric flux through this surface is

(A) 0

(B) ∞

(C) Depends on the surface enclosing the dipole.

(D) Depends on the dipole moment

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

Q. 45. **Assertion (A):** In a cavity in a conductor, the electric field is zero.

Reason (R): Charges in a conductor reside only at its surface.

Q. 46. **Assertion (A):** Capacity of a conductor is independent on the amount of charge on it.

Reason (R): Capacitance depends on the dielectric constant of surrounding medium, shape and size of the conductor.

Q. 47. **Assertion (A):** Galvanometer to ammeter conversion takes place by connecting a low value resistance in parallel with it.

Reason (R): The low value resistance increases the effective resistance and protects the galvanometer.

Q. 48. **Assertion (A):** Self inductance may be called the inertia of electricity.

Reason (R): Due to self inductance, opposing induced e.m.f. is generated in a coil as a result of change in current or magnetic flux linked with the coil.

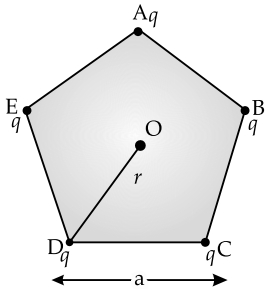
Q. 49. **Assertion (A):** A transformer does not work on DC.

Reason (R): DC neither change direction nor magnitude.

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

AI Q. 50. Five charges, q each are placed at the corners of a regular pentagon of side 'a'. Electric field at the centre of the pentagon is



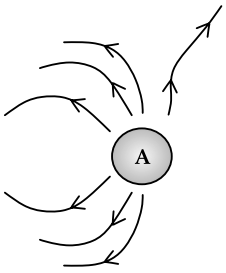
(A) $q/4\pi\varepsilon_0 r^2$

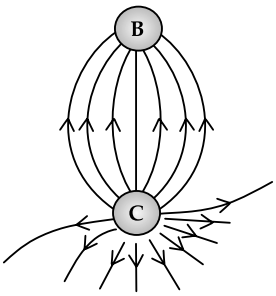
(B) $5q/4\pi\varepsilon_0 r^2$

(C) 0

(D) $5q/4\pi\varepsilon_0 a^2$

Q. 51. Figure shows the electric field lines around three-point charges A, B and C.





(A) A and B are positive, C is negative

(B) A and C are positive, B is negative

(C) B is positive, A and C are negative

(D) A is positive, B and C are negative.

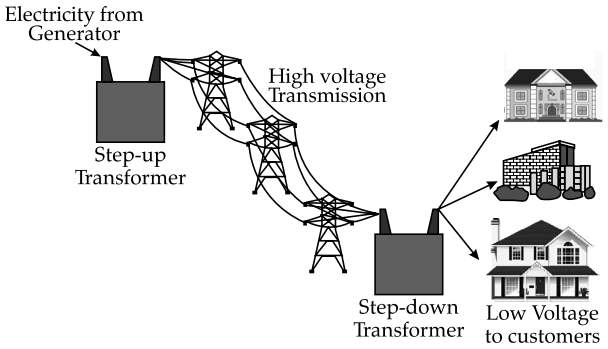
CASE STUDY

Read the following text and answer the following questions on the basis of the same:

At power plant, a transformer increases the voltage of generated power by thousands of volts so that it can be sent of long distances through high-voltage transmission power lines. Transmission lines are bundles of wires that carry electric power from power plants to distant substations.

At substations, transformers lower the voltage of incoming power to make it acceptable for high-volume delivery to nearby end-users.

Electricity is sent at extremely high voltage because it limits so-called line losses. Very good conductors of electricity also offer some resistance and this resistance becomes considerable over long distances causing considerable loss.



At generating station, normally voltage is stepped up to around thousands of volts. Power losses increase with the square of current. Therefore, keeping voltage high current becomes low and the loss is minimized.

Another option of minimizing loss is the use of wires of super-conducting material. Super-conducting materials are capable of conducting without resistance, they must be kept extremely cold, nearly absolute zero, and this requirement makes standard super-conducting materials impractical to use. However, recent advances in super-conducting materials have decreased cooling requirement. In Germany recently 1 km super-conducting cable have been installed connecting the generating station and the destination. It has eliminated the line loss and the cable is capable of sending five times more electricity than conventional cable. Using super-conducting cables Germany has also get rid of the need of costly transformers.

Transformers generate waste heat when they are in operation and oil is the coolant of choice. It transfers the heat through convection to the transformer housing, which has cooling fins or radiators similar to heat exchangers on the outside.

Flush point is a very important parameter of transformer oil. Flashpoint of an oil is the temperature at which the oil ignites spontaneously. This must be as high as possible (not less than 160° C from the point of safety).

Fire point is the temperature at which the oil flashes and continuously burns. This must be very high for the chosen oil (not less than 200° C).

Q. 52. Which of the following statement is true for long distance transmission of electricity?

(A) Step-down transformer is used at generating station and step-up transformer is used at destination substation.

(B) Step-down transformers are used at generating station and destination substation.

(C) Step-up transformers are used at generating station and destination substation.

(D) None of the above

Q. 53. Super-conducting transmission line has the following advantages:

(A) Resistance being zero, there is no I^2R loss.

(B) There is no requirement of costly step-up and step-down transformers.

(C) Cable is capable of sending more electricity.

(D) All of the above

Q. 54. Why does stepping up voltages reduce power loss?

(A) Since resistance of conductor decreases with increase of voltage

(B) Since current decreases with increase of voltage

(C) Both of the above

(D) None of the above

Q. 55. Oil transfers heat from transformer winding by the process of:

(A) convection **(B)** conduction

(C) radiation **(D)** All of these

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: **A**

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: Ⓐ Ⓑ Ⓒ Ⓓ

Roll Number: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Name

Test Date

Invigilator's Signature

Student's Signature

Certified that all the entries In this section have been properly filled by the student

Subject

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The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Sample Question Papers

Self Assessment Paper 1

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. Electric charges under action of electric forces is called

(A) electrostatic **(B)** electric flux

(C) electric field **(D)** electric field lines

Q. 2. Law stating that "force is directly proportional to product of charges and inversely proportional to square of separation between them" is called

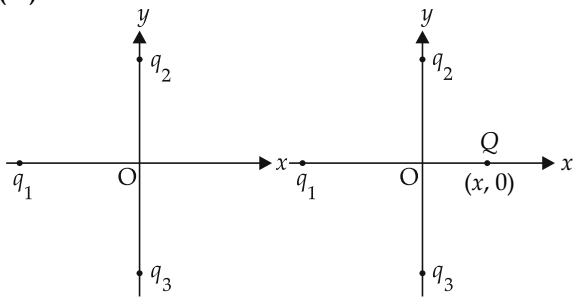
(A) Newton's law. **(B)** Coulomb's law

(C) Gauss's law. **(D)** Ohm's law

Q. 3. In given figure, two positive charges q_2 and q_3 fixed along the y axis, exert a net electric force in the $+x$ direction on a charge q_1 fixed along the x axis. If a positive charge Q is added at $(x, 0)$, the force on q_1

(A) shall increase along the positive x-axis.

(B) shall decrease along the positive x-axis.



(C) shall point along the negative x-axis.

(D) shall increase but the direction changes because of the intersection of Q with q_2 and q_3.

Q. 4. The work done to move a charge along an equipotential surface from A to B

(A) cannot be defined. **(B)** is a negative quantity.

(C) is zero. **(D)** is a positive quantity.

Q. 5. The shape of equipotential surfaces due to an isolated charge is

(A) concentric spherical shells and the distance between the shells increases with the decrease in electric field.

(B) concentric spherical shells and the distance between the shells decreases with the decrease in electric field.

(C) equi-spaced concentric spherical shells.

(D) changes with the polarity of the charge.

Q. 6. Electric potential inside a conducting sphere

(A) is zero. **(B)** remains constant.

(C) decreases from centre to surface. **(D)** increases from centre to surface.

AI Q. 7. Kirchhoff's laws are valid for _____.

(A) only passive circuits. **(B)** only linear circuits.

(C) only non-linear circuits. **(D)** both (B) and (C).

Q. 8. Two resistances are connected in two gaps of Meter Bridge. The balance point is 10 cm from the zero end. A resistance of 20 W is connected in series with the smaller of the two. The null point shifts to 20 cm. What is the value of the bigger resistance?

(A) 89 Ω **(B)** 144 Ω

(C) 100 Ω **(D)** None of the above

Q. 9. *A* circular current loop of magnetic moment M is in an arbitrary orientation in an external magnetic field B. The work done to rotate the loop by 30° about an axis perpendicular to its plane is

(A) MB **(B)** $\frac{\sqrt{3}\text{MB}}{2}$.

(C) $\frac{\text{MB}}{2}$. **(D)** zero.

Q. 10. When a charge of 1 C moving with velocity 1 m/s normal to a magnetic field experiences a force 1 N, then the magnitude of the magnetic field is

(A) 1 Gauss **(B)** 1 Tesla

(C) 1 Orested **(D)** None of the above

AI Q. 11. An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true?

(A) The electron will be accelerated along the axis.

(B) The electron path will be circular about the axis.

(C) The electron will experience a force at 45° to the axis and hence execute a helical path.

(D) The electron will continue to move with uniform velocity along the axis of the solenoid.

Q. 12. When a charged particle moves through a magnetic field perpendicular to its direction. Then

(A) linear momentum changes.

(B) kinetic energy remains constant.

(C) both (A) and (B)

(D) both linear momentum and kinetic energy varies.

Q. 13. A coil of N turns and radius R carries a current I. It is unwound and rewound to make a square coil of side a having same number of turns (N). Keeping the current I same, the ratio of the magnetic moments of the circular coil and the square coil is

(A) $\pi\frac{R^2}{a^2}$ **(B)** $\pi\frac{a^2}{R^2}$

(C) $\frac{R^2}{a^2}$ **(D)** None of the above

AIQ. 14. A magnetic dipole moment is a vector quantity directed from:

(A) South to North **(B)** North to South

(C) East to West **(D)** West to East

Q. 15. Time period of oscillation of a magnetic needle is

(A) $T = \sqrt{\frac{I}{MB}}$ **(B)** $T = 2\pi\sqrt{\frac{I}{MB}}$

(C) $T = 2\pi\sqrt{\frac{MB}{I}}$ **(D)** $T = \pi\sqrt{\frac{MB}{I}}$

Q. 16. A magnetic needle is kept in a non-uniform magnetic field experiences

(A) a force as well as a torque. **(B)** a torque but not a force.

(C) a force and a torque. **(D)** a force but not a torque.

Q. 17. The self-inductance L of a solenoid of length l and area of cross-section A, with a fixed number of turns N increases as

(A) l and A increase. **(B)** l decreases and A increases.

(C) l increases and A decreases. **(D)** both l and A decrease.

AIQ. 18. An iron-cored solenoid has self inductance 2.8 H. When the core is removed, the self inductance becomes 2 mH. The relative permeability of the material of the core is

(A) 1400 **(B)** 1200

(C) 2800 **(D)** 2000

Q. 19. To reduce the resonant frequency in an *L*-*C*-*R* series circuit with a generator

(A) the generator frequency should be reduced.

(B) another capacitor should be added in parallel to the first.

(C) the iron core of the inductor should be removed.

(D) dielectric in the capacitor should be removed.

AIQ. 20. L, C and R represent physical quantities inductance, capacitance and resistance. The combination which has the dimensions of frequency is

(A) $\frac{1}{RC}$ and $\frac{R}{L}$ **(B)** $\frac{1}{\sqrt{RC}}$ and $\sqrt{\frac{R}{L}}$

(C) $\sqrt{LC}$ **(D)** $\frac{C}{L}$

Q. 21. When the distance between the parallel plates of a parallel plate capacitor is halved and the dielectric constant of the dielectric used is made three times, then the capacitance becomes

(A) 3 times **(B)** 6 times

(C) 4 times **(D)** 2 times

AIQ. 22. In balanced condition of a Wheatstone bridge, there is:

(A) no current flow through the galvanometer

(B) no current flow through the resistors

(C) no current is drawn from the voltage source

(D) current flow through galvanometer becomes maximum.

Q. 23. The magnetic field at the ends of a very long current carrying solenoid is

(A) same as that at the centre. **(B)** half as that at the centre.

(C) one -fourth as that at the centre. **(D)** none of the above

Q. 24. The magnetic field produced by a current carrying solenoid is independent of its

(A) length. **(B)** area of cross section.

(C) both (A) and (B) **(D)** none of the above

Q. 25. The basic difference between magnetic lines of force and electric lines of force is

(A) magnetic lines of force are continuous and electric lines of force are discontinuous.

(B) electric lines of force are continuous and magnetic lines of force are discontinuous.

(C) magnetic lines of force intersect each other and electric lines of force do not intersect each other.

(D) electric lines of force intersect each other and magnetic lines of force do not intersect each other.

Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. Toroid is a

(A) fixed value resistor. **(B)** capacitor.

(C) inductor. **(D)** variable resistor.

AI **Q. 27.** Which of the followings is the reason for Earth's magnetism ?

(A) Rotation of electric current **(B)** Rotation of Earth

(C) Attraction due to other celestial bodies **(D)** Solar flares

Q. 28. A toroid has _____ inductance, for a given number of turns, than a solenoid with a core of same material and similar size.

(A) same **(B)** more

(C) less **(D)** variable

Q. 29. Electric current in the Earth's body is generated due to:

(A) movement of charged particle in the atmosphere.

(B) flowing of liquid metal in the outer core.

(C) electric discharges during thunderstorm.

(D) its revolution round the Sun.

Q. 30. Why inductance of solenoid is more than the inductance of a solenoid having same number of turns, core of same material and similar size?

(A) Core is endless hence there is no leakage of flux.

(B) Resistance of wire is less hence magnitude of current flow is more

(C) Number of turns per unit length is more.

(D) Both (A) and (B)

Q. 31. Why sound system engineers prefer to use toroidal transformer?

(A) It is cheaper. **(B)** It is lighter.

(C) It is compact. **(D)** It does not create vibration or hum.

Q. 32. Average magnetic field strength in the Earth's outer core is:

(A) 5 Gauss **(B)** 25 Gauss

(C) 500 Gauss **(D)** Cannot be measured

Q. 33. Efficiency of toroidal transformer is around _____ % which is _____ than laminated core transformer.

(A) 95, lower **(B)** 95, higher

(C) 50, lower **(D)** 80, higher

Q. 34. Which of the following statements is true ?

(A) Earth's magnetic field is due to electric current induced in the ionosphere.

(B) The average magnetic field strength in the Earth's outer core is equal to the magnetic field at the surface.

(C) Earth's magnetic field reverses at an average interval of approximately 3,00,000 years.

(D) Angle of dip is same at every point of the surface of Earth.

Q. 35. According to Faraday's law of electromagnetic induction :

(A) electric field is produced by time varying magnetic field.

(B) magnetic field is produced by time varying electric field.

(C) Both (A) and (B).

(D) None of these

Q. 36. If a coil of insulated wire connected to a battery is brought to galvanometer, its pointer is deflected, because

(A) a current is induced in the galvanometer coil.

(B) the coil produces a magnetic field.

(C) the coil produces an electric field.

(D) None of these

AIQ. 37. The polarity of induced emf is defined by

(A) Faraday's law **(B)** Biot-Savart law

(C) Lenz's law **(D)** Fleming's left hand rule

Q. 38. The resistors of resistance boxes are made by double folded wire to nullify the effect of :

(A) heating. **(B)** magnetism.

(C) self induction. **(D)** None of the above

Q 39. A magnet is moved towards a coil (i) quickly (ii) slowly.

(A) Induced e.m.f. is more in case (i).

(B) Induced e.m.f. is less in case (i).

(C) Induced e.m.f.s are equal in both the cases.

(D) In which case induced e.m.f. will be more that depends upon the radius of the coil.

AIQ. 40. Two identical coaxial circular coils carry same current in same direction. If the loops approach each other then the current

(A) increases.

(B) decreases.

(C) remains the same.

(D) in one coil current increases and in the other coil decreases.

Q. 41. When current in a coil changes from 7 A to 2 A in 0.1 s, 50 V is induced. The self-inductance of the coil is

(A) 1 H **(B)** 2 H

(C) 3 H **(D)** 4 H

Q. 42. A unit positive charge is taken from one point to another over an equipotential surface. Then

(A) no work is done. **(B)** work is done on the charge.

(C) work is done by the charge. **(D)** work done is constant.

AI **Q. 43.** A hollow metal sphere is so charged that the potential on its surface is 10 V. The potential at the centre of the sphere is

(A) 10 V **(B)** 0 V

(C) Depends on the radius of the sphere **(D)** None of the above

Q. 44. A current or a (electric or magnetic) field (i) emerging out of the plane of the paper and (ii) going into the plane of the paper is depicted by

(A) Both by a dot **(B)** Both by a cross.

(C) (i) By a dot ⊙ (ii) by a cross ⊗ **(D)** (i) by a cross ⊗ (ii) by a dot ⊙

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Q. 45. Assertion (A) : Circuit containing capacitors should be handled very carefully even when the power is off.

Reason (R) : The capacitors may break down at any time.

AI **Q. 46. Assertion (A) :** Kirchhoff's voltage law indicates that the electric field is conservative.

Reason (R) : Potential difference between two points in a circuit does not depend on the path.

Q. 47. Assertion (A) : In balanced condition, if the galvanometer and the voltage source is interchanged, the balanced condition remains same.

Reason (R) : The balanced condition of Wheatstone bridge does not depend on the value of the resistances.

Q. 48. Assertion (A) : When the magnetic flux changes around a metallic conductor, the eddy current is produced.

Reason (R) : Electric potential determines the flow of charge.

Q. 49. Assertion (A) : The cores of electromagnets are made of soft iron.

Reason (R) : Coercivity of soft iron is small.

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

Q. 50. Magnetic flux is a _____ quantity and its unit is _____ .

(A) Scalar quantity, Weber **(B)** Vector quantity, Weber

(C) vector quantity, Tesla Meter square **(D)** Scalar quantity, Tesla

AI **Q. 51.** An induced e.m.f. produced by inserting a magnet into a coil is independent of

(A) the strength of the magnet **(B)** number of turns of coil

(C) the resistance of the wire of the coil **(D)** speed with which the magnet is inserted

CASE STUDY

Read the following text and answer the following questions on the basis of the same :

Power factor corrector capacitor

Power factor correction is a method to reduce the lagging power factor in inductive loads by fixing a high value capacitor across the phase and neutral line close to the load. When the Voltage and Current are in phase with each other in an AC circuit, the energy from the source is fully converted into another form to drive the load and in this case power factor is in unity. When the power factor drops, the system becomes less efficient.

In inductive loads, current "lags" the voltage leading to "lagging power factor". Power factor correction is the method to reduce the lagging power factor in inductive loads by fixing a high value capacitor across the phase and neutral close to the load. These capacitors have leading power factor so that it will neutralize the lagging power factor of the load.

Power capacitors are huge non polarized metal film electrolytic type capacitors.

Capacitors should be sufficiently rated to the load capacity. It should be connected to the lines, only when the loads are running and drawing current. Only the passage. Nothing else.

Q. 52. What is meant by power factor correction?

(A) The method to reduce the lagging power factor in inductive loads

(B) The method to enhance the lagging power factor in inductive load

(C) The method to reduce the lagging power factor in capacitive loads

(D) The method to enhance the lagging power factor in capacitive loads

Q. 53. When the energy from source is fully converted into another form, the power factor is

(A) 0.5 **(B)** 1.0

(C) 0 **(D)** ∞

Q. 54. Power capacitors for power factor correction are

(A) polarized metal film electrolytic type.

(B) non-polarized metal film electrolytic type.

(C) non-polarized metal film non-electrolytic type.

(D) polarized ceramic non- electrolytic type.

Q. 55. Power capacitors for power factor correction have

(A) lagging power factor.

(B) leading power factor.

(C) leading or lagging power factor depending on the value of the capacitor.

(D) leading or lagging power factor depending on the type of load.

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: **A**

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: Ⓐ Ⓑ Ⓒ Ⓓ

Roll Number: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Name

Test Date

Invigilator's Signature

Student's Signature

Certified that all the entries In this section have been properly filled by the student

Subject

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
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11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
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15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Self Assessment Paper 2

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

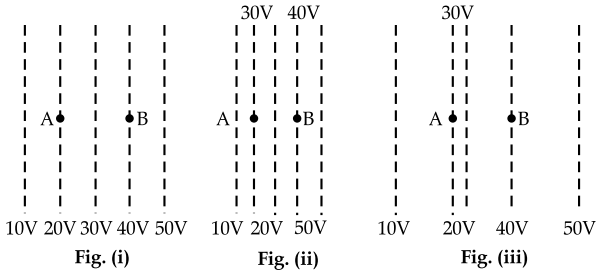
Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. Electric charge between two bodies can be produced by
(A) sticking **(B)** rubbing
(C) oiling **(D)** passing AC current

Q. 2. A positively charged particle is released from rest in an uniform electric field. The electric potential energy of the charge
(A) remains a constant because the electric field is uniform.
(B) increases because the charge moves along the electric field.
(C) decreases because the charge moves along the electric field.
(D) decreases because the charge moves opposite to the electric field.

AI **Q. 3.** Figure shows some equipotential lines distributed in space. A charged object is moved from point A to point B.



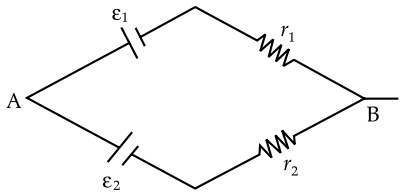
(A) The work done in Figure (i) is the greatest.

(B) The work done in Figure (ii) is least.

(C) The work done is the same in Figure (i), Figure (ii) and Figure (iii).

(D) The work done in Figure (iii) is greater than Figure (ii), but equal to that in Figure (i).

Q. 4. Two batteries of emf ε_1 and ε_2 ($\varepsilon_2 > \varepsilon_1$) and internal resistances r_1 and r_2 respectively are connected in parallel as shown in figure :



(A) The equivalent emf ε_{eq} of the two cells is between ε_1 and ε_2, *i.e.* $\varepsilon_1 < \varepsilon_{eq} < \varepsilon_2$.

(B) The equivalent emf ε_{eq} is smaller than ε_1.

(C) The ε_{eq} is given by $\varepsilon_{eq} = \varepsilon_1 + \varepsilon_2$ always.

(D) ε_{eq} is independent of internal resistances r_1 and r_2.

Q. 5. A resistance R is to be measured using a meter bridge. Student chooses the standard resistance S to be 100 Ω. He finds the null point at $l_1 = 2.9$ cm. He is told to attempt to improve the accuracy. Which of the following is a useful way?

(A) He should measure l_1 more accurately.

(B) He should change S to 1000 Ω and repeat the experiment.

(C) He should change S to 3 Ω and repeat the experiment.

(D) He should give up hope of a more accurate measurement with a meter bridge.

Q. 6. Two cells of emf's approximately 5 V and 10 V are to be accurately compared using a potentiometer of length 400 cm :

(A) The battery that runs the potentiometer should have voltage of 8 V.

(B) The battery of potentiometer can have a voltage of 15 V and R adjusted so that the potential drop across the wire slightly exceeds 10 V.

(C) The first portion of 50 cm of wire itself should have a potential drop of 10 V.

(D) Potentiometer is usually used for comparing resistances and not voltages.

AI Q. 7. Kirchhoff's current law is based on the law of conservation of

(A) charge. **(B)** energy.

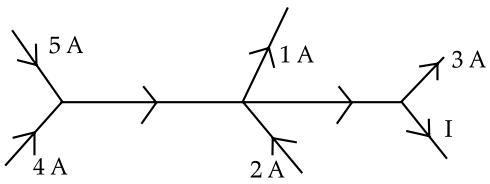
(C) mass. **(D)** (B) and (C)

Q. 8. The energy of a charged capacitor resides in

(A) the electric field only. **(B)** the magnetic field only.

(C) both the electric and magnetic field. **(D)** neither in electric nor magnetic field.

Q. 9. Apply Kirchhoff's law to find the current I in the part of the following circuit.



(A) 5 A **(B)** 3 A

(C) 7 A **(D)** 1 A

AI Q. 10. Wheatstone Bridge is not suitable for measurement of

(A) very high value resistances. **(B)** very low value resistances.

(C) both (A) and (B). **(D)** medium value resistances.

Q. 11. Biot-Savart law indicates that the moving electrons (velocity v) produce a magnetic field B such that

(A) $B \perp v$. **(B)** $B \parallel v$.

(C) it obeys inverse cube law.

(D) it is along the line joining the electron and point of observation.

Q. 12. Consider the two idealized systems : (i) a parallel plate capacitor with large plates and small separation and (ii) a long solenoid of length L, R, radius of cross-section. In (i), E is ideally treated

as a constant between plates and zero outside. In (ii), magnetic field is constant inside the solenoid and zero outside. These idealized assumptions, however, contradict fundamental laws as below :

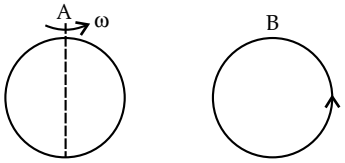
(A) Case (i) contradicts Gauss's law for electrostatic fields.

(B) Case (ii) contradicts Gauss's law for magnetic fields.

(C) Case (i) agrees with $\oint_s E.dl = 0$

(D) Case (ii) contradicts $\oint H.dl = I_{en}$

Q. 13. The coil A is made to rotate about a vertical axis figure. No current flows in B if A is at rest. The current in coil A, when the current in B (at $t = 0$) is counter-clockwise and the coil A is as shown at this instant, $t = 0$, is



(A) constant current clockwise.

(B) varying current clockwise.

(C) varying current counter-clockwise.

(D) constant current counter-clockwise.

Q. 14. The electric current in a liquid is due to

(A) electron only.

(B) positive ions only.

(C) negative and positive ions both.

(D) electrons and positive ions both.

Q. 15. The charge flowing through a resistance R varies with time as $Q = 2t - 8t^2$. The total heat produced in the resistance is $\left(\text{for } 0 \le t \le \frac{1}{8}\right)$

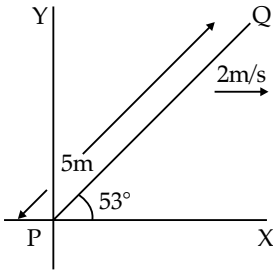
(A) $\frac{R}{6}$ joules

(B) $\frac{R}{3}$ joules

(C) $\frac{R}{2}$ joules

(D) R joules

Q. 16. A conducting rod PQ of length 5 m oriented as shown in figure is moving with velocity $(2 \text{ m/s})\hat{i}$ without rotation in a uniform magnetic field $(3\hat{j} + 4\hat{k})$ Tesla. Emf induced in the rod is



(A) –32 Volts

(B) 40 Volt.

(C) 50 Volt.

(D) none of these

AI Q. 17. Relation between r.m.s. voltage and instantaneous voltage of an AC

(A) $V_0 = V_{RMS} / \sqrt{2}$

(B) $V_{RMS} = V_0 / \sqrt{2}$

(C) $V_{RMS} = 0.707 V_0$

(D) Both (B) and (C)

Q. 18. An alternating current changes from a complete cycle in 1μs, then the frequency in Hz will be

(A) 10^{-6}

(B) 50

(C) 100

(D) 10^6

AI Q. 19. An A.C. source is connected to a resistive circuit. Which of the following statements is true?

(A) Current leads the voltage in phase.

(B) Current lags the voltage in phase.

(C) Current and voltage are in same phase.

(D) Either (A) or (B) depending on the value of resistance.

Q. 20. In which of the following circuit power dissipation is maximum?

(A) Pure capacitive circuit

(B) Pure inductive circuit

(C) Pure resistive circuit

(D) LR or CR circuit

Q. 21. The same amount of current flows through the filament and line wire. Why more heat is produced in filament?

(A) Resistance of filament is higher than the resistance of line wire.

(B) Resistance of line wire is higher than the resistance of filament.

(C) Current flows for more time through the filament.

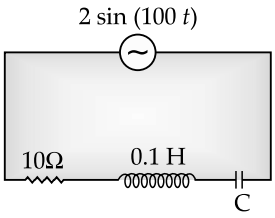
(D) Both (A) and (C)

AI Q. 22. Work done by the magnetic field on the moving charge in a magnetic field is

(A) 0 **(B)** depends on the distance travelled

(C) depends on the force acting. **(D)** Both (A) and (B)

Q. 23. The power factor of the circuit is $1/\sqrt{2}$. The capacitance of the circuit is equal to



(A) 400 μF **(B)** 300 μF

(C) 500 μF **(D)** 200 μF

AI Q. 24. V_{RMS} value of an alternating voltage $V = 4\sqrt{2}$ sin 314t is

(A) $4\sqrt{2}$ V **(B)** 4 V

(C) 8 V **(D)** None of the above

Q. 25. Both *ac* and *dc* can be measured by hot wire instrument since

(A) for both a.c. and d.c. heat generated is proportional to I.

(B) for both a.c. and d.c. heat generated is inversely proportional to I.

(C) for both a.c. and d.c. heat generated is proportional to I^2.

(D) None of the above

Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. Comparing between charge and mass which of the following statements is true?

(A) Charge is a vector quantity, mass is a vector quantity.

(B) Charge is a scalar quantity, mass is a scalar quantity.

(C) Charge is a vector quantity, mass is a scalar quantity.

(D) Charge is a scalar quantity, mass is a vector quantity.

Q. 27. If 10^9 electrons move out of a body to another body every second, how much time is required to get a total charge of 1 C on the other body?

(A) 198 hours **(B)** 198 minute

(C) 198 days **(D)** 198 years

Q. 28. From Coulomb's law,

$$F = \frac{KQ_1Q_2}{R^2}$$

The value of SI system is

(A) 9×10^9 NC^2/m^2 **(B)** 9×10^9 Nm^2/C^2

(C) 9×10^9 m^2/NC^2 **(D)** 9×10^9 N/m^2C^2

Q. 29. Which of the following statements is true?

(A) Force on any charge due to a number of other charges is the vector sum of all the forces on that charge due to the other charges, taken one at a time. The individual forces are unaffected due to the presence of other charges.

(B) Force on any charge due to a number of other charges is the sum of all the forces on that charge due to the other charges, taken one at a time. The individual forces are unaffected due to the presence of other charges.

(C) Force on any charge due to a number of other charges is the product of all the forces on that charge due to the other charges, taken one at a time. The individual forces are unaffected due to the presence of other charges.

(D) Force on any charge due to a number of other charges is the vector sum of all the forces on that charge due to the other charges, taken one at a time. Each individual force is affected by the other forces.

AIQ. **30.** Which of the following statements is true?

(A) The electric field due to a charge Q at a point in space may be defined as the force that a unit negative charge would experience if placed at that point.

(B) The electric field due to a charge Q at a point in space may be defined as the force that a unit positive charge would experience if placed at that point.

(C) The electric field due to a charge Q at a point in space may be defined as the force that a unit charge (positive or negative) would experience if placed at that point.

(D) None of the above.

Q. 31. Electrostatic potential varies

(A) directly with the distance. **(B)** inversely with the distance.

(C) directly with the square of the distance. **(D)** inversely with the square of the distance.

Q. 32. The potential in the equatorial plane of an electric dipole is

(A) 0 **(B)** depends on the distance.

(C) depends on the dipole moment. **(D)** ∞

Q. 33. Ordinary rubber is an insulator. But special rubber tyres of aircraft are made slightly conducting. Why is this necessary?

(A) To enable the dissipation of heat generated due to friction

(B) So that the tyres have longer life

(C) To enable them to conduct charge (produced by friction) to the ground

(D) Both (A) and (B)

AIQ. **34.** Potential due to a charge q at its own location is

(A) 0 **(B)** ∞

(C) depends on the magnitude of charge. **(D)** None of the above

Q. 35. The relaxation time in conductors

(A) increases with the increase of temperature. **(B)** decreases with the increase of temperature.

(C) it is independent of temperature. **(D)** is zero.

Q. 36. The suitable material for electric fuse is

(A) Copper **(B)** Aluminium

(C) Tin-lead alloy **(D)** silver

Q. 37. With increase in temperature, the

(A) resistivity of metal and semiconductor increase.

(B) resistivity of metal and semiconductor decrease.

(C) resistivity of metal increases and resistivity of semiconductor decrease.

(D) resistivity of metal decreases and resistivity of semiconductor increase.

Q. 38. Appliances based on heating effect of current work on

(A) only d.c. **(B)** only a.c.

(C) both (A) and (B) **(D)** None of these

Q. 39. Potentiometer is based on

(A) zero deflection method. **(B)** deflection method.

(C) both (A) and (B) **(D)** None of these

Q. 40. Biot-Savart law indicates that the magnetic field B produced due to the velocity (v) of an electrons is such that

(A) B perpendicular to v. **(B)** B parallel to v.

(C) in any arbitrary direction. **(D)** it obeys inverse cube law.

Q. 41. A beam of electrons and a beam of protons are moving parallel to each other in the same direction.

(A) There will be an attract between them

(B) There will be a repulsion between them.

(C) Neither (A) nor (B).

(D) Attraction or repulsion will depend on the respective velocities.

AI **Q. 42.** Magnetic field at the centre of a circular coil is

(A) directly proportional to the radius of the coil.

(B) inversely proportional to the radius of the coil.

(C) directly proportional to the current through the coil.

(D) Both (B) and (C)

Q. 43. A strong magnetic field is applied on a stationary electron. The electron

(A) moves in the direction of the field.

(B) remains stationary.

(C) moves perpendicular to the direction of the field.

(D) moves in a circular path.

Q. 44. Two similarly charge particles have the ratio of their velocities as 3 : 2 on entering a magnetic field. The ratio of the radii of their paths is

(A) 2:3 **(B)** 3:2

(C) 4:9 **(D)** 9:4

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Q. 45. Assertion (A) : The basic difference between magnetic lines of force and electric lines of force is electric lines of force are discontinuous and magnetic lines of force are continuous.

Reason (R) : Magnetic lines of force exist in a magnet but no electric lines of force exists in a charged body.

AI **Q. 46. Assertion (A) :** Work done in moving a charge between any two points in a uniform electric field is independent of the path followed by the charge between these two points.

Reason (R) : Electrostatic forces are non-conservative.

Q. 47. Assertion (A) : Electric potential and electric potential energy are two different quantities.

Reason (R) : For a test charge Q and a point charge Q, the electric potential energy becomes equal to the potential.

Q.48. Assertion (A) : Power rating of resistance is so important when used in a circuit.

Reason (R) : The resistance value does not change with temperature.

AI **Q. 49. Assertion (A) :** Kirchhoff's junction rule is applicable for any number of connection meeting at a point in an electrical circuit.

Reason (R) : When there is a flow of steady current, then there is no accumulation of charge at the junction.

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

Q. 50. The frequency of A.C. in India is

(A) 30 Hz **(B)** 50 Hz

(C) 60 Hz **(D)** 220 Hz

Q. 51. In inverter,

(A) A.C. to D.C. conversion takes place **(B)** A.C. to A.C. conversion takes place

(C) D.C. to D.C. conversion takes place **(D)** D.C to A.C. conversion takes place.

Case Study

Read the following text and answer the following questions on the basis of the same:

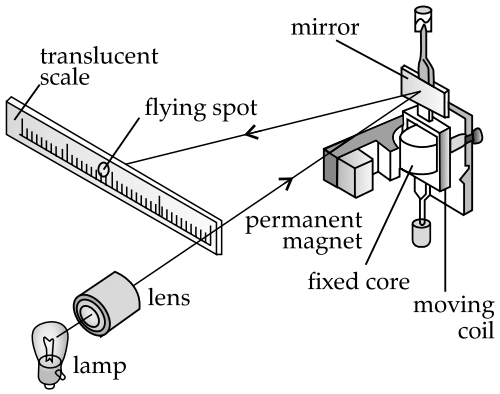
Galvanometer can sense/measure current. Improved mirror galvanometer was developed by William Thomson, later to become Lord Kelvin, in 1858. Thomson intended the instrument to read weak signal currents on very long submarine telegraph cables.

The fundamental problems of transmitting/ receiving a signal through a lengthy submarine cable was that the electrical current tended to be very low (as little as 1/100,000th of a standard light bulb). So, it was very difficult to detect it. To solve the problem, it was thought that larger amount of electric current would be sent through the line. But Thomson had a different approach. He thought the best response was to devise a device that could read faint signals. The galvanometer, first invented in 1802, was a means of detecting electric current. It consisted of a needle that was deflected by the magnetic field created by the electric current. But the galvanometers of the day couldn't detect the weak signals that came through a long underwater cable. But the improved version of galvanometer was highly sensitive to detect the lowest current.

The mirror galvanometer consists of a long fine coil of silk-covered copper wire. In the heart of that coil, within a little air-chamber, a small round mirror is hung by a single fibre of floss silk, with four tiny magnets cemented to its back.

A beam of light is thrown from a lamp upon the mirror, and reflected by it upon a white screen or scale a few feet distant, where it forms a bright spot of light; when there is no current on the instrument, the spot of light remains stationary at the zero position on the screen; but the instant a current traverses the long wire of the coil, the suspended magnets twist themselves horizontally out of their former position, the mirror is inclined with them, and the beam of light is deflected along the screen to one side or the other, according to the nature of the current. If a positive electric current gives a deflection to the right of zero, a negative current will give a deflection to the left of zero, and vice versa.

The air in the little chamber surrounding the mirror is compressed, so as to act like a cushion, and deaden the movements of the mirror; the mirror is thus prevented from idly swinging about at each deflections.



Q. 52. Improved mirror galvanometer was developed by

(A) Lord Kelvin **(B)** Johann Schweigger

(C) Luigi Galvani **(D)** Andre-Marie Ampère

Q. 53. Mirror galvanometer was primarily used to

(A) measure the current passing through electric bulb.

(B) measure the weak current received through lengthy submarine cable.

(C) measure current passing through human body.

(D) all of these.

Q. 54. The basic principle of galvanometer is

(A) heating effect of current.

(B) torque developed by the electric current passing through a coil.

(C) magnetic effect of current.

(D) none of the above.

Q. 55. The mirror galvanometer consists of

(A) a small round mirror attached to a fine coil of silk-covered copper wire.

(B) a long fine coil of silk-covered copper wire and a small round mirror hung by a single fibre of floss silk, with four tiny magnets cemented to its back.

(C) a small round mirror attached to four tiny magnets.

(D) None of the above

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: A

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: ⒶⒷⒸⒹ

Roll Number: 0 1 2 3 4 5 6 7 8 9

Name

Subject

Test Date

Student's Signature

Invigilator's Signature

Certified that all the entries In this section have been properly filled by the student

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: 0 1 2 3 4 5 6 7 8 9

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Sample Question Papers

Self Assessment Paper 3

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. Suppose the charge of a proton and an electron differ slightly. One of them is $-e$, the other is $(e+e)$. If the net f electrostatic force and gravitational force between two hydrogen atoms placed at a distance d (much greater than atomic size) apart is zero, then Δe is of the order of : [Given mass of hydrogen $m_H = 1.67 \times 10^{-27}$ kg]

(A) 10^{-23} C **(B)** 10^{-37} C

(C) 10^{-47} C **(D)** 10^{-20} C

AI **Q.2.** The electrostatic potential on the surface of a charged conducting sphere is 100 V.

Two statements are made in this regard :

S_1 : At any point inside the sphere, electric intensity is zero.

S_2 : At any point inside the sphere, the electrostatic potential is 100 V.

Which of the following is a correct statement?

(A) S_1 is true, but S_2 is false.

(B) Both S_1 and S_2 are false.

(C) S_1 is true, S_2 is also true and S_1 is the cause of S_2.

(D) S_1 is true, S_2 is also true but the statements are independent.

Q. 3. Equipotential at a great distance from a collection of charges whose total sum is not zero are approximately

(A) spheres. **(B)** planes.

(C) paraboloids. **(D)** ellipsoids.

Q. 4. In a region the potential is represented by $V(x, y, z) = 6x - 8xy - 8y + 6yz$, where V is in volts and x, y, z are in meters. The electric force experienced by a charge of 2 coulomb situated at point (1, 1, 1) is :

(A) $6\sqrt{5}$ N **(B)** 30 N

(C) 24 N **(D)** $4\sqrt{35}$

Q. 5. Which of the following characteristics of electrons determines the current in a conductor?

(A) Drift velocity alone **(B)** Thermal velocity alone

(C) Both drift velocity and thermal velocity **(D)** Neither drift nor thermal velocity.

Q. 6. A metal rod of length 10 cm and a rectangular cross-section of 1 cm $\times \frac{1}{2}$ cm is connected to a battery across opposite faces. The resistance will be

(A) maximum when the battery is connected across 1 cm $\times \frac{1}{2}$ cm faces.

(B) maximum when the battery is connected across 10 cm $\times$ 1 cm faces.

(C) maximum when the battery is connected across 10 cm $\times \frac{1}{2}$ cm faces.

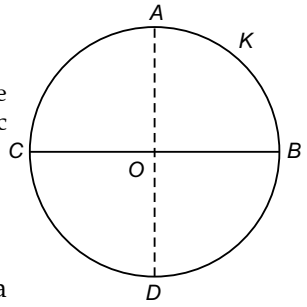
(D) same irrespective of the three faces.

AI Q. 7. Two positive ions, each carrying a charge q, are separated by a distance d. If F is the force of repulsion between the ions, the number of electrons missing from each ion will be (e being the charge on an electron) :

(A) $4\pi\varepsilon_0 F d^2/e^2$ **(B)** $\sqrt{4\pi\varepsilon_0 F e^2 / d^2}$

(C) $\sqrt{4\pi\varepsilon_0 F d^2 / e^2}$ **(D)** $4\pi\varepsilon_0 F d^2 / q^2$

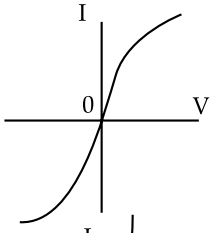
Q. 8. A thin conducting ring of radius R is given a charge +Q. The electric field at the centre O of the ring due to the charge on the part AKB of the ring is E. The electric field at the centre due to the charge on the part ACDB of the ring is :

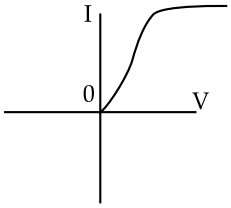


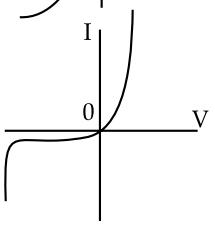
(A) 3 E along OK **(B)** 3 E along KO

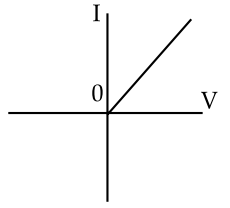
(C) E along OK **(D)** E along KO

AI Q. 9. Which of the following I-V characteristic represent the characteristic of a Ohmic conductor?

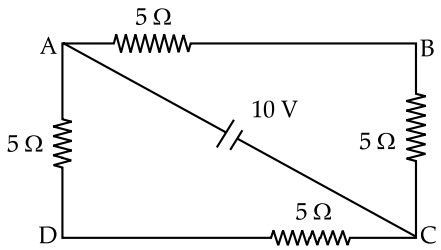
(A)


(B)


(C)


(D)


AI Q. 10. What is the potential difference between points A and B in the following circuit?



(A) 10 V **(B)** 5 V
(C) 2.5 V **(D)** 20 V

Q. 11. The acceleration of an electron in an electric field of magnitude 50 V/cm, if e/m value of the electron is 1.76×10^{11} C/kg, is :

(A) 8.8×10^{14} m/sec^2 **(B)** 6.2×10^{13} m/sec^2
(C) 5.4×10^{12} m/sec^2 **(D)** Zero

Q. 12. A toroid of n turns, mean radius R and cross-sectional radius a carries current I. It is placed on a horizontal table taken as x-y plane. Its magnetic moment m

(A) is non-zero and points in the z-direction by symmetry.

(B) points along the axis of the toroid ($m = m_\phi$).

(C) is zero, otherwise there would be a field falling as $\frac{1}{r^3}$ at large distances outside the toroid.

(D) is pointing radially outwards.

AI Q. 13. A square of side L meters lies in the x-y plane in a region where the magnetic field is given by $B = B_0\ (2\hat{i} + 3\hat{j} + 4\hat{k})$ Tesla, where B_0 is constant. The magnitude of flux passing through the square is

(A) $2B_0L^2$ Wb **(B)** $3B_0L^2$ Wb
(C) $4B_0L^2$ Wb **(D)** $\sqrt{29}B_0L^2$ Wb

Q. 14. A loop, made of straight edges has six corners at A(0, 0, 0), B(L, 0, 0) C(L, L, 0), D(0, L, 0), E(0, L, L) and F(0, 0, L). A magnetic field $B=B_0\ (\hat{i} + \hat{k})$ Tesla is present in the region. The flux passing through the loop ABCDEFA (in that order) is

(A) B_0L^2 Wb. **(B)** $2B_0L^2$ Wb.
(C) $\sqrt{2}B_0L^2$ Wb . **(D)** $4B_0L^2$ Wb.

Q. 15. A capacitor of 20 μF is charged to 500 volts and connected in parallel with another capacitor of 10 μF and charged to 200 volts. The common potential is :

(A) 200 volts **(B)** 300 volts
(C) 400 volts **(D)** 500 volts

Q. 16. The capacity of a parallel plate condenser is 5 μF. When a glass plate is placed between the plates of the conductor, its potential becomes $1/8^{th}$ of the original value. The value of dielectric constant will be :

(A) 1.6 **(B)** 5
(C) 8 **(D)** 40

Q. 17. A condenser of capacity 50 μF is charged to 10 volts. Its energy is equal to :

(A) 2.5×10^{-3} joule **(B)** 2.5×10^{-4} joule
(C) 5×10^{-2} joule **(D)** 1.2×10^{-8} joule

Q. 18. An alternating current generator has an internal resistance R_g and an internal reactance X_g. It is used to supply power to a passive load consisting of a resistance R_g and a reactance X_L. For maximum power to be delivered from the generator to the load, the value of X_L is equal to

(A) zero **(B)** X_g
(C) $-X_g$ **(D)** R_g

Q. 19. When a voltage measuring device is connected to AC mains, the meter shows the steady input voltage of 220 V. this means

(A) input voltage cannot be AC voltage, but a DC voltage.

(B) maximum input voltage is 220 V.

(C) The meter reads not v but (v^2) and is calibrated to read $\sqrt{(v^2)}$.

(D) The pointer of the meter is stuck by some mechanical defect.

Q. 20. In a charged capacitor, the energy resides :

(A) the positive charges. **(B)** both the positive and negative charges

(C) the field between the plates. **(D)** around the edge of the capacitor plates.

AI Q. 21. Electric field inside a hollow conducting sphere is

(A) zero **(B)** infinite

(C) depends on the magnitude of charge **(D)** depends on the radius of the sphere

Q. 22. Fuse wire has high resistance and low melting point.

(A) should have high resistance **(B)** should have low melting point

(C) should have low resistance **(D)** both (A) and (B)

Q. 23. The resistance of superconductor is

(A) too large **(B)** too small

(C) Negative **(D)** zero

AI Q. 24. An electron and a proton moving with same velocity enters a magnetic field.

(A) Proton will experience more force **(B)** Electron will experience more force

(C) Both will experience same force **(D)** Force is mass dependent

Q. 25. Faraday's laws of electromagnetic induction are consequences of law of conservation of

(A) Energy **(B)** Momentum

(C) Mass **(D)** None of the above

Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. The average value of current over a complete cycle is

(A) 0 **(B)** I_0

(C) $I_0/2$ **(D)** $I_0/\sqrt{2}$

Q. 27. Which one of the following has dimension of time?

(A) LR **(B)** LC

(C) 1/RC **(D)** RC

Q. 28. In a LCR circuit energy is dissipated by

(A) L **(B)** C

(C) R **(D)** All of the above

AI Q. 29. The ratio of X_C and X_L in a A.C. circuit is

(A) 1 **(B)** $1/\omega^2LC$

(C) ω^2L **(D)** None of the above

AI Q. 30. In series resonant circuit, the total reactance is

(A) 0 **(B)** ∞

(C) Maximum **(D)** Minimum

Q. 31. A metal plate can be heated by

(A) placing in a time varying magnetic field.

(B) passing either a direct or alternating current.

(C) placing in a space varying magnetic field, but does not vary with time.

(D) both (A) and (B) are correct.

AI **Q. 32.** Which of the following is not an application of eddy current?

(A) Electric power meters **(B)** Induction furnace

(C) Magnetic brakes in trains **(D)** LED lights

Q. 33. 1 Henry is equal to

(A) Weber / Volt **(B)** Weber / ampere

(C) Weber Ampere **(D)** Weber Volt

Q. 34. 1 Farad is equivalent to

(A) 1 C/J **(B)** 1 J/C

(C) $1\ C^2/J$ **(D)** $1\ C^2/J^2$

Q. 35. The role of inductance is equivalent to

(A) Force **(B)** Inertia

(C) Moment **(D)** Energy

Q. 36. Which of the following represents Ampere's Circuital law?

(A) $\oint \vec{H}.\vec{dl} = \mu_0 I_{enclo}$ **(B)** $\oint \vec{B}.\vec{dl} = \mu_0 I_{enclo}$

(C) $\oint \vec{H}.\vec{dl} = \mu_0 J$ **(D)** $\oint \vec{B}.\vec{dl} = \mu_0 J$

Q. 37. The nature of parallel and anti-parallel current carrying wires are

(A) parallel current carrying wires repel and anti-parallel current carrying wires attract.

(B) parallel current carrying wires attract and anti-parallel currents carrying wires repel.

(C) both attract.

(D) both repel.

Q. 38. The defection of pointer of a moving coil galvanometer is given by

(A) $\left(\frac{NA}{KB}\right)I$ **(B)** $\left(\frac{NAB}{K}\right)I$

(C) $\frac{NAB}{KI}$ **(D)** $\left(\frac{N}{KAB}\right)I$

Q. 39. A moving coil galvanometer can be converted into an ammeter by

(A) putting a shunt in series. **(B)** putting a shunt in parallel.

(C) putting a high value resistance in series. **(D)** Putting a high value resistance in parallel.

Q. 40. The conversion of a moving coil galvanometer into a voltmeter is done by

(A) putting a shunt in series. **(B)** putting a shunt in parallel.

(C) putting a high value resistance in series. **(D)** Putting a high value resistance in parallel.

AI **Q. 41. Two thin long parallel wires carrying current I ampere is separated by a distance *r*. The magnitude of the force per unit length applied by one wire on the other is**

(A) $\mu_0 I^2 / 2\pi r$ **(B)** $\mu_0 I^2 / r^2$

(C) $\mu_0 I^2 / 4\pi r$ **(D)** $\mu_0 I^2 / 2\pi r^2$

Q. 42. The force on a current carrying conductor in a magnetic field is maximum, when angle between the length of the conductor and the magnetic field is:

(A) $\pi/4$ **(B)** $\pi/2$

(C) π **(D)** 0

Q. 43. You are given three voltmeters A, B and C having internal resistance 50 Ω, 50 kΩ and 1 MΩ. Which one will you select for better accuracy?

(A) A **(B)** B

(C) C **(D)** Any one

Q. 44. A current carrying coil is placed in a uniform magnetic field. If θ is the angle between the axis of the coil and the direction of magnetic field, then the torque is directly proportional to:

(A) sin θ **(B)** cos θ

(C) cosec θ **(D)** sec θ

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Q. 45. Assertion (A) : In a non-uniform electric field, a dipole will have translatory as well as rotational motion.

Reason (R) : In a non-uniform electric field, a dipole experiences a force as well as torque.

AI **Q.46. Assertion (A) :** Electric field is always normal to equipotential surfaces and along the direction of decreasing order of potential.

Reason (R) : Negative gradient of electric potential is electric field.

Q. 47. Assertion (A) : Electric appliance with metal body has three electrical connections. But an electrical bulb has two electrical connection.

Reason (R) : Three pin connection reduces chances of electrical shocks.

Q. 48. Assertion (A) : The magnetic field at the ends of a very long current carrying solenoid is half of that at the centre.

Reason (R) : Magnetic field within a sufficiently long solenoid is uniform.

AI **Q.49. Assertion (A) :** The magnetic field configuration with 3 poles is not possible.

Reason (R) : No torque acts on a bar magnet itself due to its own field.

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

Q. 50. The angle of dip where the horizontal component of earth's magnetic field is equal to the vertical component is

(A) 30° **(B)** 60°

(C) 45° **(D)** 90°

Q. 51. The magnetic lines of force inside a bar magnet is

(A) South to North pole

(B) North to South pole

(C) There is no lines of force inside a bar magnet

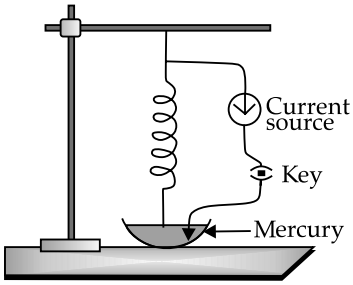
(D) Direction of lines of force depends on the pole strength

CASE STUDY

Read the following text and answer the following questions on the basis of the same:

Magnetic effects are generally smaller than electric effects. As a consequence, the force between currents is rather small, because of the smallness of the factor μ. Hence, it is difficult to demonstrate attraction or repulsion between currents. Thus, for 5 A current in each wire at a separation of 1 cm, the force per metre would be 5×10^{-4} N, which is about 50 mg weight. It would be like pulling

a wire by a string going over a pulley to which a 50 mg weight is attached. The displacement of the wire would be quite unnoticeable. With the use of a soft spring, we can increase the effective length of the parallel current and by using mercury, we can make the displacement of even a few mm observable very dramatically. You will also need a constant-current supply giving a constant current of about 5 A. Take a soft spring whose natural period of oscillations is about 0.5^{-1} s. Hang it vertically and attach a pointed tip to its lower end, as shown in the figure here. Take some mercury in a dish and adjust the spring such that the tip is just above the mercury surface. Take the DC current source, connect one of its terminals to the upper end of the spring and dip the other terminal in mercury. If the tip of the spring touches mercury, the circuit is completed through mercury. Let the DC source be put off to begin with. Let the tip be adjusted so that it just touches the mercury surface. Switch on the constant current supply and watch the fascinating outcome. The spring shrinks with a jerk, the tip comes out of mercury (just by a mm or so), the circuit is broken, the current stops, the spring relaxes and tries to come back to its original position, the tip again touches mercury establishing a current in the circuit and the cycle continues with tick, tick, tick,...



Q. 52. Magnetic effects:

(A) are equal to electric effects.
(B) are greater than electric effects.
(C) are smaller than electric effects.
(D) cannot be compared with electric effects.

Q. 53. The force 10^{-3} N,is equivalent to:

(A) 100 mg
(B) 100 g
(C) 10 g
(D) 10 mg

Q. 54. Why the spring shrinks in Roget's spiral ?

(A) The spring functions as a solenoid
(B) Due to force acting between two current carrying wires
(C) Due to magnetic effect of current
(D) Since the spring is soft

Q. 55. What are the main 3 components in a Roget's spiral?

(A) Mercury, AC voltage source
(B) Mercury, DC voltage source
(C) Mercury, DC voltage source, key
(D) Mercury, AC voltage source, key

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: A

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: Ⓐ Ⓑ Ⓒ Ⓓ

Roll Number: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Name

Test Date

Student's Signature

Invigilator's Signature

Certified that all the entries In this section have been properly filled by the student

Subject

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Self Assessment Paper 4

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. A gold leaf electroscope

(A) measures the magnitude of positive charge present in a body.

(B) measures the magnitude of negative charge present in a body.

(C) Both (A) and (B)

(D) detects the presence of charge in a body.

AI **Q. 2.** The value of permittivity of free space is

(A) $8.854 \times 10^{12}\ C^2\ N^{-1}m^{-2}$ **(B)** $8.854 \times 10^{-12}\ C^2\ N^{-1}m^{-2}$

(C) $88.54 \times 10^{12}\ C^2\ N^{-1}m^{-2}$ **(D)** $88.54 \times 10^{-12}\ C^2\ N^{-1}m^{-2}$

Q. 3. Coulomb's law agrees with the _____ law.

(A) Faraday's **(B)** Newton's

(C) Lenz's **(D)** Maxwell

Q. 4. All of electrostatics is basically a consequence of _____ law and the superposition principle.

(A) Coulomb's **(B)** Faraday's

(C) Kirchhoff's **(D)** Gauss's

Q. 5. Electric field due to a charge Q at a point in space may be defined as the _____ that a unit _____ charge would experience if placed at that point.

(A) Force, negative **(B)** Force, positive

(C) Torque, negative **(D)** Torque, positive

AI Q. 6. For a positive charge, the electric field will be directed radially _____ from the charge and for negative charge the electric field is directed radially _____.

(A) Outward, outward **(B)** Inward, inward

(C) Outward, inward **(D)** Inward, outward

Q. 7. Which of the followings is a non-polar molecule?

(A) CO_2 **(B)** H_2O

(C) NH_3 **(D)** SO_2

Q. 8. A dielectric develops a net dipole moment in the presence of an external field. The dipole moment per unit volume is called polarisation and is denoted by P. For linear isotropic dielectrics, the expression of P is

(A) $\vec{P} = \varepsilon_0 \chi_e \vec{E}$ **(B)** $\vec{P} = \frac{\varepsilon_0}{\chi_0} \vec{E}$

(C) $\vec{P} = \frac{\chi_e}{\varepsilon_0} \vec{E}$ **(D)** None of the above

Q. 9. Dielectric strength is

(A) the maximum electric field that a dielectric medium can withstand without break-down.

(B) the maximum magnetic field that a dielectric medium can withstand without break-down.

(C) the maximum electric current a dielectric medium can withstand without break-down.

(D) the maximum electric potential that a dielectric medium can withstand without break-down.

Q. 10. 1 million electrons from point A to B in 2 μs. The direction and magnitude of current are

(A) 8×10^{-7} A **(B)** 8×10^{7} A

(C) 0.8×10^{7} A **(D)** 0.8×10^{-7} A

Q. 11. In a Hydrogen atom, an electron moves in a orbit of radius 5×10^{-11} m with a speed $\pi \times 10^{6}$ m/s. The equivalent current is

(A) 1.6×10^{-3} A **(B)** 1.6×10^{3} A

(C) 16×10^{-3} A **(D)** 16×10^{3} A

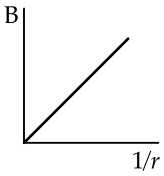
AI Q. 12. 10^{19} electrons per second move from A to B. 10^{19} protons per second move from B to A. The magnitude and the direction of current are

(A) 3.2 A, B to A **(B)** 3.2 A, A to B

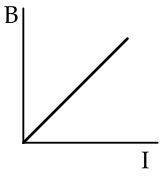
(C) 32 A, B to A **(D)** 32 A, A to B

AI Q. 13. For a straight current carrying wire which of the following graph is incorrect?

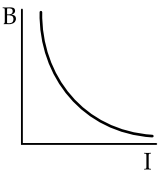
(A)



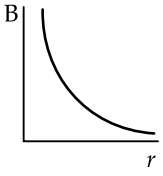
(B)



(C)



(D)



Q. 14. A circular loop of one turn carries a current I. The wire of the loop is used to construct a loop of two turns and the same current I is allowed to flow through it. The field at the center of this coil will be times of the first coil.

(A) 2 **(B)** 4

(C) 3 **(D)** 8

Q. 15. Which one of the following statements is correct?

(A) Ammeter and voltmeter have the resistance of same order.

(B) Voltmeter is a high resistance galvanometer and an ammeter is a low resistance galvanometer

(C) Ammeter is a high resistance galvanometer and voltmeter is a low resistance galvanometer

(D) Ammeter is used in parallel and voltmeter is used in series in a circuit.

Q. 16. An alpha-particle is moving in a magnetic field $(5\hat{i} + 10\hat{j})$ T with a velocity $5 \times 10^3\ \hat{i}$ ms^{-1}. The magnetic force acting on the particle is

(A) $16 \times 10^{-16}\ \hat{k}$ dyne **(B)** $16 \times 10^{16}\ \hat{k}$ dyne

(C) $16 \times 10^{-16}\ \hat{k}$ N **(D)** $16 \times 10^{16}\ \hat{k}$ N

Q. 17. Two capacitors 2 μF and 3 μF are connected in series with a 10 V battery. When the capacitors get charged fully then

(A) The potential difference across the 2 μF and 3 μF capacitors are respectively 4 V and 6 V

(B) The potential difference across the 2 μF and 3 μF capacitors are respectively 6 V and 4 V

(C) The ratio of charges on the two capacitors is 1:1

(D) The ratio of electrical energies stored is 1:1

Q. 18. Two copper wires of length l and $2l$ have radii $2r$ and r respectively. The ratio of the specific resistances is

(A) 1:1 **(B)** 1:2

(C) 2:1 **(D)** 1:3

Q. 19. The magnetic dipole moment of a current loop is independent of

(A) current in the loop. **(B)** area of the loop.

(C) number of turns on the loop. **(D)** magnetic field in which it is lying.

Q. 20. An electron is moving in a circular orbit of radius 0.5 nm with a frequency 5×10^{19} Hz in anti-clockwise direction. The loop current is

(A) 8 A, anti-clockwise **(B)** 8 A, clockwise

(C) 5 A, anti-clockwise **(D)** 5 A, clockwise

Q. 21. A charged 30μF capacitor is connected to a 3 mH inductor. The angular frequency of free oscillation is

(A) 10000×3 rad/s **(B)** $\frac{10000}{3}$ rad/s

(C) $\frac{10000}{3}$ Hz **(D)** None of the above

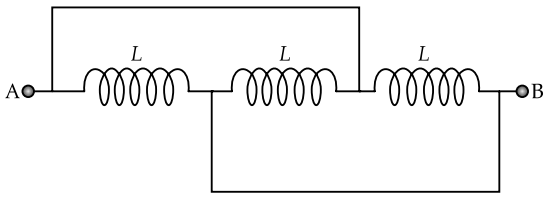
AI **Q. 22.** The inductance between A and B is

(A) L

(B) 3L

(C) L/3

(D) 3/L



AI **Q. 23.** Transformer works on the principle of

(A) Magnetic effect of electric current **(B)** Mutual induction

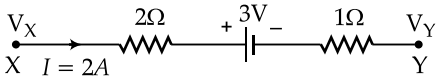
(C) Self induction **(D)** Electrical inertia

Q. 24. Consider the following two statements:
Statement I: Kirchhoff's junction law follows conservation of charge.
Statement II: Kirchhoff's loop law follows conservation of energy.
Which of the followings is true?

(A) Both statements I and II are wrong
(B) Both statements I and II are correct.
(C) Statement I is correct. Statement II is wrong
(D) Statement II is correct. Statement I is wrong.

Q. 25. The potential difference between the points X and Y is

(A) 3V
(B) 6V
(C) 9V
(D) –9V



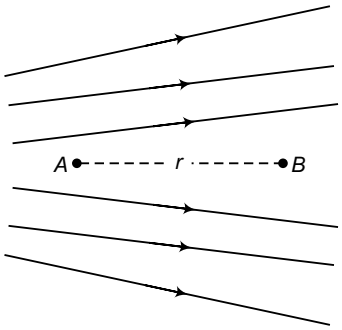
Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. A hollow insulated conducting sphere is given a positive charge of 10 μC. What will be the electric field at the centre of the sphere if its radius is 2 meters :

(A) Zero
(B) $5\ \mu Cm^{-2}$
(C) $20\ \mu Cm^{-2}$
(D) $8\ \mu Cm^{-2}$

AIQ. 27. Figure shows the electric lines of force emerging from a charged body. If the electric field at A and B are E_A and E_B respectively and if the displacement between A and B is r then :



(A) $E_A > E_B$
(B) $E_A < E_B$
(C) $E_A = E_B/r$
(D) $E_A = E_B/r^2$

AIQ. 28. The electric potential at a point on the axis of an electric dipole depends on the distance r of the point from the dipole as :

(A) $\propto 1/r$
(B) $\propto 1/r^2$
(C) $\propto r$
(D) $\propto 1/r^3$

Q. 29. An electric dipole when placed in a uniform electric field E will have minimum potential energy, if the positive direction of dipole moment makes the following angle with E :

(A) π
(B) π/2
(C) Zero
(D) 3π/2

Q. 30. The electrostatic force between the metal plates of an isolated parallel plate capacitor C having a charge Q and area A, is :

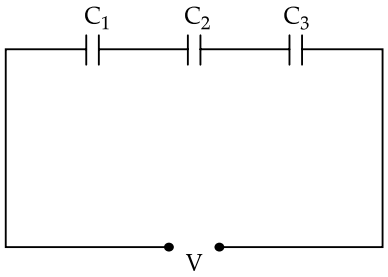
(A) proportional to the square root of the distance between the plates.
(B) linearly proportional to the distance between the plates.
(C) independent of the distance between the plates.
(D) inversely proportional to the distance between the plates.

Q. 31. The capacity of a parallel plate condenser is 10 μF, when the distance between its plates is 8 cm. If the distance between the plates is reduced to 4 cm, then the capacity of this parallel plate condenser will be :

(A) 5 μF **(B)** 10 μF

(C) 20 μF **(D)** 40 μF

Q. 32. In the figure, three capacitors each of capacitance 6 pF are connected in series. The total capacitance of the combination will be :



(A) 9×10^{-12} F

(B) 6×10^{-12} F

(C) 3×10^{-12} F

(D) 2×10^{-12} F

Q. 33. Three capacitors of capacitance 3 μF, 10 μF and 15 μF are connected in series to a voltage source of 100 V. The charge on 15 μF is :

(A) 50 μC **(B)** 100 μC

(C) 200 μC **(D)** 280 μC

Q. 34. The internal resistance of a 2.1 V cell which gives a current of 0.2 A through a resistance of 10 Ω is :

(A) 1.0 Ω **(B)** 0.2 Ω

(C) 0.5 Ω **(D)** 0.8 Ω

Q. 35. The temperature co-efficient of resistance of a wire is 0.00125/^{o}C. At 300 K it's resistance is 1 Ω. The resistance of the wire will be 2 Ω at :

(A) 1154 K **(B)** 1127 K

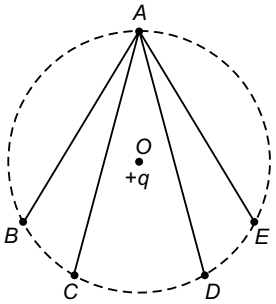
(C) 1100 K **(D)** 1400 K

Q. 36. By ammeter, which of the following can be measured :

(A) electric potential. **(B)** potential difference.

(C) current. **(D)** resistance.

Q. 37. In the electric field of a point charge q, a certain charge is carried from point A to B, C, D and E. Then the work done :



(A) Is least along the path AB

(B) Is least along the path AD

(C) Is zero along all the paths AB, AC, AD and AE

(D) Is least along

Q. 38. A coil of self-inductance L is connected in series with a bulb B and an AC source. Brightness of the bulb decreases when :

(A) an iron rod is inserted in the coil.

(B) frequency of the AC source is decreased.

(C) number of turns in the coil is reduced.

(D) A capacitance of reactance $X_C = X_L$ is included in the same circuit.

Q. 39. An e.m.f. of 5 volt is produced by a self inductance, when the current changes at a steady rate from 3 A to 2 A in 1 millisecond. The value of self inductance is :

(A) Zero **(B)** 5 H

(C) 5000 H **(D)** 5 mH

Q. 40. When the number of turns and the length of the solenoid are doubled keeping the area of cross-section same, the inductance :

(A) Remains the same **(B)** Is halved

(C) Is doubled **(D)** Becomes four times

Q. 41. The self-inductance of a coil is 5 henry, a current of 1 amp change to 2 amp within 5 second through the coil. The value of induced e.m.f. will be :

(A) 10 volt **(B)** 0.10 volt

(C) 1.0 volt **(D)** 100 volt

AI **Q. 42.** The quality factor of LCR circuit having resistance (R) and inductance (L) at resonance frequency (ω) is given by :

(A) $\omega L/R$ **(B)** $R/\omega L$

(C) $(\omega L/R)^{1/2}$ **(D)** $(\omega L/R)^2$

Q. 43. For high frequency, a capacitor offers :

(A) More reactance **(B)** Less reactance

(C) Zero reactance **(D)** Infinite reactance

Q. 44. The phase difference between the current and voltage of LCR circuit in series combination at resonance is :

(A) $0°$ **(B)** $\pi/2$

(C) π **(D)** $-\pi$

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Q. 45. Assertion (A): In a non-uniform electric field, a dipole will have translatory as well as rotatory motion.

Reason (R): In a non-uniform electric field, a dipole experiences a force as well as torque.

Q. 46. Assertion (A): An alternator is a machine which converts mechanical energy into electrical energy.

Reason (R): When a coil rotates in a magnetic field an e.m.f. is induced in it.

Q. 47. Assertion (A): Fuse wire has high resistance and low melting point.

Reason (R): Fuse wire is for small current flow only.

Q. 48. Assertion (A): Magnetic field interacts with a moving charge only.

Reason (R): Moving charge produces a magnetic field.

AI **Q. 49. Assertion(A):** Faraday's laws of electromagnetic induction are consequences of law of conservation of energy.

Reason (R): The parameter LR in a L-R circuit has the dimension of time.

Section-C

Read the following text and answer the questions

AI **Q. 50.** The electric potential at a point (x, y, z) is given by

$V = -xy^2 - xz^3 + 4$

The electric field $\vec{E}$ at that point is

(A) $(2xy + z^3)\hat{i} + x^2\hat{j} + 3xz^2\hat{k}$ **(B)** $z^3\hat{i} + x^2\hat{j} + 3xz^2\hat{k}$

(C) $2xy^3\hat{i} + x^2\hat{j} + 3z^2\hat{k}$ **(D)** $(2xy + z^3)\hat{i} - x^2\hat{j} - 3xz^2\hat{k}$

Q. 51. A potentiometer wire has length of 4 m and resistance 8Ω. The resistance that must be connected in series with the wire and an accumulator of e.m.f. 2V, so as to get a potential gradient 1 mV per cm of the wire is

(A) 32Ω **(B)** 40Ω

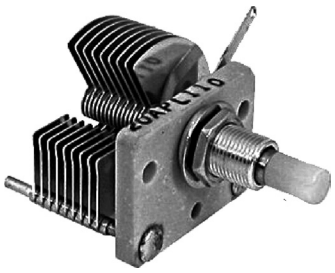
(C) 44Ω **(D)** 48Ω

CASE STUDY

Read the following text and answer the following questions on the basis of the same:

Tuning a radio set: In essence the simplest tuned radio frequency receiver is a simple crystal set. Desired frequency is tuned by a tuned coil / capacitor combination, and then the signal is presented to a simple crystal or diode detector where the amplitude modulated signal, is demodulated. This is then passed straight to the headphones or speaker. In radio set there is an LC oscillator comprising of a variable capacitor (or sometimes a variable coupling coil), with a knob on the front panel to tune the receiver.

Capacitor used in old radio sets is gang capacitor. It consists of two sets of parallel circular plates one of which can rotate manually by means of a knob. The rotation causes overlapping areas of plates to change, thus changing its capacitance. Air gap between plates acts as dielectric.



The capacitor has to be tuned in tandem corresponding to the frequency of a station so that the LC combination of the radio set resonates at the frequency of the desired station.

When capacitive reactance (X_C) is equal to the inductive reactance (X_L), then the resonance occurs and the resonant frequency is given by $\omega_0 = \frac{1}{\sqrt{LC}}$ current amplitude becomes maximum at the resonant frequency. It is important to note that resonance phenomenon is exhibited by a circuit only if both *L* and *C* are present in the circuit. Only then do the voltages across L and C cancel each other (both being out of phase) and the Current amplitude is $\frac{V_m}{R}$, the total source voltage appearing across R.

This means that we cannot have resonance in a RL or RC circuit.

Q. 52. Name the phenomenon involved in tuning a radio set to a particular radio station.

(A) Stabilization **(B)** Rectification

(C) Resonance **(D)** Reflection

AI Q. 53. Resonance may occur in:

(A) RL circuit. **(B)** RC circuit.

(C) LC circuit. **(D)** circuit having resistor only.

AI Q. 54. Resonance frequency is equal to:

(A) $\frac{1}{LC}$ **(B)** $1/\sqrt{LC}$

(C) $\sqrt{\frac{L}{C}}$ **(D)** $\sqrt{\frac{C}{L}}$

Q. 55. Resonance occurs only when:

(A) $X_C = R$ **(B)** $X_L = R$

(C) $X_L = X_C$ **(D)** $X_C > X_L$

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: A

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: ⒶⒷⒸⒹ

Roll Number: 0 1 2 3 4 5 6 7 8 9

Name

Subject

Test Date

Student's Signature

Invigilator's Signature

Certified that all the entries In this section have been properly filled by the student

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: 0 1 2 3 4 5 6 7 8 9

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Self Assessment Paper 5

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

AI **Q. 1.** For alternating current magnitude of r.m.s. value is

(A) Greater than peak value **(B)** Smaller than peak value

(C) Equal to peak value **(D)** No way related with peak value

Q. 2. In an a.c. circuit, average power supplied to an inductor over one complete cycle is

(A) 0 **(B)** ∞

(C) Depends on the value of inductance **(D)** Depends on the value of angular frequency

Q. 3. In an a.c. circuit when the capacitor is fully charged, the current in the circuit

(A) Maximum **(B)** Minimum but not zero

(C) Zero **(D)** Depends on the capacitance value

Q. 4. In a LCR series ac circuit, the voltage across each of the component L,C and R is 120 V. The voltage across the LC combination will be

(A) 120 V **(B)** 60 V

(C) 240 V **(D)** 0 V

Q. 5. LC oscillations is not realistic

(A) since every inductor has some resistance.

(B) Energy is radiated away from the system in the form of electromagnetic waves

(C) Both (A) and (B)

(D) Neither (A) nor (B)

Q. 6. In actual transformers, which of the followings does not cause energy loss?

(A) Flux leakage **(B)** Eddy current

(C) Mutual induction **(D)** Winding resistance

Q. 7. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled then the outward electrical flux will

(A) Remains same **(B)** Increase 4 times

(C) Reduced to half **(D)** Be doubled

Q. 8. The electric potential V at any point (x, y, z) in space is given by $V = 4x^2$ volt. The electric field at the point (1, 0, 2) is

(A) 16 V/m along positive X-axis **(B)** 16 V/m along negative X-axis

(C) 8 V/m along positive X-axis **(D)** 8 V/m along negative X-axis

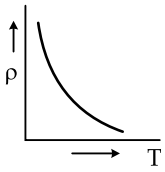
Q. 9. A electric dipole of moment p is placed in an electric field of intensity E. The dipole acquires a position such that the axis of the dipole makes an angle θ with the direction of the field. Assuming that the potential energy of the dipole t be zero when $\theta = 90°$, the torque and the potential energy of the dipole will be respectively

(A) pE cos θ, –pE sin θ **(B)** pE sin θ, pE cos θ

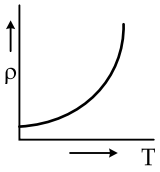
(C) pE sin θ, –pE cos θ **(D)** pE sin θ, –pE cos θ

AI **Q. 10.** Which of the following graphs represents he variation of resistivity with temperature for a metal?

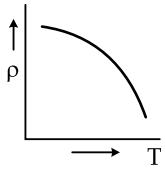
(A)



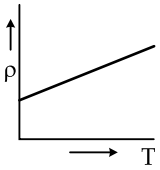
(B)



(C)



(D)



Q. 11. When a cell is connected to a 2 Ω resistor, 0.9 A current flows. If the same cell is connected to 7 Ω resistor, 0.3 A current flows. The internal resistance of the cell is

(A) 1 Ω **(B)** 0.5 Ω

(C) 1.5 Ω **(D)** 0.05 Ω

AI **Q. 12.** The amount of electric charge passing through a cross-section of wire in time t is

$$Q(t) = at^2 + bt$$

where a and b are constants having value 3 and 4 respectively. Calculate the value of electric current at $t = 4$ seconds.

(A) 27 A **(B)** 28 A

(C) 29 A **(D)** 30 A

Q. 13. When short-circuited, the terminal potential difference of a cell of e.m.f. E is

(A) 0 **(B)** E

(C) E/2 **(D)** E/2

Q. 14. When cells are connected in parallel

(A) e.m.f. increases **(B)** e.m.f. decreases

(C) Current decreases **(D)** Current increases

Q. 15. A wire loop is rotated in a magnetic field. The frequency of change in direction of induced e.m.f. is

(A) 4 **(B)** 2

(C) 1 **(D)** 0

Q. 16. The capacity of parallel plate condenser depends on :

(A) The type of metal used **(B)** The thickness of plates

(C) The potential applied across the plates **(D)** The separation between the plates

Q. 17. The energy stored in a condenser of capacity C which has been raised to a potential V is given by :

(A) (1/2)CV **(B)** $(1/2)CV^2$

(C) CV **(D)** (1/2)VC

Q. 18. The capacity of a parallel plate condenser is C. Its capacity when the separation between the plates is halved will be :

(A) 4C **(B)** 2C

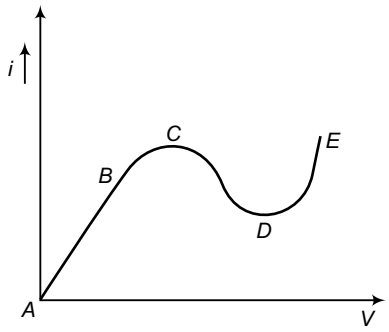
(C) C/2 **(D)** C/4

Q. 19. Three capacitors of capacitances 3μF, 9μF and 18μF are connected once in series and another time in parallel. The ratio of equivalent capacitance in the two cases (C_s/C_P) will be :

(A) 1 : 15 **(B)** 15 : 1

(C) 1 : 1 **(D)** 1 : 3

Q. 20. From the graph between current I & voltage V shown, identify the portion corresponding to negative resistance :



(A) DE

(B) CD

(C) BC

(D) AB

Q. 21. The internal resistance of a cell of emf 2V is 0.1 Ω. It's connected to a resistance of 3.9 Ω. The voltage across the cell will be :

(A) 0.5 volt **(B)** 1.9 volt

(C) 1.95 volt **(D)** 2 volt

AI **Q. 22.** The resistance of an ideal voltmeter is :

(A) Zero **(B)** Very low

(C) Very large **(D)** Infinite

Q. 23. The magnetic field at a distance R from a long wire carrying current I is 0.4 Tesla. The magnetic field at a distance 2R is :

(A) 0.2 Tesla **(B)** 0.8 Tesla

(C) 0.1 Tesla **(D)** 1.6 Tesla

Q. 24. In an ac circuit of capacitance, the current from potential is :

(A) Forward **(B)** Backward

(C) Both are in the same phase **(D)** None of these

AIQ. 25. In an a.c. circuit the e.m.f. (E) and the current (I) at any instant are given respectively by $E = E_0 \sin \omega T$, $I = I_0 \sin(\omega T - \phi)$. The average power in the circuit over one cycle of a.c. is :

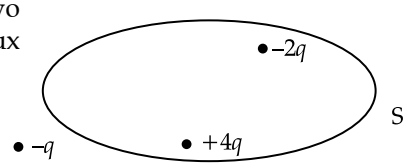
(A) $E_0 I_0$ **(B)** $E_0 I_0/2$

(C) $(E_0 I_0/2) \sin \phi$ **(D)** $(E_0 I_0/2) \cos \phi$

Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. In the given figure shows point charges + $4q$, $-2q$ and $-q$. Two charges are enclosed within the surface S. What is the electric flux due to configuration through the surface S?



(A) $\phi = 2q/\varepsilon_0$ **(B)** $\phi = q/\varepsilon_0$

(C) $\phi = -q/\varepsilon_0$ **(D)** ϕ

Q. 27. A point charge $+q$, is placed at a distance D from an isolated conducting plane. The field at a point P on the other side of the plane is

(A) directed perpendicular to the plane and away from the plane.

(B) directed perpendicular to the plane but towards the plane.

(C) directed radially away from the point charge.

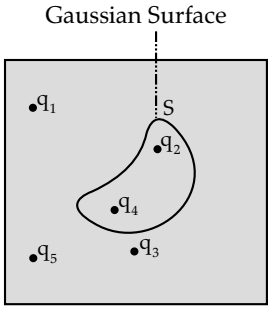
(D) directed radially towards the point charge.

Q. 28. A hemisphere is uniformly charged positively. The electric field at a point on a diameter away from the centre is directed

(A) perpendicular to the diameter. **(B)** parallel to the diameter.

(C) at an angle tilted towards the diameter. **(D)** at an angle tilted away from the diameter.

AIQ. 29. Five charges q_1, q_2, q_3, q_4, and q_5 are fixed at their positions as shown in Figure. S is a Gaussian surface. The Gauss's law is given by:



$$\oint_S \mathrm{E}.ds = \frac{q}{\varepsilon_0}$$

Which of the following statements is correct?

(A) E on the LHS of the above equation will have a contribution from q_1, q_5 and q_3 while q on the RHS will have a contribution from q_2 and q_4 only.

(B) E on the LHS of the above equation will have a contribution from all charges while q on the RHS will have a contribution from q_2 and q_4 only.

(C) E on the LHS of the above equation will have a contribution from all charges while q on the RHS will have a contribution from q_1, q_3 and q_5 only.

(D) Both E on the LHS and q on the RHS will have contributions from q_2 and q_4 only.

Q. 30. What is the value of potential inside a hollow spherical charged conductor

(A) Constant **(B)** Same as on its surface

(C) Both (A) and (B) **(D)** None of the above

Q. 31. A positively charged particle is released from rest in an uniform electric field. The electric potential energy of the charge

(A) remains a constant because the electric field is uniform.

(B) increases because the charge moves along the electric field.

(C) decreases because the charge moves along the electric field.

(D) decreases because the charge moves opposite to the electric field.

Q. 32. Calculate the amount of work done in turning an electric dipole of dipole moment 4×10^{-6} cm from its position of unstable equilibrium to the position of stable equilibrium, in a uniform electric field of intensity 10^{-2} NC^{-1}.

(A) $-(4 \times 10^{-8})$ J **(B)** $-(8 \times 10^{-8})$ J

(C) (8×10^{-8}) J **(D)** (4×10^{-8}) J

Q. 33. Two cells of EMFs 1 volt and 1.5 volt having internal resistance of 0.1 Ω and 0.2 Ω respectively are connected in parallel. Calculate the EMF and the internal resistance of the equivalent cells.

(A) 1.17 V **(B)** 1.20 V

(C) 1.10 V **(D)** 1.00 V

AI Q. 34. 7 drops each having the capacity C and potential V are combined to form a big drop. If the charge on the small drop is q, then the net charge on the big drop will be

(A) 3.5 q **(B)** 7q

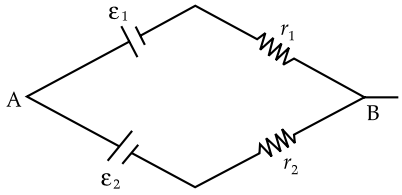
(C) 14 q **(D)** 4q

Q. 35. When an electron is projected along the axis of the same circular conductor carrying the same current. Electron will experience.

(A) A force along the axis **(B)** No force experienced

(C) A force perpendicular to the axis **(D)** None of these

Q. 36. Two batteries of emf ε_1 and ε_2 ($\varepsilon_2 > \varepsilon_1$) and internal resistances r_1 and r_2 respectively are connected in parallel as shown in figure :



(A) The equivalent emf ε_{eq} of the two cells is between ε_1 and ε_2, i.e. $\varepsilon_1 < \varepsilon_{eq} < \varepsilon_2$.

(B) The equivalent emf ε_{eq} is smaller than ε_1.

(C) The ε_{eq} is given by $\varepsilon_{eq} = \varepsilon_1 + \varepsilon_2$ always.

(D) ε_{eq} is independent of internal resistances r_1 and r_2.

Q. 37. A resistance R is to be measured using a meter bridge. Student chooses the standard resistance S to be 100 Ω. He finds the null point at $l_1 = 2.9$ cm. He is told to attempt to improve the accuracy. Which of the following is a useful way?

(A) He should measure l_1 more accurately.

(B) He should change S to 1000 Ω and repeat the experiment.

(C) He should change S to 3 Ω and repeat the experiment.

(D) He should give up hope of a more accurate measurement with a meter bridge.

Q. 38. Two resistances are connected in two gaps of Meter Bridge. The balance is 10 cm from the zero end. A resistance of 20 Ω is connected in series with the smaller of the two. The null point shifts to 20 cm. What is the value of the bigger resistance?

(A) 89 Ω **(B)** 144 Ω

(C) 100 Ω **(D)** None of the above

Q. 39. A current carrying circular loop of radius R is placed in the x-y plane with centre at the origin. Half of the loop with $x > 0$ is now bent so that it now lies in the y-z plane.

(A) The magnitude of magnetic moment now diminishes.

(B) The magnetic moment does not change.

(C) The magnitude of B at (0,0,z), $z >> R$ increases.

(D) The magnitude of B at (0,0,z), $z >> R$ is unchanged.

Q. 40. A magnetic needle lying parallel to the magnetic field requires w unit of work to turn it through 60°. Find the value of torque needed to maintain the needle in this position.

(A) W ($\sqrt{3}$/2) **(B)** W/2

(C) W $\sqrt{3}$ **(D)** 3W/2

AI **Q. 41.** An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true?

(A) The electron will be accelerated along the axis.

(B) The electron path will be circular about the axis.

(C) The electron will experience a force at 45° to the axis and hence execute a helical path.

(D) The electron will continue to move with uniform velocity along the axis of the solenoid.

Q. 42. Consider the two idealized systems : (i) a parallel plate capacitor with large plates and small separation and (ii) a long solenoid of length $L >> R$, radius of cross-section. In (i) E is ideally treated as a constant between plates and zero outside. In (ii) magnetic field is constant inside the solenoid and zero outside. These idealized assumptions, however, contradict fundamental laws as below :

(A) case (i) contradicts Gauss's law for electrostatic fields.

(B) case (ii) contradicts Gauss's law for magnetic fields.

(C) case (i) agrees with $\oint_s E.dl = 0$

(D) case (ii) contradicts $\oint H.dl = I_{en}$

Q. 43. The magnetic field of Earth can be modelled by that of a point dipole placed at the centre of the Earth. The dipole axis makes an angle of 11.3° with the axis of Earth. At Mumbai, declination is nearly zero. Then,

(A) the declination varies between 11.3° W to 11.3° E.

(B) the least declination is 0°.

(C) the plane defined by dipole axis and Earth axis passes through Greenwich.

(D) declination averaged over Earth must be always negative.

Q. 44. Consider a metre bridge whose length of wire is 2 m. A resistance of 10 Ω is connected across one gap of the meter bridge and an unknown resistance is connected across the other gap. When the resistances are interchanged, the balance point shifts by 50 cm. What is the value of the unknown resistance?

(A) 250 Ω **(B)** 10 Ω

(C) 16.7 Ω **(D)** None of the above

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Q. 45. Assertion (A): Magnetic field interacts with a moving charge only.

Reason (R): Moving charge produces a magnetic field.

Q. 46. Assertion (A): Compass needle points the magnetic north-south direction.

Reason (R): The magnetic meridian of the earth merges with the axis of rotation of earth.

Q. 47. Assertion (A): When two identical loops of copper and aluminium are rotated with same speed in the same magnetic field, the induced e.m.f. will be same.

Reason (R): Resistance of the two loops are equal.

Q. 48. Assertion (A): Mutual inductance becomes maximum when coils are wound on each other.

Reason (R): Mutual inductance is independent of orientation of coils.

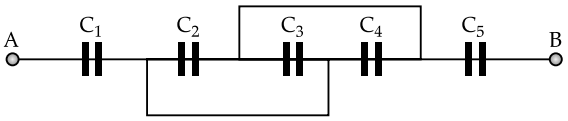
Q. 49. Assertion (A): Both *ac* and *dc* can be measured by hot wire instrument.

Reason (R): Hot wire instrument is based on the principal of magnetic effect of current.

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

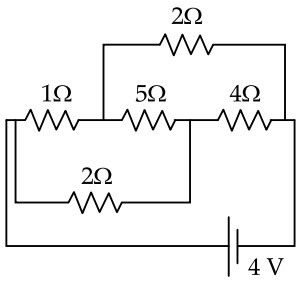
Q. 50. The equivalent capacitance between A and B in the given combination of 5 capacitors (each 2μF) is



(A) 7/6 μF **(B)** 6/7 μF

(C) 10 μF **(D)** 2 μF

Q. 51. Current drawn from the battery by the network of resistors is



(A) 2A

(B) 0.5A

(C) 4A

(D) 0

CASE STUDY

Read the following text and answer the following questions on the basis of the same:

Losses of transformer

There are 4 types of losses in a transformer: Core loss, Ohmic loss, Stray load loss and dielectric loss.

(1) Core loss

Core loss has two components - hysteresis loss and eddy current loss. These together are called no-load losses of a transformer and are calculated by open circuit test.

(A) Hysteresis loss: This loss mainly depends on the core material used in the transformer. To reduce this loss, the high-grade core material can be used. CRGO- Cold rolled grain oriented Si steel is commonly used for this purpose.

(B) Eddy current loss: This loss can be reduced by designing the core using slight laminations.

These losses are present even when no load is connected. So, these are also known as no-load loss.

(2) Copper Loss

Copper losses occur because of the Ohmic resistance in the windings of the transformer. If the currents in primary and secondary windings of the transformer are I_1 and I_2, and if the resistances of these windings are R_1 & R_2 then the copper losses that occurred in the windings are $I_1^2R_1$ & $I_2^2R_2$ respectively. So, the entire copper loss will be $I_1^2R_1 + I_2^2R_2$.

This loss is also called variable or ohmic losses because this loss changes based on the load.

(3) Stray Loss

These types of losses in a transformer occur because of the occurrence of the leakage flux. As compared with copper and iron losses, the percentage of stray losses are less, so these losses can be neglected.

(4) Dielectric Loss

This loss mainly occurs within the oil of the transformer. Oil is an insulating material. Once the oil quality in the transformer deteriorates then the transformer's efficiency is affected.

Efficiency of Transformer

It is the ratio of output power and input power.

Efficiency = Output Power / Input Power.

The transformer is a highly efficient device which ranges between 95% – 98.5%.

Q. 52. What is the relationship among core loss, hysteresis loss and eddy current loss?

(A) Eddy current loss = Core loss + Hysteresis loss

(B) Core loss = Hysteresis loss + eddy current loss

(C) Hysteresis loss = Core loss + eddy current loss

(D) Core loss = Hysteresis loss X eddy current loss

Q. 53. Which of the following losses in transformer is also known as no-load loss?

(A) Copper loss **(B)** Stray loss

(C) Dielectric loss **(D)** Core loss

Q. 54. Which of the following losses in transformer is also known as variable loss?

(A) Copper loss **(B)** Stray loss

(C) Dielectric loss **(D)** Core loss

Q. 55. How hysteresis loss can be reduced?

(A) Using core of Si Steel **(B)** Using laminated core

(C) Using core of non-ferromagnetic material **(D)** Using oil of higher dielectric constant

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: **A**

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: Ⓐ Ⓑ Ⓒ Ⓓ

Roll Number: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Name

Test Date

Invigilator's Signature

Student's Signature

Certified that all the entries In this section have been properly filled by the student

Subject

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Sample Question Papers

Self Assessment Paper 6

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. The magnitude of electric force, F is

(A) directly proportional to the multiplication of both charges.

(B) directly proportional to the distance between both charges.

(C) directly proportional to the square of the distance between both charges.

(D) constant.

Q. 2. A body is negatively charged means

(A) it has only negative charges.

(B) positive charges have been neutralized by negative charges.

(C) the quantity of negative charge present is more than the quantity positive charge present.

(D) the positive are displaced from their original positions.

Q. 3. When a body is charged by conduction, its mass

(A) remains same. **(B)** increases.

(C) decreases. **(D)** increase or decrease.

AI **Q. 4.** The electric potential at a point on the equatorial line of a electric dipole is

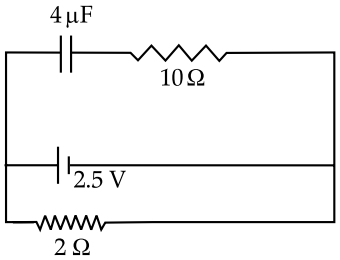
(A) directly proportional to the square of the distance.

(B) indirectly proportional to the square of the distance.

(C) directly proportional to the charge.

(D) None of the above

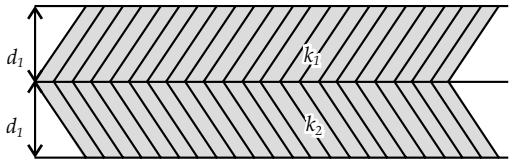
Q. 5. A capacitor of 4 μF is connected as shown in the circuit Figure. The internal resistance of the battery is 0.5 Ω. The amount of charge on the capacitor plates will be :



(A) 0 μC **(B)** 4 μC

(C) 16 μC **(D)** 8 μC

AI **Q. 6.** A parallel plate capacitor is made of two dielectric blocks in series. One of the blocks has thickness d_1 and dielectric constant k_1 and the other has thickness d_2 and dielectric constant k_2 as shown in Figure. This arrangement can be thought as a dielectric slab of thickness d ($= d_1+d_2$) and effective dielectric constant k. The k is :



(A) $\dfrac{k_1d_1+k_2d_2}{d_1+d_2}$ **(B)** $\dfrac{k_1d_1+k_2d_2}{k_1+k_2}$

(C) $\dfrac{k_1k_2(d_1+d_2)}{(k_1d_1+k_2d_2)}$ **(D)** $\dfrac{2k_1k_2}{k_1+k_2}$

Q. 7. In a metre bridge, what is the effect on null deflection of galvanometer, when the radius of the meter bridge wire is doubled?

(A) There will be no change **(B)** Null point will shift to $L_1/2$ point

(C) Null point will shift to $2L_1$ point **(D)** Null point will not be available

Q. 8. Consider a metre bridge whose length of wire is 2 m. A resistance of 10 Ω is connected across one gap of the meter bridge and an unknown resistance is connected across the other gap. When these resistances are interchanged, the balance point shifts by 50 cm. What is the value of the unknown resistance?

(A) 250 Ω **(B)** 10 Ω

(C) 16.7 Ω **(D)** None of the above

Q. 9. A length L of wire carries a steady current I. It is bent first to form a circular plane coil of one turn. A current I flowing through it produces a magnetic field B at the centre of the coil. The same length is now bent more sharply to form a double loop of smaller radius. The magnetic field at the centre caused by the same current is

(A) B **(B)** 2B

(C) 4B **(D)** B/2

Q. 10. A straight conductor carries a current from south to north. Point P and Q lie to the east and west of it at the same distance. The magnetic field at P is

(A) equal to magnetic field at Q.

(B) smaller than the magnetic field at Q.

(C) greater than the magnetic field at Q.

(D) cannot be predicted unless the value if I is known.

AI **Q. 11.** Magnetic field due to a straight solenoid at any point inside it is $B = \mu_0 ni$. Magnetic field at the end of the solenoid is

(A) B **(B)** B/2

(C) 2B **(D)** B/4

Q. 12. At any point, empty space surrounded by a toroid, the magnetic field is B_1. At any point, outside the toroid, the magnetic field is B_2.

(A) $B_1 > B_2$ **(B)** $B_2 > B_1$

(C) $B_1 = B_2$ **(D)** $B_1 = B_2 = 0$

Q. 13. Ratio of total intensity of magnetic field at equator to poles is

(A) 1 : 2 **(B)** 1 : 2

(C) 2 : 1 **(D)** None of the above

Q. 14. Let the magnetic field on Earth be modelled by that of a point magnetic dipole at the centre of Earth. The angle of dip at a point on the geographical equator

(A) is always zero. **(B)** is always positive.

(C) is always negative. **(D)** can be positive or negative or zero.

Q. 15. Relative permeability of a magnetic material is 0.5. The material is

(A) diamagnetic. **(B)** ferromagnetic.

(C) paramagnetic. **(D)** not a magnetic material.

AI **Q. 16.** Which of the following relation is correct?

(A) $B = B_V \times B_H$ **(B)** $B = B_V / B_H$

(C) $B = B_V + B_H$ **(D)** $B = \sqrt{B_V^2 + B_H^2}$

Q. 17. Two identical capacitors are joined in parallel, charged to a potential V and then separated and then connected in series i.e. the positive plate of one is connected to negative of the other :

(A) The charges on the free plates connected together are destroyed.

(B) The charges on the free plates are enhanced.

(C) The energy stored in the system increases.

(D) The potential difference in the free plates becomes 2V.

Q. 18. Which one of the following statements is wrong?

(A) Eddy currents are produced in a steady magnetic field.

(B) Eddy current is used to produce braking force in moving trains.

(C) Eddy currents is minimized by using laminated core.

(D) Induction furnace uses eddy current to produce heat.

Q. 19. With increase in frequency of an A.C. supply, the impedance of a series L-C-R circuit

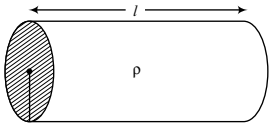
(A) remains constant.

(B) increases.

(C) decreases.

(D) decreases at first, becomes minimum and then increases.

Q. 20. An electric cable contains a single copper wire of radius 9 mm. It's resistance is 5 Ω. This cable is replaced by six insulated copper wires, each of radius 3 mm. The resultant resistance of cable will be :



(A) 7.5 Ω **(B)** 45 Ω

(C) 90 Ω **(D)** 270 Ω

Q. 21. An electric dipole is placed at an angle of 30° with an electric field intensity 2.0×10^5 N/C. It experiences a torque equal to 4 N m. The charge on the dipole, if the dipole length is 2 cm, is :

(A) 8 mC **(B)** 2 mC

(C) 5 mC **(D)** 7 μC

Q. 22. The electric field in a certain region is acting radially outward and is given by $E = Aa$. A charge contained in a sphere of radius *'a'* centred at the origin of the field, will be given by :

(A) $4\pi\varepsilon_o A a^3$ **(B)** $\varepsilon_o A a^3$

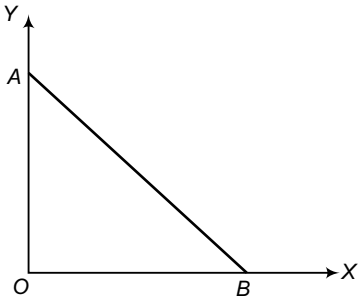
(C) $4\pi\varepsilon_o A a$ **(D)** $A\varepsilon_o a^2$

AI **Q. 23.** A charge Q is enclosed by a Gaussian spherical surface of radius *R*. If the radius is doubled, then the outward electric flux will :

(A) increase four times **(B)** be reduced to half

(C) remain the same **(D)** be doubled

Q. 24. As per this diagram a point charge $+q$ is placed at the origin O. Work done in taking another point charge $-Q$ from the point A [co-ordinates $(0, a)$] to another point B [co-ordinates $(\mathbf{a}, 0)$] along the straight path AB is :



(A) Zero

(B) $(-qQ/4\pi\varepsilon_0 \times 1/a^2)\sqrt{2a}]$

(C) $(qQ/4\pi\varepsilon_0 \times 1/a^2)a/\sqrt{2}$

(D) $(qQ/4\pi\varepsilon_0 \times 1/a^2)\sqrt{2a}$

Q. 25. A, B and C are three points in a uniform electric field. The electric potential is :



(A) Same at all the three points A, B and C **(B)** Maximum at A

(C) Maximum at B **(D)** Maximum at C

Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. A parallel plate capacitor has a uniform electric field E in the space between the plates. If the distance between the plates is *d* and area of each plate is A, the energy stored in the capacitor is :

(A) E^2Ad/ε_0 **(B)** $(1/2)\ \varepsilon_0E^2Ad$

(C) ε_0EAd **(D)** $(1/2)\ \varepsilon_0E^2$

Q. 27. In a potentiometer of 5 wires, the balance point is obtained on the 3rd wire. To shift the balance point to the 4th wire,

(A) current of the main circuit is to be decreased. **(B)** current of the main circuit is to be increased.

(C) the shifting is not possible **(D)** None of the above

Q. 28. The electric potential at a point in free space due to a charge Q coulomb is $Q \times 10^{11}$ volts. The electric field at that point is :

(A) $12\pi\varepsilon_0\ Q \times 10^{22}$ volt/m **(B)** $4\pi\varepsilon_0\ Q \times 10^{22}$ volt/m

(C) $12\pi\varepsilon_0\ Q \times 10^{20}$ volt/m **(D)** $4\pi\varepsilon_0\ Q \times 10^{20}$ volt/m

Q. 29. Three capacitors each of capacity 4μF are to be connected in such a way that the effective capacitance is 6μF. This can be done by :

(A) Connecting them in parallel

(B) Connecting two in series and one in parallel

(C) Connecting two in parallel and one in series

(D) Connecting all of them in series

Q. 30. A capacitor of capacity C_1 is charged upto V volt and then connected to an uncharged capacitor of capacity C_2. Then final potential difference across each will be :

(A) $C_2V/(C_1+C_2)$ **(B)** $(1+C_2/C_1) \times V$

(C) $C_1V/(C_1+C_2)$ **(D)** $(1-C_2/C_1) \times V$

Q. 31. The resistance of a wire is 'R' ohm. If it is melted and stretched to 'n' times its original length, its new resistance will be:

(A) R/n **(B)** n^2R

(C) R/n^2 **(D)** nR

AI **Q. 32.** A potentiometer is an accurate and versatile device to make electrical measurements of E.M.F. because the method involves:

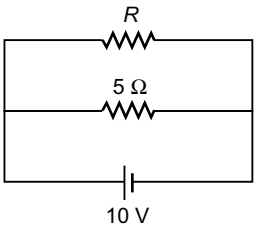
(A) potential gradients

(B) a condition of no current flow through the galvanometer

(C) a combination of cells, galvanometer and resistances

(D) cells

Q. 33. The power dissipated in the circuit shown in the figure is 30 Watts. The value of R is:



(A) 15 Ω **(B)** 10 Ω

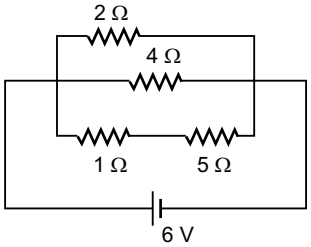
(C) 30 Ω **(D)** 20 Ω

Q. 34. A wire of a certain material is stretched slowly by ten percent. It new resistance and specific resistance become respectively :

(A) 1.1 times, 1.1 times **(B)** 1.2 times, 1.1 times

(C) 1.21 times, same **(D)** Both remain the same

AI **Q. 35.** A current of 3 amp. flows through the 2 Ω resistor shown in the circuit. The power dissipated in the 5 Ω resistor is :



(A) 5 watt **(B)** 4 watt

(C) 2 watt **(D)** 1 watt

Q. 36. A galvanometer has a coil of resistance 100 ohm and gives a full scale deflection for 30 mA current. If it is to work as a voltmeter of 30 volt range, the resistance required to be added will be :

(A) 900 Ω **(B)** 1800 Ω

(C) 500 Ω **(D)** 1000 Ω

Q. 37. A galvanometer having a coil resistance of 60 Ω shows full scale deflection when a current of 1.0 A passes through it. It can be converted into an ammeter to read currents upto 5.0 A by :

(A) putting in series a resistance of 15 Ω **(B)** putting in series a resistance of 240 Ω

(C) putting in parallel a resistance of 15 Ω **(D)** putting in parallel a resistance of 240 Ω

AI **Q. 38.** An electron is moving in a circular path under the influence of a transverse magnetic field of 3.57×10^{-2} T. If the value of e/m is 1.76×10^{11} C/kg, frequency of revolution of the electron is :

(A) 1 GHz **(B)** 100 MHz

(C) 62.8 MHz **(D)** 6.28 MHz

Q. 39. A beam of electrons is moving with constant velocity in a region having simultaneous perpendicular electric and magnetic fields of strength 20 V/m and 0.5 T respectively at right angles to the direction of motion of the electrons. Then the velocity of electrons must be :

(A) 8 m/s **(B)** 20 m/s

(C) 40 m/s **(D)** 1/40 m/s

Q. 40. A charged particle (charge q) is moving in a circle of radius R with uniform speed v. The associated magnetic moment μ is given by :

(A) qvR **(B)** qvR/2

(C) qvR^2 **(D)** qvR^2/2

Q. 41. An iron rod of length L and magnetic moment M is bent in the form of a semicircle. Now its magnetic moment will be :

(A) M **(B)** $2M/\pi$

(C) M/π **(D)** $M\pi$

AI **Q. 42.** Unit of magnetic flux density (or magnetic induction) is :

(A) Tesla **(B)** Weber/metre^2

(C) Newton/ampere-metre **(D)** All of the above

Q. 43. A magnet of magnetic moment M and pole strength m is divided in two equal parts, then magnetic moment of each part will be :

(A) M **(B)** M/2

(C) M/4 **(D)** 2M

Q. 44. Two coils of self inductances 2 mH and 8 mH are placed so close together that the effective flux in one coil is completely linked with the other. The mutual inductance between these coils is :

(A) 10 mH **(B)** 6 mH

(C) 4 mH **(D)** 16 mH

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

AI **Q. 45. Assertion (A):** When bodies are charged through friction, there is transfer of charge from one body to another. No charge is created or destroyed.

Reason (R): This is according to the law of conservation of electric charge.

Q. 46. Assertion (A): If two spherical conductors of different radii have the same surface charge densities, then their electric field intensities will be equal.

Reason (R): Surface charge density $= \dfrac{\text{Total charge}}{\text{area}}$

Q. 47. Assertion (A): A high resistance is connected in series with the galvanometer of meter bridge.

Reason (R): As resistance increases, the current also increases.

Q. 48. Assertion (A): A direct current flowing through a metallic rod produces magnetic field both inside and outside of the rod.

Reason (R): There is no flow of charge carrier inside the rod.

AI **Q. 49. Assertion (A):** Gauss theorem is not applicable in magnetism.

Reason (R): Magnetic monopole does not exist.

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

Q. 50. A 220 volt input is supplied to a transformer. The output circuit draws a current of 2.0 ampere at 440 volts. If the efficiency of the transformer is 80% the current drawn by the primary windings of the transformer is :

(A) 3.6 ampere **(B)** 2.8 ampere

(C) 2.5 ampere **(D)** 5.0 ampere

Q. 51. What is the value of inductance L for which the current is a maximum in a series LCR circuit with $C = 10\ \mu F$ and $\omega = 1000/s$?

(A) 10 mH **(B)** 100 mH

(C) 1 mH **(D)** cannot be calculated unless R is known

Case Study

Read the following text and answer the following questions on the basis of the same:

Types of resistors

Most common type of resistor is Carbon Composition Resistors. Carbon resistors are a cheap, general purpose resistor used in electrical and electronic circuits. Their resistive element is manufactured from a mixture of finely ground carbon dust or graphite and a non-conducting ceramic powder to bind it all together.

The ratio of carbon dust to ceramic (conductor to insulator) determines the resistive value of the resistor. Higher the ratio of carbon, lower the overall resistance.

Film Type Resistors consist of Metal Film, Carbon Film and Metal Oxide Film .Such resistors are generally made by depositing pure metals, such as nickel, or an oxide film, such as tin-oxide, on an insulating ceramic rod or substrate.

The resistive value of the resistor is controlled by increasing the desired thickness of the deposited film giving them the names of either "thick-film resistors" or "thin-film resistors".

Film type resistors can achieve much higher ohmic value compared to other types.

Another type of resistor, called a Wirewound Resistor, is made by winding a thin metal alloy wire (Nichrome) or similar wire on an insulating ceramic former in the form of a spiral helix.

These types of resistors are generally only available in very low ohmic value with high precision .

They are able to handle much higher electrical currents than other resistors of the same ohmic value with much excessive power ratings. These high power resistors are moulded into an aluminium heat sink body with fins attached to increase their overall surface area to promote heat loss and cooling.

Q. 52. Carbon composition resistors are made from a mixture of

(A) finely ground metal dust and ceramic powder.

(B) finely ground carbon dust or graphite and ceramic powder.

(C) finely ground carbon dust or graphite and copper powder.

(D) finely ground carbon dust or graphite.

Q. 53. In carbon composition resistors, _____ the ratio of carbon, _____ the overall resistance.

(A) Higher, lower **(B)** Lower, higher

(C) Lower, lower **(D)** Higher, higher

Q. 54. Metal Film Type Resistors are generally made by depositing pure _____, on _____ rod or substrate.

(A) Ceramic, metal **(B)** Carbon, ceramic

(C) Metal, ceramic **(D)** Carbon, metal

Q. 55. Wirewound Resistors are made by winding a thin _____ or similar wire on an ____ former in the form of a spiral helix.

(A) Nichrome, copper **(B)** Nichrome, ceramic

(C) Copper, ceramic **(D)** Copper, Nichrome

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: **A**

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: Ⓐ Ⓑ Ⓒ Ⓓ

Roll Number: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Name

Test Date

Invigilator's Signature

Student's Signature

Certified that all the entries in this section have been properly filled by the student

Subject

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Sample Question Papers

Self Assessment Paper 7

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

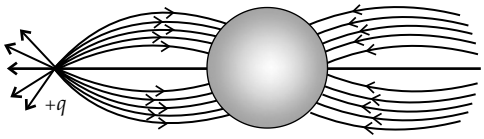
6. There is no negative marking.

Section-A

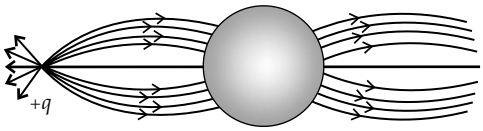
This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. A point positive charge is brought near an isolated conducting sphere in Figure. The electric field is best given by :

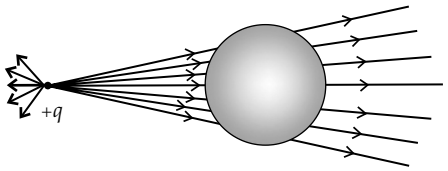
(i)



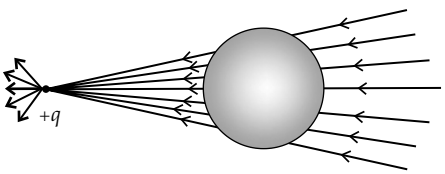
(ii)



(iii)



(iv)



(A) Fig (i)
(B) Fig (iii)
(C) Fig (ii)
(D) Fig (iv)

AI **Q. 2.** In a potentiometer of 5 wires, the balance point is obtained on the 3rd wire. To shift the balance point to the 4th wire,

(A) current of the main circuit is to be decreased.

(B) current of the main circuit is to be increased.

(C) the shifting is not possible

(D) None of the above

AI **Q. 3.** At resonance, the impedance in series LCR circuit is

(A) maximum. **(B)** zero.

(C) infinity. **(D)** minimum.

Q. 4. In a LCR circuit having L = 8.0 henry, C = 0.5 μF and R = 100 ohm in series. The resonance frequency in per second is :

(A) 600 radian **(B)** 600 Hz

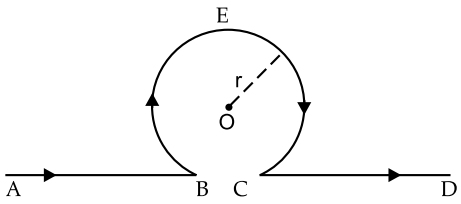
(C) 500 radian **(D)** 500 Hz

AI **Q. 5.** Ratio of total intensity of magnetic field at equator to poles is

(A) 1 : 1 **(B)** 1 : 2

(C) 2 : 1 **(D)** None of the above

AI **Q. 6.** An infinitely long straight conductor is bent into the shape as shown in the figure. Current in it is i and the radius of the circular loop is r. The magnetic field at its centre is



(A) Zero **(B)** Infinite

(C) $\frac{\mu_0 i}{2\pi r}(\pi - 1)$ **(D)** $\frac{\mu_0 i}{2\pi r}(\pi + 1)$

AI **Q. 7.** A point charge $+q$, is placed at a distance d from an isolated conducting plane. The field at a point P on the other side of the plane is

(A) directed perpendicular to the plane and away from the plane.

(B) directed perpendicular to the plane but towards the plane.

(C) directed radially away from the point charge.

(D) directed radially towards the point charge.

Q. 8. The power factor of series LCR circuit at resonance is

(A) 0.707 **(B)** 1

(C) 0.5 **(D)** 0

Q. 9. The strength of the magnetic field at distance r from a long straight current carrying wire is B. The field at a distance $r/2$ will be

(A) B **(B)** 2B

(C) B/2 **(D)** B/4

Q. 10. A hemisphere is uniformly charged positively. The electric field at a point on a diameter away from the centre is directed

(A) perpendicular to the diameter. **(B)** parallel to the diameter.

(C) at an angle tilted towards the diameter. **(D)** at an angle tilted away from the diameter.

Q. 11. The deflecting torque acting on the coil of a galvanometer is

(A) inversely proportional to number of turns.

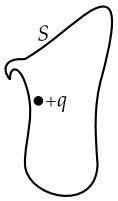
(B) inversely proportional to current flowing.

(C) inversely proportional to area of the coil.

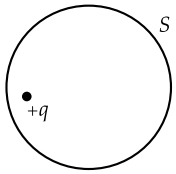
(D) directly proportional to the magnetic field strength.

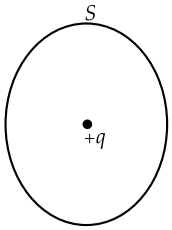
AI **Q. 12.** The electric flux through the surface :

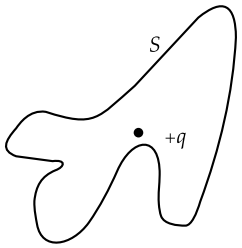
(i)



(ii)



(iii) 

(iv) 

(A) in Figure (iv) is the largest.

(B) in Figure (iii) is the least.

(C) in Figure (ii) is same as Figure (iii) but is smaller than Figure (iv).

(D) is the same for all the figures.

AI **Q. 13.** A solenoid of 1.5 metre length and 4.0 cm diameter has 10 turn per cm. A current of 5 A ampere is flowing through it. The magnetic field at axis inside the solenoid is

(A) $2\pi \times 10^{-3}$ T **(B)** $2\pi \times 10^{-3}$ G

(C) $2\pi \times 10^{-7}$ T **(D)** $2\pi \times 10^{-7}$ G

Q. 14. Capacitance of a parallel plate capacitor can be increased by

(A) increasing the distance between the plates.

(B) decreasing the distance between the plates.

(C) decreasing the area of plates.

(D) increasing the thickness of the plates.

Q. 15. In a moving coil galvanometer, current in the coil is

(A) directly proportional to angle of deflection.

(B) inversely proportional to the angle of deflection.

(C) directly proportional to the square root of the angle of deflection.

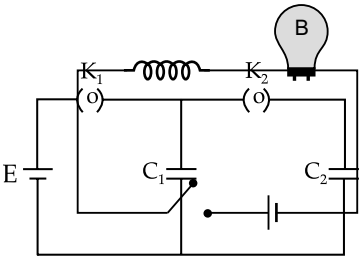
(D) inversely proportional to the square root of the angle of deflection.

Q. 16. Which error of meter bridge is removed when the known and unknown resistances are interchanged?

(A) End error **(B)** Measurement error

(C) Percentage error **(D)** Parallax error

Q. 17. In the following circuit, the bulb will become suddenly bright if :



(A) contact is made or broken.

(B) contact is made.

(C) contact is broken.

(D) won't become bright at all.

Q. 18. Current sensitivity of a galvanometer is given by

(A) Cθ/nBA **(B)** nBA/C

(C) nBA/CG **(D)** CG/nBA

AI **Q. 19.** In a pure inductive circuit or in an ac circuit containing inductance only, the current :

(A) leads the e.m.f. by 90°.

(B) lags behind the e.m.f. by 90°.

(C) sometimes leads and sometime lags behind the e.m.f.

(D) is in phase with the e.m.f.

Q. 20. The energy of a charged capacitor is given by the expression (q is the charge on the conductor and C is its capacity) :

(A) $q^2/2C$ **(B)** q^2/C

(C) $2qC$ **(D)** $q/2C^2$

Q. 21. When a capacitor C is charged to a certain potential and connected to an inductor L, then frequency of energy oscillation is given by

(A) $\frac{1}{2\pi\sqrt{LC}}$ **(B)** $\frac{1}{\sqrt{LC}}$

(C) $\frac{2\pi}{\sqrt{LC}}$ **(D)** $\frac{1}{2\pi}\sqrt{\frac{L}{C}}$

Q. 22. An electron and a proton are in a uniform electric field, the ratio of their accelerations will be :

(A) zero

(B) unity

(C) the ratio of the masses of proton and electron.

(D) the ratio of the masses of electron and proton.

Q. 23. A parallel plate condenser has a capacitance 50 μF in air and 110 μF when immersed in an oil. The dielectric constant 'K' of the oil is :

(A) 0.45 **(B)** 0.55

(C) 1.10 **(D)** 2.20

Q. 24. In an A.C. circuit containing only capacitance, the current :

(A) leads the voltage by 180° **(B)** lags the voltage by 90°

(C) leads the voltage by 90° **(D)** remains in phase with the voltage

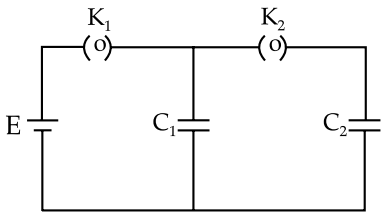
Q. 25. In the circuit shown in Figure, initially key K_1 is closed and key K_2 is open. Then K_1 is opened and K_2 is closed. Then

(A) Voltage across C_1 = Voltage across C_2

(B) Voltage across C_1 > Voltage across C_2 , if $C_1 > C_2$

(C) Charge on C_1 = charge on C_2

(D) None of the above



Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. A capacitor is charged by using a battery which is then disconnected. A dielectric slab is then slipped between the plates, which results in :

(A) Reduction of charge on the plates and increase of potential difference across the plates

(B) Increase in the potential difference across the plate, reduction in stored energy, but no change in the charge on the plates

(C) Decrease in the potential difference across the plates, reduction in the stored energy, but no change in the charge on the plates

(D) None of the above

Q. 27. A voltmeter has resistance of 2000 ohms and it can measure upto 2V. If we want to increase its range to 10 V, then the required resistance in series will be :

(A) 2000 Ω **(B)** 4000 Ω

(C) 6000 Ω **(D)** 8000 Ω

Q. 28. Magnetic field intensity at the centre of coil of 50 turns, radius 0.5 m and carrying a current of 2 A is :

(A) 0.5×10^{-5} T **(B)** 1.25×10^{-4} T

(C) 3×10^{-5} T **(D)** 4×10^{-5} T

Q. 29. Under the influence of a uniform magnetic field a charged particle is moving in a circle of radius R with constant speed v. The time period of the motion :

(A) depends on R and not on v **(B)** depends on v and not on R

(C) depends on both R and v **(D)** is independent of both R and v

Q. 30. Two thin long parallel wires separated by a distance b are carrying a current i amp each. The magnitude of the force per unit length exerted by one wire on the other is :

(A) $\mu_0 i^2 / b^2$ **(B)** $\mu_0 i^2 / 2\pi b$

(C) $\mu_0 i / 2\pi b$ **(D)** $\mu_0 i / 2\pi b^2$

Q. 31. A long wire carrying a steady current is bent into a circular loop of one turn. The magnetic field at the centre of the loop is B. It is then bent into a circular coil of n turns. The magnetic field at the centre of this coil of n turns will be :

(A) nB **(B)** n^2B

(C) $2n$B **(D)** $2n^2$B

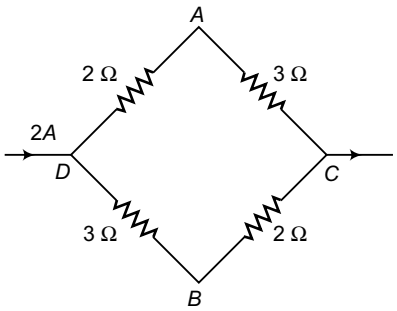
Q. 32. A current of 2 A flows in a system of conductors as shown. The potential difference ($V_A - V_B$) will be :

(A) + 2V

(B) + 1V

(C) – 1 V

(D) – 2 V



Q. 33. The potential gradient along the length of a uniform wire is 10 volt/metre. B and C are the two points at 30 cm and 60 cm point on a meter scale fitted along the wire. The potential difference between B and C will be :

(A) 3 volt **(B)** 0.4 volt

(C) 7 volt **(D)** 4 volt

AI Q. 34. n equal resistors are first connected in series and then parallel. What is the ratio of the maximum to minimum resistance?

(A) n **(B)** $1 / n^2$

(C) n^2 **(D)** $1/n$

Q. 35. A wire of length L and resistance R is stretched to get the radius of cross-section half. What is new resistance :

(A) 5 R **(B)** 8 R

(C) 4 R **(D)** 16 R

Q. 36. 100 cells each of emf 5V and internal resistance 1 Ω are to be arranged so as to produce maximum current in a 25 Ω resistance. Each row contains equal number of cells. The number of rows should be :

(A) 2 **(B)** 4

(C) 5 **(D)** 100

Q. 37. In a meter bridge, the balancing length from the left end (standard resistance of one ohm is in the right gap) is found to be 20 cm. The value of the unknown resistance is :

(A) 0.8 Ω **(B)** 0.5 Ω

(C) 0.4 Ω **(D)** 0.25 Ω

AI Q. 38. A potentiometer consists of a wire of length 4 m and resistance 10 Ω. It is connected to a cell of e.m.f. 2 V. The potential difference per unit length of the wire will be :

(A) 0.5 V/m **(B)** 2 V/m

(C) 5 V/m **(D)** 10 V/m

Q. 39. Three condensers each of capacitance 2 F are put in series. The resultant capacitance is :

(A) 6 F **(B)** 3/2 F

(C) 2/3 F **(D)** 5 F

Q. 40. When air in a capacitor is replaced by a medium of dielectric constant K, the capacity :

(A) Decreases K times **(B)** Increases K times

(C) Increases K^2 times **(D)** Remains constant

Q. 41. 1000 small water drops each of radius r and charge q coalesce together to form one spherical drop. The potential of the big drop is larger than that of the smaller drop by a factor of

(A) 1000 **(B)** 100

(C) 10 **(D)** 1

Q. 42. Two insulated charged spheres of radii 20 cm and 25 cm respectively and having an equal charge Q are connected by a copper wire, then they are separated :

(A) both the spheres will have the same charge Q.

(B) charge on the 20 cm sphere will be greater than that on the 25 cm sphere.

(C) charge on the 25 cm sphere will be greater than that on the 20 cm sphere.

(D) charge on each of the sphere will be 2Q.

Q. 43. The condensers of capacity C_1 and C_2 are connected in parallel, then the equivalent capacitance is:

(A) $C_1 + C_2$ **(B)** $C_1C_2/C_1 + C_2$

(C) C_1/C_2 **(D)** C_2/C_1

Q. 44. Two charged spheres of radii 10 cm and 15 cm are connected by a thin wire. No current will flow, if they have :

(A) The same charge on each **(B)** The same potential

(C) The same energy **(D)** The same field on their surfaces

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

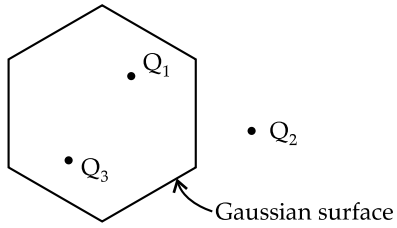
(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Q. 45. Assertion (A): In a cavity in a conductor, the electric field is zero.

Reason (R): Charges in a conductor reside only at its surface.

AI **Q. 46. Assertion (A):** Three point charges Q_1, Q_2 and Q_3 are shown in the figure. The flux over the Gaussian surface depends on only one charge point.



Reason (R): Electric flux depends on the all charges nearby.

Q. 47. Assertion (A): Two parallel metal plates having charge +Q and –Q are facing at a distance between them. The plates are now immersed in kerosene oil and the electric potential between the plates decreases.

Reason (R): Dielectric constant of kerosene oil is less than 1.

AI **Q. 48. Assertion (A):** Potentiometer is used to measure the e.m.f. of a cell.

Reason (R): Potentiometer is preferred over voltmeter to measure the e.m.f. a cell since it does not draw any net current from the cell.

Q. 49. Assertion (A): Torque on a coil is maximum when it is suspended radially in a magnetic field.

Reason (R): Torque tends to rotate a coil .

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

Q. 50. When a proton is accelerated through 1 V, then its kinetic energy will be :

(A) 1840 eV **(B)** 13.6 eV

(C) 1 eV **(D)** 0.54 eV

Q. 51. Electric field strength due to a point charge of 5μC at a distance of 80 cm from the charge is :

(A) 8×10^4 N/C **(B)** 7×10^4 N/C

(C) 5×10^4 N/C **(D)** 4×10^4 N/C

CASE STUDY

Read the following text and answer the following questions on the basis of the same:

Earth's magnetism: Earth's magnetic field is caused by a dynamo effect. The effect works in the same way as a dynamo light on a bicycle. Magnets in the dynamo start spinning when the bicycle is pedaled, creating an electric current. The electricity is then used to turn on the light. This process also works in reverse. If you have a rotating electric current, it will create a magnetic field. On Earth, flowing of liquid metal in the outer core of the planet generates electric currents. The rotation of Earth on its axis causes these electric currents to form a magnetic field which extends around the planet. The average magnetic field strength in the Earth's outer core was measured to be 25 Gauss, 50 times stronger than the magnetic field at the surface. The magnetic field is extremely important for sustaining life on Earth. Without it, we would be exposed to high amounts of radiation from the Sun and our atmosphere would be free to leak into space. This is likely what happened to the atmosphere on Mars. As Mars doesn't have flowing liquid metal in its core, it doesn't produce the same dynamo effect. This left the planet with a very weak magnetic field, allowing for its atmosphere to be stripped away by solar winds, leaving it uninhabitable. Based upon the study of lava flows throughout the world, it has been proposed that the Earth's magnetic field reverses at an average interval of approximately 300,000 years. However, the last such event occurred some 780,000 years ago.

Q. 52. Which of the followings is the reason for Earth's magnetism ?

(A) Rotation of electric current **(B)** Rotation of Earth

(C) Attraction due to other celestial bodies **(D)** Solar flares

Q. 53. Electric current in the Earth's body is generated due to:

(A) movement of charged particle in the atmosphere.

(B) flowing of liquid metal in the outer core.

(C) electric discharges during thunderstorm.

(D) its revolution round the Sun.

Q. 54. Which planet has no own magnetic field ?

(A) Jupiter **(B)** Neptune

(C) Mars **(D)** Mercury

Q. 55. Average magnetic field strength in the Earth's outer core is :

(A) 5 Gauss **(B)** 25 Gauss

(C) cannot be measured **(D)** 50 Gauss

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: **A**

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: Ⓐ Ⓑ Ⓒ Ⓓ

Roll Number: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Name

Test Date

Student's Signature

Invigilator's Signature

Certified that all the entries In this section have been properly filled by the student

Subject

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Self Assessment Paper 8

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. Three concentric metallic spherical shells of radii R, 2R, 3R, are given charges Q_1, Q_2, Q_3, respectively. The surface charge densities on the outer surfaces of the shells are equal. $Q_1 : Q_2 : Q_3$ is

(A) 1:4:9 **(B)** 1:2:3

(C) 3:2:1 **(D)** 9:4:1

Q. 2. Value of k in coulomb's law depends on

(A) nature of medium between two charges **(B)** distance between two charges

(C) magnitude of charges **(D)** both (A) and (C)

Q. 3. Gold leaf electroscope can be charged by

(A) conduction **(B)** induction

(C) radiation **(D)** both (A) and (B)

AI **Q. 4.** There is an electric field in X-direction If the work done in moving a charge 0.2C through a distance of 2m along a line making an angle 60° with x-axis is 2J, the value of E is

(A) 10 N/C **(B)** 20 N/C

(C) 30 N/C **(D)** 40 N/C

Q. 5. The study of the effect associated with electric field at rest is

(A) Magnetostatics **(B)** Electrostatics

(C) Electromagnetism **(D)** None of the above

Q. 6. If the terminals of a charged capacitor is touched by hand

(A) It may give us a shock **(B)** It discharges through our body

(C) Nothing happens **(D)** Both (A) and (B)

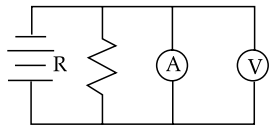
Q. 7. The electric field required to keep of charged body of mass of *m* and charge suspended freely

(A) *mg/e* **(B)** *mge*

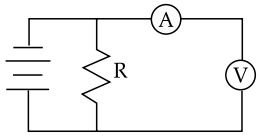
(C) *e/mg* **(D)** *em/g*

Q. 8. Which of the following demonstrate the proper connection of voltmeter and ammeter?

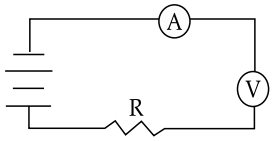
(A)



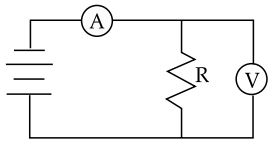
(B)



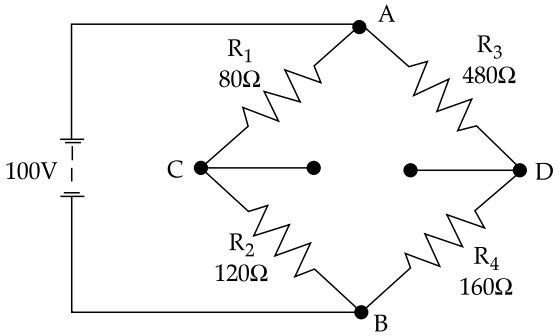
(C)



(D)



AI **Q. 9.** In the following Wheatstone bridge the voltage across C and D points is



(A) 35 V **(B)** 50 V

(C) 100 V **(D)** 65 V

AI **Q. 10.** Combine three resistors 5 Ω, 4.5 Ω and 3 Ω in such a way that the total resistance of this combination is maximum.

(A) 12.5 Ω in series **(B)** 12.5 Ω in parallel

(C) 13.5 Ω in series **(D)** 13.5 Ω in parallel

AI **Q. 11.** $[M^{-1}L^{-3}T^{3}A^{2}]$ is the dimension of

(A) resistivity **(B)** conductivity

(C) resistance **(D)** capacitance

Q. 12. The resistances of a wire at 20°C and 500°C are 20 Ω and 60 Ω respectively. Its resistance will be 25 Ω at temperature

(A) 50°C **(B)** 60°C

(C) 70°C **(D)** 80°C

AI **Q. 13.** Earth's magnetic field is horizontal at

(A) magnetic equator **(B)** magnetic pole

(C) geographic equator **(D)** geographic pole

AI **Q. 14.** Angle between magnetic meridian and geographical meridian is

(A) angle of declination **(B)** angle of dip

(C) magnetic latitude **(D)** magnetic longitude

AI **Q. 15.** 1 tesla = _____ gauss.

(A) 10^4 **(B)** 10^{-4}

(C) 10^7 **(D)** 10^{-7}

Q. 16. A long hollow metal current carrying pipe produces magnetic field

(A) inside only **(B)** outside only

(C) both (A) and (B) **(D)** no magnetic field is produced

Q. 17. Energy in a current carrying coil is the form of

(A) magnetic field **(B)** electric field

(C) both (A) and (B) **(D)** dielectric strength

Q. 18. The force on a charged particle moving with velocity $\vec{v}$ is subjected to a magnetic field $\vec{B}$ is zero. It implies that

(A) the angle between $\vec{v}$ and $\vec{B}$ is 0° **(B)** the angle between $\vec{v}$ and $\vec{B}$ is 180°

(C) the angle between $\vec{v}$ and $\vec{B}$ is 90° **(D)** both (A) and (B)

Q. 19. Kinetic energy of a proton is _____ when it is is accelerated through 1V.

(A) 1 eV **(B)** – 1 eV

(C) 1836 eV **(D)** 1.6×10^{-19} eV

Q. 20. In a series LCR circuit, the voltage across each component L, R and C is 30V. The voltage across LC combination is

(A) 30 V **(B)** 60 V

(C) 0 V **(D)** 90 V

Q. 21. In a series LCR circuit, the voltages across component L, R and C are 50 V, 20 V, 40 V. The supply voltage is

(A) 110V **(B)** $10\sqrt{5}$

(C) 50V **(D)** none of the above

Q. 22. A _____ H inductor shows 100 Ω reactance when connected to a 200 V 100 Hz supply.

(A) $1/\pi$ **(B)** $1/2\pi$

(C) π **(D)** 2π

Q. 23. When an A.C. supply whose V_{RMS} = 10 V is connected across a resistor 10Ω, the power loss is _____ W.

(A) 20 W **(B)** 0

(C) 5 W **(D)** 10 W

Q. 24. The reactance of a capacitor is X_C. If capacitance and frequency both are doubled, the reactance becomes _____ .

(A) $2X_C$ **(B)** $X_C/2$

(C) $4X_C$ **(D)** $X_C/4$

AI **Q. 25.** A a.c. circuit is having voltage V and current I. The power dissipation is

(A) VI

(B) VI/2

(C) $VI/\sqrt{2}$

(D) Dependant on the phase difference between V and I.

Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. The magnitude of electric force, F is

(A) inversely proportional to the multiplication of both charges.

(B) directly proportional to the distance between both charges.

(C) inversely proportional to the square of the distance between both charges.

(D) constant.

Q. 27. The Electric field at a point is

(A) always continuous.

(B) continuous if there is no charge at that point.

(C) discontinuous only if there is a negative charge at that point.

(D) continuous if there is a charge at that point.

AI **Q. 28.** Consider a region inside which there are various types of charges but the total charge is zero. At points outside the region

(A) the electric field is necessarily zero.

(B) the electric field is due to the dipole moment of the charge distribution only.

(C) the dominant electric field is proportional to $\frac{1}{r^3}$, for large r, where r is the distance from a origin in this region.

(D) the work done to move a charged particle along a closed path, away from the region, will be nonzero.

Q. 29. In a region of constant potential,

(A) the electric field is uniform.

(B) the electric field is non-zero.

(C) there can be no charge inside the region.

(D) the electric field shall necessarily change if a charge is placed outside the region.

AI **Q. 30.** If a conductor has a potential $V \neq 0$ and there are no charges anywhere else outside, then

(A) there must be charges on the surface or inside itself.

(B) there must be charges in the body of the conductor.

(C) there must be charges only on the surface.

(D) there must be charges inside the surface.

Q. 31. The mutual inductance M_{12} of coil 1 with respect to coil 2

(A) decreases when they are brought nearer.

(B) depends on the current passing through the coils.

(C) increases when one of them is rotated about an axis.

(D) is the same as M_{21} of coil 2 with respect to coil 1.

Q. 32. As the frequency of an ac circuit increases, the current first increases and then decreases. What combination of circuit elements is most likely to comprise the circuit?

(A) Resistor

(B) Resistor and inductor

(C) Resistor and capacitor

(D) Resistor, inductor and capacitor

Q. 33. A polythene piece rubbed with wool is found to have a negative charge of 3×10^{-7} C. Amount of mass transfer from wool to polythene is

(A) 1.706×10^{18} kg

(B) 1.706×10^{-18} kg

(C) 3×10^{-7} kg

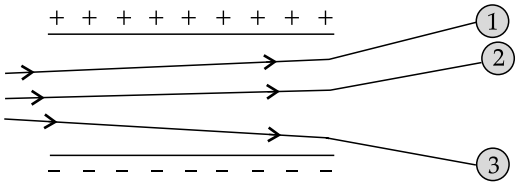
(D) 3×10^{7} kg

Q. 34. The electrostatic force on a small sphere A of charge 0.4 μC due to another small sphere B of charge -0.8 μC in air is 0.2 N. What is the force on the B due to the A?

(A) 0.2 N **(B)** 0

(C) Less than 0.2 N **(D)** More than 0.2 N

AI **Q. 35.** Figure shows tracks of three charged particles in a uniform electrostatic field. Give the signs of the three charges.



(A) Positive, positive, negative **(B)** Negative negative, positive

(C) Positive, negative, positive **(D)** Negative, positive, negative

Q. 36. What is the value of dielectric constant for a metal

(A) Zero **(B)** 1

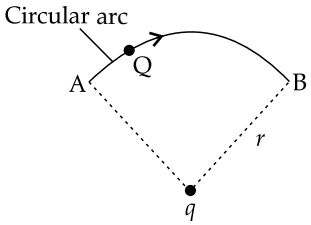
(C) Infinity **(D)** Both (A) and (C)

Q. 37. A metallic spherical shell has an inner radius R_1 and outer radius R_2. A charge Q is placed at the centre of the spherical cavity. What will be surface charge density on (i) the inner surface, and (ii) the outer surface?

(A) (i) $-Q/4\pi R_1^2$ (ii) $+Q/4\pi R_2^2$ (B) (i) $+Q/4\pi R_1^2$ (ii) $-Q/4\pi R_2^2$

(C) (i) $-Q/4\pi R_1^2$ (ii) $-Q/4\pi R_2^2$ (D) (i) $+Q/4\pi R_1^2$ (ii) $+Q/4\pi R_2^2$

AI **Q. 38.** The amount of work done in moving a point charge Q around a circular arc of radius '***r***' at the centre of which another point charge 'q' is located is



(A) Depends on the value of Q and q

(B) Depends on the value of r

(C) Both (A) and (B)

(D) 0

AI **Q. 39.** Two charges $-q$ and $+q$ are located at points $(0, 0, -a)$ and $(0, 0, a)$, respectively.

The electrostatic potential at the points $(0, 0, z)$ is

(A) $\dfrac{p}{4\pi\varepsilon_0(a^2 - z^2)}$ **(B)** $\dfrac{p}{4\pi\varepsilon_0(z^2 - a^2)}$

(C) $\dfrac{p}{4\pi\varepsilon_0 a^2}$ **(D)** 0

Q. 40. Nichrome and copper wires of same length and same radius are connected in series. Resistivity of Nichrome is more than that of copper. Current I is passed through them. Which wire gets heated up more?

(A) Copper **(B)** Nichrome

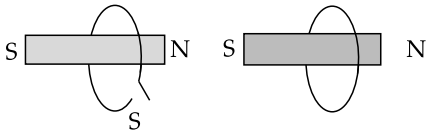
(C) Both will be equally heated **(D)** None of the above

Q. 41. The magnitude of magnetic force per unit length on a wire carrying a current of 8 A and making an angle of 30° with the direction of a uniform magnetic field of 0.15 T is

(A) 6 N/m **(B)** 0.06 N/m

(C) 0.6 N/m **(D)** 0.6 N/cm

Q. 42. Consider a magnet surrounded by a wire with an on/off switch S in the figure. If the switch is thrown from the off position (open circuit) to the on position (closed circuit), will a current flow in the circuit?



(A) No.

(B) Yes. Magnitude will depend on the area of the coil

(C) Yes. Magnitude will depend on the strength of the current.

(D) Yes. An instantaneous current will flow.

AI **Q. 43.** A horizontal straight wire 10 m long extending from east to west is falling with a speed of 5.0 m/sec, at right angles to the horizontal component of the earth's magnetic field, 0.30×10^{-4} Wbm^{-2}. What is the instantaneous value of the emf induced in the wire and in which direction?

(A) 1.5 mV, West to East **(B)** 1.5 mV, East to West

(C) 1.5V, West to east **(D)** 1.5V, East to West

Q. 44. If a L-C circuit is considered analogous to a harmonically oscillating spring block system, _____ energy of the L-C circuit would be analogous to _____ energy and _____ energy of L-C circuit is analogous to _____ energy?

(A) Magnetic, kinetic, electrical, potential **(B)** Electrical, kinetic, Magnetic, potential

(C) Kinetic, Magnetic, Potential, Electrical **(D)** Potential, Magnetic, kinetic, electrical

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

AI **Q. 45. Assertion (A):** Quality factor of a series LCR circuit is $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$

Reason (R): As bandwidth decreases, Q increases in a resonant LCR circuit.

Q. 46. Assertion (A): A step-up transformer converts input low AC voltage to output high AC voltage.

Reason (R): It violate the law of conservation of energy.

Q. 47. Assertion (A): Earth's magnetic field does not affect the functioning of a moving coil galvanometer.

Reason (R): Earth's magnetic field is too weak.

Q. 48. Assertion (A): In moving coil galvanometer, the coil is wound on a metallic frame.

Reason (R): The metallic frame helps in making steady deflection without oscillation.

AI **Q. 49. Assertion (A):** Meter bridge wire is generally made of Constantan.

Reason (R): Constantan has a very low temperature coefficient of resistance.

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

Q. 50. A 44 mH inductor is connected to 220 V, 50 Hz ac supply. The rms value of the current in the circuit is

(A) 5A **(B)** 15.92A

(C) 5×10^{-3}A **(D)** None of the above

Q. 51. Which one of the following statements is correct?

(A) Alloys of metals usually have less resistivity than that of their constituent metals.

(B) Alloys usually have much higher temperature coefficients of resistance than pure metals.

(C) The resistivity of the alloy Manganin increases rapidly with increase of temperature.

(D) The resistivity of a typical insulator (*e.g.*, amber) is greater than that of a metal by a factor of the order of 10^{22}.

CASE STUDY

Read the following text and answer the following questions on the basis of the same:

Capacitor Colour Code: Capacitor values as written on small capacitors are sometimes misleading. Letters like p (pico) or n (nano) are used in place of the decimal point to identify its position and the value of the capacitor.

For example, a capacitor labelled as n33 = 0.33nF, 8n2 = 8.2nF, 22n = 47nF and so on.

Sometimes capacitors are marked with the capital letter K to signify a value of Kilo pico-Farads. As for example, a capacitor with the markings of 100K would be 1000 × 100 pF = 100 Kpf = 100 nF.

Sometimes, a three letter code consists of the two value digits and a multiplier. For example, the digits 471 = 47 × 10 = 470 pF, 332 = 33 × 100 = 3300 pf.

To reduce these confusions an International colour coding scheme was developed almost same as that of resistance colour code.

Band	Digit 1	Digit 2	Multiplier
Colour			
Black	0	0	x1
Brown	1	1	x10
Red	2	2	x100
Orange	3	3	x1,000
Yellow	4	4	x10,000
Green	5	5	x1000,00
Blue	6	6	x1,000,000
Violet	7	7	
Grey	8	8	x0.01
White	9	9	x0.1

The value obtained from colour code is in pf.

Q. 52. What is the value of the capacitor if n27 is written on it?

(A) 0.27 nF **(B)** 0.27 pF

(C) 27 nF **(D)** 27 pF

Q. 53. Two capacitors marked as 221 and 220 respectively are joined in parallel. What is the total capacitance value?

(A) 441 pF **(B)** 242 pF

(C) 242 nF **(D)** 441 nF

Q. 54. 68K is written on a capacitor. What is its value?

(A) 68 pF **(B)** 68 nF

(C) 68 μF **(D)** None of these.

Q. 55. What is the value of the capacitor bearing a colour code: brown, green, brown?

(A) 15 pF **(B)** 15 nF

(C) 15 nF **(D)** 150 pF

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: **A**

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: Ⓐ Ⓑ Ⓒ Ⓓ

Roll Number: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Name

Test Date

Student's Signature

Invigilator's Signature

Certified that all the entries In this section have been properly filled by the student

Subject

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
04	Ⓐ Ⓑ Ⓒ Ⓓ	19	Ⓐ Ⓑ Ⓒ Ⓓ	34	Ⓐ Ⓑ Ⓒ Ⓓ	49	Ⓐ Ⓑ Ⓒ Ⓓ
05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Sample Question Papers

9

Self Assessment Paper

Solved

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 1. Two metal spheres of radius R and 2R having same charge density σ are brought in contact. After redistribution of charge, the new charge densities will be

(A) $\frac{3}{5}\sigma, \frac{6}{5}\sigma$ **(B)** $\frac{6}{5}\sigma, \frac{3}{5}\sigma$

(C) $\frac{6}{5}\sigma, \frac{3}{5}\sigma$ **(D)** $\frac{5}{3}\sigma, \frac{5}{6}\sigma$

AI **Q. 2.** An electron is accelerated from rest by applying a voltage V. If a magnetic field B is then applied the radius of its path will be

(A) $\frac{\sqrt{2meV}}{eB}$ **(B)** $\sqrt{2meVB}$

(C) $\frac{\sqrt{2meB}}{eV}$ **(D)** $\frac{\sqrt{2meV}}{B}$

Q. 3. A long solenoid has 1000 turns. When a current of 4 A flows through it, the magnetic flux linked with each turn of the solenoid is 4×10^{-3} Wb. The self–inductance of the solenoid is :

(A) 4 H **(B)** 3 H

(C) 2 H **(D)** 1 H

Q. 4. In a uniform electric field, the ratio of acceleration of a proton and an electron is

(A) 1 **(B)** 0

(C) m_E/m_P **(D)** m_P/m_E

AI **Q. 5.** Which of the followings is most preferable and accurate instrument for measurement of voltage of a voltage source?

(A) Voltmeter **(B)** Meter bridge

(C) Potentiometer **(D)** Wheatstone bridge

Q. 6. Two long conductors, separated by a distance d, carry currents I_1 and I_2 respectively. They exert a force F on each other. If of the currents and distance between them are doubled, the force acting between them

(A) will remain unchanged **(B)** will be doubled

(C) will be halved **(D)** will be one fourth

Q. 7. When the space between the two plates of a parallel plate capacitor is filled with a metal, it behaves like a

(A) Inductor **(B)** Conductor

(C) Insulator **(D)** Semiconductor

Q. 8. What is the frequency of oscillation in a LC circuit when the values of the inductor and capacitor are respective 10^{-6}H and 10^{-4F}?

(A) $100/2\pi$ Hz **(B)** $2\pi/10$ Hz

(C) $10^5/2\pi$ Hz **(D)** 1/10 Hz

Q. 9. A wire loop is rotated in magnetic field. The frequency of change of direction of the induced e.m.f. is :

(A) Six times per revolution **(B)** Once per revolution

(C) Twice per revolution **(D)** Four times per revolution

Q. 10. Magnetic field changes from B_0 to $5B_0$ in time $2t$ through a coil having n number of turns and area of cross section A. The magnitude of induced e.m.f. is

(A) $2.5nAB_0/t$ **(B)** $5nAB_0/t$

(C) $2.5nB_0/At$ **(D)** $5\ nB_0/At$

Q. 11. When an electric charge is in uniform motion then it produces

(A) Only magnetic field **(B)** Only electric field

(C) Both (A) and (B) **(D)** Neither (A) nor (B)

AI **Q. 12.** The direction of induced current in electromagnetic induction is defined by

(A) Faraday's Law **(B)** Maxwell's Law

(C) Ampere's Law **(D)** Lenz's Law

AI **Q. 13.** Coefficient of self inductance of a coil becomes four times when number of turns is

(A) two times **(B)** three times

(C) four times **(D)** None of the above

Q. 14. Which one of the following is the unit of magnetic moment?

(A) Am^2 **(B)** Nm / T

(C) J/T **(D)** All of the above

AI **Q. 15.** Electric field inside a uniformly charged shell is

(A) Zero

(B) Directly proportional to the radius of the shell

(C) Inversely proportional to the radius of the shell

(D) Constant irrespective of the radius of the shell

Q. 16. A thin ring of radius R meter has charge q coulomb uniformly spread on it. The ring rotates about its axis with a constant frequency of f revolutions/s. The value of magnetic induction in Wb/m^2 at the centre of the ring is :

(A) $\mu_0 qf/2\pi R$ **(B)** $\mu_0 q/2\pi fR$

(C) $\mu_0 q/2fR$ **(D)** $\mu_0 qf/2R$

Q. 17. When current flows through a conductor, then the direction of motion of electrons, the current density (J) and electric field (E) are

(A) Directions of motion and electron and current density are in same. Electric field is in opposite direction.

(B) Directions of motion of electrons and electric field are in same. Current density is in opposite direction.

(C) Directions of electric field and current density are in same. Motion of electrons is in opposite direction.

(D) Directions of motion of electrons, electric field and current density are same.

AI **Q. 18** An A.C. source is connected to a pure resistive circuit. Which of the following statements is correct?

(A) Current leads the voltage

(B) Voltage leads the current

(C) Current and voltage are in same phase

(D) Whether voltage or current will lead that depends on the value of the resistance.

AI **Q. 19.** The electrical resistance of a conductor depends on

(A) temperature **(B)** Length

(C) area of cross-section **(D)** All of the above

Q. 20. A capacitor functions as a insulator when

(A) Connected to a high frequency A.C. **(B)** Connected to a D.C.

(C) When connected to either A.C. and D.C. **(D)** None of the above

Q. 21. A 20 cm long solenoid of radius 2 cm having 1000 total number of turns carrying 10 A current. It is equivalent to a magnet of same size and magnetization

(A) 500 A/m **(B)** 5000 A/m

(C) 50000 A/m **(D)** 0.5 A/m

Q. 22. Electric flux emerging from a closed surface is 2×10^3 Vm. What is the amount of charge enclosed?

(A) 18×10^3 μC **(B)** 18×10^{-3} μC

(C) 18×10^{-3} C **(D)** 18×10^3 C

Q. 23. A thin bar magnet of length 5 is bent at its mid point so that the angle between the two halves become 600. Now the length of the magnet is

(A) 5 cm **(B)** 2.5 cm

(C) 10 cm **(D)** 7.5 cm

AI **Q. 24.** Electric potential at a point O (x meter, y meter, z meter) is given by V = $10x^2$ volt. The electric field at point ($2m$, $2m$, $2m$) is

(A) $-10\ \hat{i}$ V/m **(B)** $-20\ \hat{i}$ V/m

(C) $10\ \hat{i}$ V/m **(D)** $20\ \hat{i}$ /m

Q. 25. Electric power transmission at high voltage is advantageous?

(A) Transmission is faster **(B)** Low transmission loss

(C) High current transmission **(D)** None of the above

Section-B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

AI **Q. 26.** Why capacitor blocks D.C. but allows A.C.?

(A) Capacitive reactance is higher a low frequency
(B) Capacitive reactance is lower at high frequency
(C) Capacitor behaves like an inductor at high frequency
(D) Capacitor behaves as a resistor a high frequency.

Q. 27. Why thick wire is used for secondary winding of a step-down transformer?

(A) Secondary current is high. So to reduce power loss thick wire is used.
(B) Secondary current is low. So, to reduce power loss thick wire is used.
(C) To reduce core loss thick wire is used.
(D) To reduce eddy current loss thick wire is used.

Q. 28. For better filtering higher value capacitors are used. Which of the following statement in this context is correct?

(A) As the value of capacitance increases, its reactance decreases and hence it is connected in parallel.
(B) As the value of capacitance increases, its reactance decreases and hence it is connected in series.
(C) As the value of capacitance increases, its reactance increases and hence it is connected in parallel.
(D) As the value of capacitance increases, its reactance increases and hence it is connected in series.

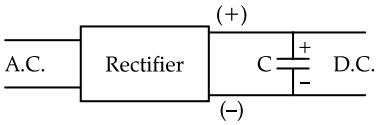
Q. 29. Inductors may also be used for filtering. Which of the following statement in this context is correct?

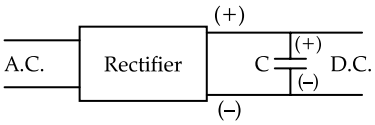
(A) As the value of inductance increases, its reactance decreases and hence it is connected in parallel.
(B) As the value of inductance increases, its reactance decreases and hence it is connected in series.
(C) As the value of inductance increases, its reactance increases and hence it is connected in parallel.
(D) As the value of inductance increases, its reactance increases and hence it is connected in series.

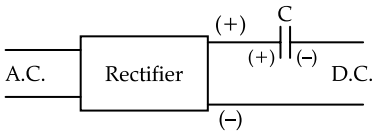
Q. 30. What is the function of a filter circuit?

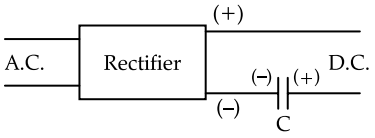
(A) To convert A.C. to D.C.
(B) To convert D.C. to A.C.
(C) To remove ripples
(D) To step-up D.C.

Q. 31. Which of the following is the proper connection of a filter capacitor?

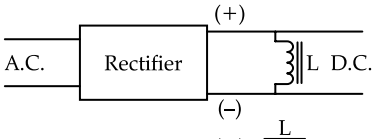
(A)


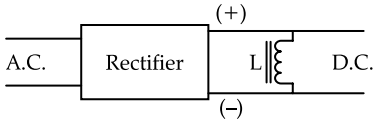
(B)


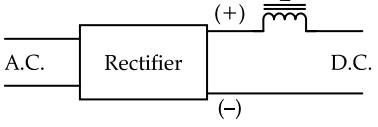
(C)


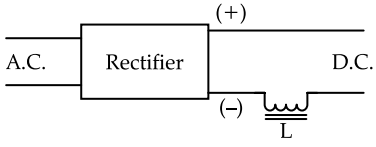
(D)


Q. 32. Which of the following is the proper connection of a filter inductor?

(A)


(B)


(C)


(D)


Q. 33. Transformers are

(A) Dynamic electrical device **(B)** Static electrical device

(C) Dynamic mechanical device **(D)** Static mechanical device

AI **Q. 34.** Which of the following quantity remains same in a transformer?

(A) Frequency **(B)** Voltage

(C) Current **(D)** None of the above

Q. 35. Which of the following quantity increases in a step-down transformer?

(A) Voltage **(B)** Current

(C) Frequency **(D)** Power

Q. 36. Secondary output of a transformer is 12 V, for 220 V primary input. Which of the following statements is true for this transformer?

(A) It is a step-up transformer with turns ratio greater than 1.

(B) It is a step-up transformer with turns ratio less than 1.

(C) It is a step-down transformer with turns ratio less than 1.

(D) It is a step-down transformer with turns ratio greater than 1.

Q. 37. A transformer has primary no. of turns 5 times that of the secondary number of turns. If primary is connected to 200 V A.C. source what will be the secondary voltage?

(A) 40 V **(B)** 1000 V

(C) 200 V **(D)** 0.025 V

Q. 38. Volt is equivalent to

(A) Newton/ second **(B)** Joule / second

(C) Newton / coulomb **(D)** Joule / coulomb

AI **Q. 39.** The magnetic flux linked with a coil, in webers, is given by the equations $\phi = 3t^2 + 4t + 9$. Then the magnitude of induced e.m.f. at $t = 2$ second will be :

(A) 2 volt **(B)** 4 volt

(C) 8 volt **(D)** 16 volt

Q. 40. Two capacitors of capacitance 6 μF and 4 μF are put in series across a 120 V battery. What is the potential difference across the 6 μF capacitor ?

(A) 0 V **(B)** 72 V

(C) 100 V **(D)** 48 V

Q. 41. Which form of energy is stored in a capacitor?

(A) Electrostatic potential energy **(B)** Mechanical potential energy

(C) Magnetic energy **(D)** Kinetic energy

AI **Q. 42.** An electron is accelerated through 1V from rest. Energy gained by electron is

(A) 1 J **(B)** 10 eV

(C) 1.6×10^{-19} J **(D)** 1.6×10^{-19} eV

Q. 43. Minimum number of 4μF capacitors required to form a 10μF capacitor is

(A) 2 **(B)** 5

(C) 6 **(D)** 4

Q. 44. Unit of surface charge density is

(A) Cm^{-2} **(B)** Cm^{-1}

(C) Cm^{-3} **(D)** Cm^{-3}

Given below are two statements labelled as Assertion (A) and Reason (R)
Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Assertion (A) is false, but Reason (R) is true.

AI **Q. 45. Assertion (A):** Electric lines of force never form a closed loop.

Reason (R): Number of electric lines of force originating from or terminating at a charge is proportional to the magnitude of the charge.

Q. 46. Assertion (A): During charging, transfer of electrons takes place.

Reason (R): When a body is positively charge, it gains some mass.

Q. 47. Assertion (A) : Charge on each capacitor connected in series is same.

Reason (R) : Capacitance is directly proportional to the charge on it.

AI **Q. 48. Assertion (A) :** Voltmeter is connected in parallel in a circuit.

Reason (R) : Internal resistance of voltmeter is very low.

Q. 49. Assertion (A) : Ammeter is connected in series in a circuit.

Reason (R) : Internal resistance of Ammeter is very low.

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

Q. 50. In series combination of two resistances
(A) the voltage through each resistance is same.
(B) both current and voltage through each resistance are same.
(C) neither current nor voltage through each resistance is same.
(D) the current through each resistance is same.

AI **Q. 51.** n cells each of emf E and internal resistance r are connected in parallel. The equivalent emf and equivalent internal resistance become
(A) E, nr **(B)** nE, r
(C) E, r/n **(D)** E, r

CASE STUDY

Read the following text and answer the following questions on the basis of the same:
A voltmeter is said to be of good quality if it draws little current from the source. The quality of voltmeter depends on the value of I_g required to produce full scale deflection in the meter. Smaller the value of I_g, better is the quality of voltmeter.

Hence the quality of voltmeter is expressed as $j = \frac{I}{I_g}$
As $I_g = \frac{V}{R+G} = \frac{V}{R_m'}$, where $R_m = R + G$ and V is the voltage which gives full scale deflection in

the voltmeter.

$\therefore \qquad j = R_m/V$

The quality of voltmeter is usually given in $\Omega\ V^{-1}$.

I_g is the characteristics of the galvanometer which is converted into a voltmeter by connected the high resistance R in series. The value of R is given by $R = \frac{V}{I_g} - G$

Q. 52. You are provided with 4 voltmeters whose resistances are follows. Which one will you select?

(A) 10 KΩ **(B)** 100 KΩ

(C) 1 MΩ **(D)** 10 MΩ

Q. 53. The unit of quality of voltmeter is

(A) V Ω **(B)** $\Omega\ V^{-1}$

(C) A Ω **(D)** $\Omega\ A^{-1}$

Q. 54. A galvanometer which shows full scale deflection for 100 μA current is converted into a 0 – 50 V range voltmeter. The resistance which is to be connected in series with the galvanometer should be such that when 50 V is applied to the voltmeter, the current through the galvanometer should be

(A) equal to 100 μA **(B)** Less than 100 μA

(C) More than 100 μA **(D)** within 0-100 μA

Q. 55. A galvanometer gives a full scale deflection for 1.5 mA current and has a resistance 5 Ω. Which of the following resistors is to be connected with it to convert into a voltmeter of 0 – 1.5 V range?

(A) 995 Ω in parallel **(B)** 995 Ω in series

(C) 0.005 Ω in series **(D)** 0.005 in parallel

■■■

CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: **A**

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: Ⓐ Ⓑ Ⓒ Ⓓ

Roll Number: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Name

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Certified that all the entries In this section have been properly filled by the student

Subject

Proper Marking

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Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

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Darken the circle for each question.

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05	Ⓐ Ⓑ Ⓒ Ⓓ	20	Ⓐ Ⓑ Ⓒ Ⓓ	35	Ⓐ Ⓑ Ⓒ Ⓓ	50	Ⓐ Ⓑ Ⓒ Ⓓ
06	Ⓐ Ⓑ Ⓒ Ⓓ	21	Ⓐ Ⓑ Ⓒ Ⓓ	36	Ⓐ Ⓑ Ⓒ Ⓓ	51	Ⓐ Ⓑ Ⓒ Ⓓ
07	Ⓐ Ⓑ Ⓒ Ⓓ	22	Ⓐ Ⓑ Ⓒ Ⓓ	37	Ⓐ Ⓑ Ⓒ Ⓓ	52	Ⓐ Ⓑ Ⓒ Ⓓ
08	Ⓐ Ⓑ Ⓒ Ⓓ	23	Ⓐ Ⓑ Ⓒ Ⓓ	38	Ⓐ Ⓑ Ⓒ Ⓓ	53	Ⓐ Ⓑ Ⓒ Ⓓ
09	Ⓐ Ⓑ Ⓒ Ⓓ	24	Ⓐ Ⓑ Ⓒ Ⓓ	39	Ⓐ Ⓑ Ⓒ Ⓓ	54	Ⓐ Ⓑ Ⓒ Ⓓ
10	Ⓐ Ⓑ Ⓒ Ⓓ	25	Ⓐ Ⓑ Ⓒ Ⓓ	40	Ⓐ Ⓑ Ⓒ Ⓓ	55	Ⓐ Ⓑ Ⓒ Ⓓ
11	Ⓐ Ⓑ Ⓒ Ⓓ	26	Ⓐ Ⓑ Ⓒ Ⓓ	41	Ⓐ Ⓑ Ⓒ Ⓓ	56	Ⓐ Ⓑ Ⓒ Ⓓ
12	Ⓐ Ⓑ Ⓒ Ⓓ	27	Ⓐ Ⓑ Ⓒ Ⓓ	42	Ⓐ Ⓑ Ⓒ Ⓓ	57	Ⓐ Ⓑ Ⓒ Ⓓ
13	Ⓐ Ⓑ Ⓒ Ⓓ	28	Ⓐ Ⓑ Ⓒ Ⓓ	43	Ⓐ Ⓑ Ⓒ Ⓓ	58	Ⓐ Ⓑ Ⓒ Ⓓ
14	Ⓐ Ⓑ Ⓒ Ⓓ	29	Ⓐ Ⓑ Ⓒ Ⓓ	44	Ⓐ Ⓑ Ⓒ Ⓓ	59	Ⓐ Ⓑ Ⓒ Ⓓ
15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Sample Question Papers

Self Assessment Paper 10

Solved _____

General Instructions :

1. The Question Paper contains three sections.

*2. **Section A** has **25** questions. Attempt any **20** questions.*

*3. **Section B** has **24** questions. Attempt any **20** questions.*

*4. **Section C** has **6** questions. Attempt any **5** questions.*

5. All questions carry equal marks.

6. There is no negative marking.

Section-A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

AI **Q. 1.** "Total electric flux out of a closed surface is equal to the charge enclosed divided by the permittivity". This is known as

(A) Gauss's Law **(B)** Faraday's law

(C) Maxwell's law **(D)** Coulomb's law

AI **Q. 2.** In spite of variation of which of the following parameter, the capacitance of a parallel plate capacitor remains unaffected?

(A) Thickness of the plate **(B)** Area of the plate

(C) Distance between the plates **(D)** Dielectric between the two plates

Q. 3. Two parallel plate capacitors C_1 and C_2 have same dimensions. C_1 has dielectric of dielectric constant K_1 and C_2 has dielectric of dielectric constant K_2. If $K_1 > K_2$, then which one will store more charge?

(A) C_1 **(B)** C_2

(C) Both will have same charge **(D)** This will depend on applied voltage.

Q. 4. An uncharged body gets charged by keeping it closed to a charged body. This phenomenon is known as

(A) Conduction **(B)** Induction

(C) Isolation **(D)** Magnetization

Q. 5. A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6 A, the voltage across the secondary coil and the current in the primary coil respectively are

(A) 450 V, 13.5 A **(B)** 600 V, 15 A

(C) 300 V, 15 A **(D)** 450 V, 15 A

Q. 6. In a Wheatstone bridge if the galvanometer and the voltage source are interchanged which of the following observations will be true?

(A) Deflection of galvanometer will be reversed **(B)** Deflection of galvanometer will increase.

(C) Deflection of galvanometer will decrease. **(D)** Deflection of galvanometer will remain same.

Q. 7. If one end of each of the given n number of resistors are joined together and similarly other ends of all the resistors are joined together, then the combination is a

(A) Series combination **(B)** Parallel combination

(C) Either (A) or (B) **(D)** Combination of (A) and (B)

AI **Q. 8.** In a potentiometer of 10 wires, the balance point is achieved on 6th wire. To shift the balance point to 9th wire

(A) Resistance to be increased in series with the cell whose e.m.f. is to be measured.

(B) Resistance to be decreased in series with the cell whose e.m.f. is to be measured.

(C) Resistance to be increased in the primary circuit

(D) Resistance to be decreased in the primary circuit

Q. 9. In electronic circuits flow of current is shown from positive terminal of a battery to its negative terminal. This current known as

(A) Alternating current **(B)** Pulsating current

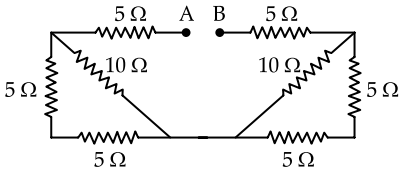
(C) Eddy current **(D)** Conventional current

Q. 10. In a equation XY = Z, if Z represents the current density, X represents the electric field then Y represents

(A) Resistivity **(B)** Conductivity

(C) Resistance **(D)** Potential difference

AI **Q. 11.** The effective resistance in the following circuit between the points A and B is



(A) 10Ω **(B)** 5Ω

(C) 20Ω **(D)** 40Ω

Q. 12. A short bar magnet has a magnetic moment of 0.5 JT-1. The magnitude and direction of the magnetic field produced by the magnet at a distance 5 cm from the centre of magnet on the axis is

(A) 8×10^{-4} T along SN **(B)** 8×10^{-4} T along NS

(C) 4×10^{-4} T along SN **(D)** 4×10^{-4} T along NS

AI **Q. 13.** The torque acting on a current carrying loop is placed in a uniform magnetic field depends upon

(A) area of loop **(B)** magnitude of current

(C) magnetic field **(D)** all of the above

Q. 14. When a strong magnetic field is applied to a stationary electron, the electron

(A) Moves in the direction of the field **(B)** Remains stationary

(C) Moves in the opposite direction of the field **(D)** spins

AI **Q. 15.** A charged particle is moving in circular orbit with velocity v in a uniform magnetic field B. If the velocity of charged particle and strength of magnetic field both are doubled, then radius of the circular orbit

(A) increases **(B)** Remains same

(C) decreases **(D)** depends of the magnitude of the charge

Q. 16. Two identical coaxial coils X and Y carrying current of same magnitude in the same direction are brought closer. The current

(A) Both in X and Y will increase **(B)** Both in X and Y will decrease

(C) In X will increase and in Y will decrease **(D)** In Y will increase and in X will decrease

Q. 17. A metal plate may be heated

(A) By sending direct current through it

(B) By sending alternating current through it

(C) By placing it in a time varying magnetic field

(D) By all of the above processes

Q. 18. Two inductors L_1 and L_2 are connected in series. The equivalent inductance is

(A) $\frac{L_1 L_2}{L_1 + L_2}$ **(B)** $L_1 + L_2$

(C) $\frac{L_1 + L_2}{2}$ **(D)** $L_1 L_2$

AI **Q. 19.** Which of the following is dimensionally different from the others?

(A) 1/RC **(B)** R/L

(C) RC **(D)** $\frac{1}{\sqrt{LC}}$

Q. 20. The dimensional formula of impedance is

(A) $[ML^2 T^{-3} A^{-2}]$ **(B)** $[ML^2 T^{-2} A^{-2}]$

(C) $[M^{-1} L^{-2} T^4 A^2]$ **(D)** $[ML^{-3} T^{-3} A^{-2}]$

AI **Q. 21.** A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the outward electric flux will :

(A) increase four times **(B)** be reduced to half

(C) remain the same **(D)** be doubled

Q. 22. A charge Q is placed at the centre of the line joining two equal charges Q. The system of the three charges will be in equilibrium, if Q is equal to :

(A) $-\frac{Q}{2}$ **(B)** $-\frac{Q}{4}$

(C) $\frac{Q}{4}$ **(D)** $\frac{Q}{2}$

Q. 23. A battery of 6 volts is connected to the terminals of a three metre long wire of uniform thickness and resistance of the order of 100 Ω. The difference of potential between two points separated by 50 cm on the wire will be :

(A) 1 V **(B)** 1.5 V

(C) 2 V **(D)** 3 V

Q. 24. A charged particle moves through a magnetic field in a direction perpendicular to it. Then the

(A) Speed of the particle remains unchanged

(B) Direction of the particle remains unchanged

(C) Acceleration remains unchanged

(D) Velocity remains unchanged

AI **Q. 25.** Magnetic field due to 0.1 A current flowing through a circular coil of radius 0.1 m and 1000 turns at the centre of the coil is :

(A) 2×10^{-1} T **(B)** 4.31×10^{-2} T

(C) 6.28×10^{-4} T **(D)** 9.81×10^{-4} T

Section-B

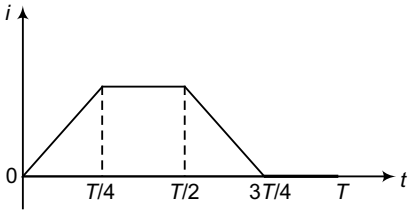
This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q. 26. Two cities are 150 km apart. Electric power is sent from one city to another city through copper wires. The fall of potential per km is 8 volt and the average resistance per km is 0.5 Ω. The power loss in the wire is:

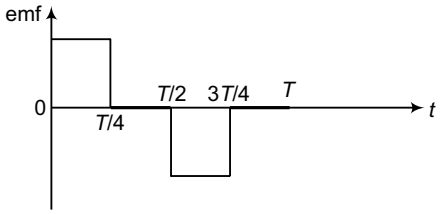
(A) 19.2 W **(B)** 19.2 kW

(C) 19.2 J **(D)** 12.2 kW

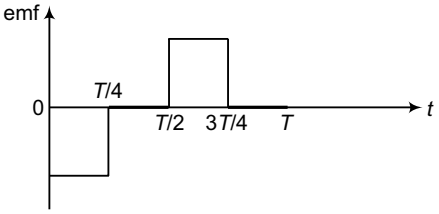
AI **Q. 27.** The current I in a coil varies with time as shown in the figure. The variation of induced emf with time would be :



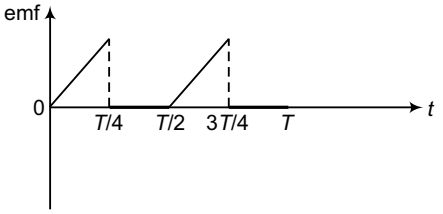
(A)



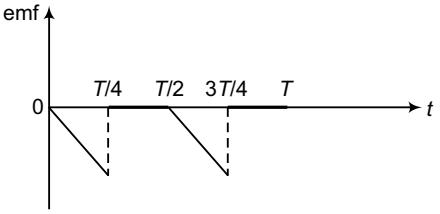
(B)



(C)



(D)



Q. 28. A copper ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet while it is passing through the ring is :

(A) Equal to that due to gravity

(B) Less than that due to gravity

(C) More than that due to gravity

(D) Depends on the diameter of the ring and the length of the magnet

Q. 29. The average e.m.f. induced in a coil in which a current changes from 0 to 2 A in 0.05 s is 8 V. The self inductance of the coil is :

(A) 0.1 H **(B)** 0.2 H

(C) 0.4 H **(D)** 0.8 H

Q. 30. The dimensions of magnetic flux are :

(A) $[MLT^{-2}A^{-2}]$ **(B)** $[ML^2T^{-2}A^{-2}]$

(C) $[ML^2T^{-1}A^{-2}]$ **(D)** $[ML^2T^{-2}A^{-1}]$

AI **Q. 31.** A transformer is used to light a 100 W and 110 V lamp from a 220 V mains. If the main current is **0.5 amp, the efficiency of the transformer is approximately :**

(A) 10% **(B)** 30%

(C) 50% **(D)** 90%

Q. 32. When the number of turns in a coil is doubled without any change in the length of the coil, its self inductance becomes :

(A) Four times **(B)** Doubled

(C) Halved **(D)** Unchanged

Q. 33. The core of a transformer is laminated because :

(A) Energy losses due to eddy currents may be minimised

(B) The weight of the transformer may be reduced

(C) Rusting of the core may be prevented

(D) Ratio of voltage in primary and secondary may be increased

AI **Q. 34.** The instantaneous values of alternating current and voltages in a circuit are given as

$$I = (1/\sqrt{2})\sin(100\,\pi T) \text{ ampere}$$

$$E = (1/\sqrt{2})\sin(100\,\pi T + \pi/3) \text{ volt}$$

The average power in Watts consumed in the circuit is :

(A) $\sqrt{3/4}$ **(B)** 1/2

(C) 1/8 **(D)** 1/4

Q. 35. In an AC generator, a coil with N turns all of the same area A and total resistance R, rotates with frequency ω in a magnetic field B. The maximum value of emf generated in the coil will be :

(A) NABRω **(B)** NAB

(C) *NABR* **(D)** NABω

Q. 36. In an A.C. circuit the current :

(A) Always leads the voltage

(B) Always lags behind the voltage

(C) Is always in phase with the voltage

(D) May lead or lag behind or be in phase with the voltage

Q. 37. An electric dipole is placed at an angle of 30° with an electric field intensity 2.0×10^5 N/C. It experiences a torque equal to 4 N m. The charge on the dipole, if the dipole length is 2 cm, is :

(A) 8 mC **(B)** 2 mC

(C) 5 mC **(D)** 7 μC

Q. 38. An electric dipole is kept in non-uniform electric field. It experiences

(A) A force and a torque **(B)** A force but not a torque

(C) A torque but not a force **(D)** Neither a force nor a torque

Q. 39. If a unit positive charge is taken from one point to another over an equipotential surface, then :

(A) Work is done on the charge **(B)** Work is done by the charge

(C) Work done is constant **(D)** No work is done

Q. 40. When one electron is taken towards the other electron, then the electric potential energy of the system

(A) Decreases **(B)** Increases

(C) Remains unchanged **(D)** Becomes zero

AI **Q. 41.** A charge of 40μC is given to a capacitor having capacitance C =10μF. The stored energy in ergs is :

(A) 80×10^{-6} **(B)** 800

(C) 80 **(D)** 8000

Q. 42. If the distance between parallel plates of a capacitor is halved and dielectric constant is doubled then the capacitance :

(A) Decreases two times **(B)** Increases two times

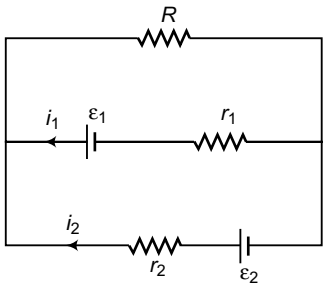
(C) Increases four times **(D)** Remain the same

Q. 43. A potentiometer wire has length 4 m and resistance 8 Ω. The resistance that must be connected in series with the wire and an accumulator of e.m.f. 2V, so as to get a potential gradient 1 mV per cm on the wire is :

(A) 44 Ω **(B)** 48 Ω

(C) 32 Ω **(D)** 40 Ω

AI **Q. 44.** See the electric circuit shown in this Figure. Which of the following equations is a correct equation for it?



(A) $\varepsilon_1 - (i_1+i_2)R + i_1 r_1 = 0$

(B) $\varepsilon_1 - (i_1+i_2)R - i_1 r_1 = 0$

(C) $\varepsilon_2 - i_2 r_2 - \varepsilon_1 - i_1 r_1 = 0$

(D) $-\varepsilon_1 - (i_1+i_2)R + i_2 r_2 = 0$

Given below are two statements labelled as Assertion (A) and Reason (R)

Directions: In the following questions, a statement of Assertion (A) and is followed by a statement of Reason (R). Mark the correct choice as:

(A) Both Assertion (A) and Reason (R) are true, and Reason(R) is the correct explanation of (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

Q. 45. Assertion (A): Induction furnace uses eddy current for preparation of alloys, by melting the constituent metals.

Reason (R): Eddy currents are undesirable since they heat up the core and dissipate electrical energy in the form of heat.

Q. 46. Assertion (A): Whenever there is change in magnetic flux there is induced E.M.F. in a loop.

Reason (R): Whenever there is change in flux there is induced current in a loop.

Q. 47. Assertion (A): Acceleration of a magnet falling through a long solenoid decreases.

Reason (R): The induced current produced in a circuit always flow in such direction that it opposes the change or the cause that produces it.

AI **Q. 48. Assertion (A):** An e.m.f. is induced by moving a conductor in a magnetic field.

Reason (R): An e.m.f is induced by changing the magnetic field.

Q. 49. Assertion (A): In an impedance diagram of LCR circuit, if $X_C > X_L$, ϕ is positive and when $X_C < X_L$, ϕ is negative.

Reason (R): Impedance diagram is a right angled triangle with Z as hypotenuse, R is along X-axis and $X_C - X_L$ is along Y axis.

Section-C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

AI **Q. 50.** The value of A.C. domestic supply is 240 V and its amplitude is

(A) 240 V **(B)** 340 V

(C) 440 V **(D)** 140 V

AI **Q. 51.** In pure capacitive and inductive circuit, power dissipation
(A) Is maximum
(B) Is minimum
(C) 0
(D) Depends on the value the angular frequency of the supply voltage.

Case Study

Read the following text and answer the following questions on the basis of the same:

Electric charge density is the electric charge per unit dimension. Electric charge may be distributed along the length, over the surface and in the volume of a conductor.

Surface charge density of a conductor is defined as the amount of charge distributed per unit surface area of the conductor. It is denoted by σ.

If Q amount charge is distributed over the surface of a conductor of total surface area A, then $\sigma = Q/A$. SI unit of surface charge density is C/m^2 .

The dimension of electric charge is [TA] and the dimension of surface area is $[L^2]$.

So, the dimension of Surface charge density of a conductor is $[L^{-2}TA]$.

Let a conducting sphere of radius *r* have total charge Q on its surface. Now, the surface area of the sphere is $A = 4\pi r^2$.

So, the surface charge density is $\sigma = Q/4\pi r^2$. This is the formula for surface charge density of a sphere.

Surface charge density of a conducting spherical shell is also same as that of a conducting sphere of same radius and same charge. Since, the curvature of the surface of a sphere is same at every point on its surface, the surface charge density is constant at everywhere on the surface of sphere.

For a conductor of irregular shape, the surface area will be different at different points on its surface. So, surface charge density will vary point to point on its surface. The value of surface charge density will be greater at that region where the curvature is greater. That means it will have greater surface charge density at its edges. So, there is no fixed formula for surface charge density of an irregular shaped conductor.

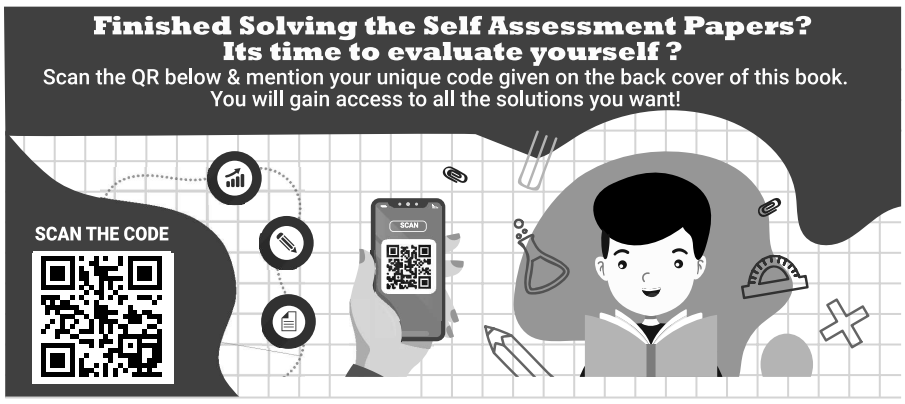
Q. 52. Surface charge density of a spherical conductor of radius 100 cm is $0.5\ c/m^2$. The total charge on the surface is
(A) 6.25×10^4 C
(B) 6.25 C
(C) 0.625 C
(D) 12.5 C

Q. 53. Same amounts of charges are given to each of a sphere and a spherical shell having same radius. The ratio of their surface charge densities is
(A) 2 : 1
(B) 1 : 2
(C) 1 : 1
(D) 1 : 4

Q. 54. Which of the following statement is correct?
(A) The value of surface charge density is greater at that region where the curvature is greater.
(B) The value of surface charge density is less at that region where the curvature is greater.
(C) The value of surface charge density does not depend on curvature of the surface.
(D) None of the above

Q. 55. Dimension of surface charge density is
(A) $[L^2TA]$
(B) $[L^{-2}TA[$
(C) $[LT^2A]$
(D) $[LT^{-2}A]$

■■■



CBSE - Sample Question Paper
Term – I

OMR SHEET

Booklet Series: **A**

Use English Numbers / Letters only. Use Blue / Black Ball Point Pen to write in box.

Booklet Series: Ⓐ Ⓑ Ⓒ Ⓓ

Roll Number: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Name

Test Date

Student's Signature

Invigilator's Signature

Certified that all the entries In this section have been properly filled by the student

Subject

Proper Marking

The OMR Sheet will be computer checked Fill the circles completely and dark enough for proper detection, Use ballpen (black or blue) for marking.

Ⓐ Ⓑ ● Ⓓ

Avoid Improper Marking

Partially Filled

Lightly Filled

Test Center Code: ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

IMPORTANT

The candidate should check that the Test Book Series printed on the OMR Sheet is the same as printed on the Test Booklet. In case of discrepancy, the candidate should immediately report the matter to the invigilator for replacement of both the Test Booklet and the Answer Sheet.

Darken the circle for each question.

Q.No.	Response	Q.No.	Response	Q.No.	Response	Q.No.	Response
01	Ⓐ Ⓑ Ⓒ Ⓓ	16	Ⓐ Ⓑ Ⓒ Ⓓ	31	Ⓐ Ⓑ Ⓒ Ⓓ	46	Ⓐ Ⓑ Ⓒ Ⓓ
02	Ⓐ Ⓑ Ⓒ Ⓓ	17	Ⓐ Ⓑ Ⓒ Ⓓ	32	Ⓐ Ⓑ Ⓒ Ⓓ	47	Ⓐ Ⓑ Ⓒ Ⓓ
03	Ⓐ Ⓑ Ⓒ Ⓓ	18	Ⓐ Ⓑ Ⓒ Ⓓ	33	Ⓐ Ⓑ Ⓒ Ⓓ	48	Ⓐ Ⓑ Ⓒ Ⓓ
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15	Ⓐ Ⓑ Ⓒ Ⓓ	30	Ⓐ Ⓑ Ⓒ Ⓓ	45	Ⓐ Ⓑ Ⓒ Ⓓ	60	Ⓐ Ⓑ Ⓒ Ⓓ

Solutions of Question Paper 2

Section-A

Ans. 1. Option (C) is correct.

Explanation : Rubbing a rod with certain materials will cause the rod to become charged. A plastic rod when rubbed with fur becomes negatively charged and a glass rod when rubbed with silk becomes positively charged.

Ans. 2. Option (C) is correct.

Explanation : From the quantization of charge; $Q = ne$

$$\Rightarrow n = \frac{Q}{e} = \frac{10}{1.6 \times 10^{-19}}$$

$$\Rightarrow n = 6.25 \times 10^{19}$$

Ans. 3. Option (D) is correct.

Explanation : If a charge q is enclosed inside Gaussian surface, then according to Gauss's law

$$\oint E.ds = q/\varepsilon_0$$

Ans. 4. Option (B) is correct.

Explanation: Given that

$$Q_1 = +6Q, Q_2 = -2Q$$

Form the coulombs law,

$$F \propto \frac{Q_1 Q_2}{r^2}$$

$$\Rightarrow F = \frac{K(6Q)(2Q)}{r^2}$$

$$\Rightarrow F = \frac{12KQ^2}{r^2} \quad \ldots(i)$$

Now, after contact force on each will be $\frac{(+6Q)+(-2Q)}{2} = +2Q$ and force is F_2.

$$\Rightarrow F_2 = \frac{K(2Q)(2Q)}{r^2}$$

$$\Rightarrow F_2 = \frac{4KQ^2}{r^2} \quad \ldots(ii)$$

Now,

$$\Rightarrow \frac{F}{F_2} = \frac{\frac{12KQ^2}{r^2}}{\frac{4KQ^2}{r^2}}$$

$$\Rightarrow \frac{F}{F_2} = 3$$

$$\Rightarrow F_2 = \frac{F}{3}$$

Ans. 5. Option (B) is correct.

Explanation: Electric potential

$$V = \frac{\text{Work (W)}}{\text{Charge } (q)}$$

So unit is $\frac{\text{joule}}{\text{Coulomb}}$ or $\frac{\text{newton-meter}}{\text{Coulomb}}$ as Work = Force × displacement.

Additionally, the SI unit of electric potential is volt. So, Option (B) is not the unit of electric potential.

Ans. 6. Option (B) is correct.

Explanation : As we know that current density (J) depends on
(a) conductivity [$\sigma = 1/\rho = 1/RA$]
(b) Electric field [$J = \sigma E$]
(c) current, length and area of cross-section
But in the given options only B, that is, electric field can be varied by the charges accumulated on the surface of wire.

Ans. 7. Option (A) is correct.

Explanation:
As we know that,

$$i = neAv_d$$

So current,

$$i \propto v_d$$

And, current (I) also depend on n, the number of free electrons which increases on increasing temperature which makes more collision between electrons and increases resistance or decrease current.

Ans. 8. Option (B) is correct.

Explanation : With decrease in electric field, the number of free electrons coming from the negative terminal of voltage source decreases. Additionally, drift velocity v_d is related to electric field E as $v_d = \mu E$. This states that $v_d \propto E$. Therefore, on decreasing the electric field E, the drift velocity v_d decreases.

Ans. 9. Option (B) is correct.

Explanation : Given that
Total Power = 100 W,
Time = 1 min = 60s

$$\text{As, Power} = \frac{\text{Energy}}{\text{Time}}$$

$$\Rightarrow \text{Energy} = \text{Power} \times \text{Time}$$

$$\Rightarrow \text{Energy} = 100 \times 60 = 6000 \text{ J}$$

Ans. 10. Option (A) is correct.

Explanation : For a balanced Meter Bridge

$$\frac{P}{Q} = \frac{L}{100 - L_1}$$

There is no parameter related to the radius of the wire. So, the null deflection of galvanometer does not depend on the radius of the wire. So, even if the radius of the wire is doubled, the null deflection of the galvanometer will not be changed.

Ans. 11. Option (B) is correct.

Explanation : Potentiometer is used to measure internal resistance of a cell, e.m.f. of a cell and to compare the e.m.f.'s of cells.

Ans. 12. Option (A) is correct.

Explanation : Potentiometer wire should posses high specific resistance and low temperature coefficient. Therefore, copper wire is not use in potentiometer.

Ans. 13. Option (A) is correct.

Explanation : Kirchhoff's current law is based on the law of conservation of charge.

Ans. 14. Option (A) is correct.

Explanation : For a circular loop of radius R, carrying current I in $x - y$ plane, the magnetic moment

$$M = I \times \pi R_2.$$

It acts perpendicular to the loop along z-direction.
When half of the current loop is bent in $y - z$ plane, then magnetic moment due to half current loop is $x - y$ plane, $M_1 = I \times (\pi R_1/2)$ acting along z-direction.
Magnetic moment due to half current loop in $y - z$ plane, $M_2 = I \times (\pi R_2/2)$ acting along x-direction.
Net magnetic moment due to entire bent current loop,

$$M_{net} = \sqrt{M_1^2 + M_2^2}$$

$$= \sqrt{2}\,\frac{I\pi R^2}{2}$$

$$= \frac{M}{\sqrt{2}}$$

Therefore, $M_{net} < M$ or M diminishes.

Ans. 15. Option (D) is correct.

Explanation : When charge/mass ratio of these two particles is same and charges on them are of opposite nature, then the charged particles will traverse identical helical paths in a completely opposite sense.

Ans. 16. Option (A) is correct.

Explanation : Shunt (S) is connected in parallel to the galvanometer (resistance G). So, the effective resistance is GS/(G + S).

Ans. 17. Option (A) is correct.

Explanation :

$$S = \frac{i_g G}{i - i_g}$$

$$\frac{S}{G} = \frac{i_g}{i - i_g} = \frac{1}{10 - 1} = 1 : 9$$

Ans. 18. Option (A) is correct.

Explanation :

$$\mu_r = \frac{L}{L_0} = \frac{2.4}{6 \times 10^{-3}} = 400$$

Ans. 19. Option (A) is correct.

Explanation : If two coils of self-inductance L_1 and L_2 are coupled together, their mutual inductance becomes $M = k\sqrt{L_1 L_2}$ where k = coupling constant whose value lies between 0 and 1.

Ans. 20. Option (C) is correct.

Explanation: Lenz's law is a consequence of the law of conservation of energy.

Lenz's law says that induced current always tends to oppose the cause which produces it. So work is done against opposing force. This work is transformed into electrical energy. So, it a consequence of law of conservation of energy.

Ans. 21. Option (D) is correct.

Explanation: If current I flows through a coil of self-inductance L, then magnetic field energy stored in it is $\frac{1}{2}Li^2$.

Ans. 22. Option (B) is correct.

Explanation : Here,

$I_{rms} = 5A$, $n = 50Hz$ and $t = \frac{1}{300}s$.

$\Rightarrow$ Peak value $= \sqrt{2}I_{rms} = \sqrt{2} \times 5 = 5\sqrt{2}A$

Now, $I = I_0 \sin \omega t = 5\sqrt{2} \sin 2\pi \nu t$

$$= 5\sqrt{2} \sin 2\pi \times 50 \times \frac{1}{300} = 5\sqrt{\frac{3}{2}}A$$

Ans. 23. Option (A) is correct.

Explanation : $X_c = 1/2\pi fC$

So, as f increases, X_c becomes smaller and smaller. For very high value of f, X_c will be too small which may be considered as SHORT.

Ans. 24. Option (C) is correct.

Explanation : Quality factor (Q) of an L-C-R circuit is given by,

$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

Tuning of an LCR circuit depends on quality factor of the circuit. Tuning will be better when quality factor of the circuit is high.

For Q to be high, R should be low, L should be high and C should be low. Therefore, option (C) is most suitable.

Ans. 25. Option (A) is correct.

Explanation : Q factor of a series LCR circuit is given by

$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

Section-B

Ans. 26. Option (B) is correct.

Explanation : From Coulombs law,
Force between two charged particles is inversely proportion to the square of distance between them.

$$F \propto \frac{1}{r^2}$$

$$\Rightarrow \frac{F_1}{F_2} = \frac{r_2^2}{r_1^2}$$

$$\Rightarrow \frac{F_1}{F_2} = \frac{\left(\frac{9_1}{2}\right)^2}{r_1^2}$$

$$\Rightarrow \frac{F_1}{F_2} = \frac{1}{4}$$

$$\Rightarrow F_2 = 4F_1$$

Therefore, force will increase to four times.

Ans. 27. Option (B) is correct.

Explanation : Electric field is given by

$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$$

Here, $q = 1.6 \times 10^{-19}\text{C}$

$$\Rightarrow E = \frac{1}{4\pi\varepsilon_0}\frac{1.6 \times 10^{-19}}{\left(10^{-15}\right)^2}$$

$$= 9 \times 10^9 \frac{1.6 \times 10^{-19}}{\left(10^{-15}\right)^2}$$

$$= 14.4 \times 10^{20}\,\text{NC}^{-1}$$

Ans. 28. Option (C) is correct.

Explanation : Let r be the radius of smaller drop and R be the radius of bigger drop.
Since volume of 8 smaller drops = volume of a bigger drop.

$$8 \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$$

$$R = \left(8r^3\right)^{1/3} = 2r = 4 \text{ mm}$$

As the capacity of bigger drop

$$= 4\pi\varepsilon_0 R = 4\pi\varepsilon_0 2r$$

As potential on bigger drop

$$(V) = 8 \times \frac{1}{4\pi\varepsilon_0}\frac{q}{R}$$

$$= 8 \times \frac{1}{4\pi\varepsilon_0}\frac{q}{2r}$$

$$= 4 \times \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$$

$$= 4 \times V$$

$$= 4 \times 220$$

$$= 880 \text{ volt}$$

Ans. 29. Option (A) is correct.

Explanation : Maximum capacitance of capacitors is obtained when they are connected in parallel.

$$C_p = C_1 + C_2 + C_3$$

when, $C_1 = C_2 = C_3$

$$C_p = 3C$$

When these capacitors are connected in series, the effective capacitance is minimum.

$$\frac{1}{C_s} = \frac{1}{C} + \frac{1}{C} + \frac{1}{C}$$

$$\frac{1}{C_s} = \frac{3}{C}$$

$$C_s = \frac{C}{3}$$

When two in parallel and one in series, the effective capacitance is

$$C_{\text{eff}} = \frac{2C}{3}$$

When two in series and one in parallel, the effective capacitance is

$$C_{\text{eff}} = \frac{3C}{2}$$

Therefore, any combination of parallel and series capacitors, C_{eff} always be less them C_p.

Ans. 30. Option (D) is correct.

Explanation : Given that

$$e = 1.6 \times 10^{-19}\text{C and I} = 8.0\text{A}$$

Let n be the number of electrons per second.

$$\text{I} = \frac{q}{t} = \frac{n \times e}{t} \text{ as } q = n \times e$$

$$8.0 = \frac{n \times 1.6 \times 10^{-19}}{1}$$

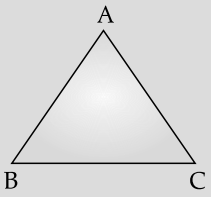
$$\Rightarrow n = \frac{8.0}{1.6 \times 10^{-19}}$$

$$= 5 \times 10^{19} \text{ electrons per senonds.}$$

Ans. 31. Option (D) is correct.

Explanation : A wire of resistance 15 Ω bent into an equilateral triangle. As resistance is directly proportional to length.

So, resistance of each arm $= \frac{15}{3} = 5\Omega$.



Since, R_{AC} and R_{BC} are in series, their combine resistance $= 5 + 5 = 10\,\Omega$.

This 10 Ω resistance and R_{AB} are in parallel.

Therefore, equivalent resistance between A and B,

$$= \frac{10 \times 5}{10 + 5} = \frac{50}{15} = 3.33\ \Omega$$

Ans. 32. Option (B) is correct.

Explanation :

Since, $\text{R} = \frac{\rho \text{L}}{\text{A}} = \frac{\rho \text{L}}{\pi r^2} = \frac{\rho \text{L}}{\pi\left(\frac{d}{2}\right)^2} = \frac{4\rho \text{L}}{\pi d^2}$

Hence, $\text{R} \propto \text{L}$

$$\text{R} \propto \frac{1}{d^2}$$

Therefore, when length becomes $\frac{\text{L}}{3}$ and diameter becomes 3d. The new resistance is minimum among all the instances.

Ans. 33. Option (A) is correct.

Explanation : Given that $\text{P}_1 = 60$ W and $\text{P}_2 = 80$ W and V = 220 V

Power is defined as $\text{P} = \frac{\text{V}^2}{\text{R}}$

$$\Rightarrow \text{P} \propto \frac{1}{\text{R}}$$

$$\Rightarrow \frac{\text{P}_1}{\text{P}_2} = \frac{\text{R}_2}{\text{R}_1}$$

$$\Rightarrow \frac{\text{R}_1}{\text{R}_2} = \frac{\text{P}_2}{\text{P}_1}$$

$$\Rightarrow \frac{\text{R}_1}{\text{R}_2} = \frac{80}{60} = \frac{4}{3}$$

Ans. 34. Option (A) is correct.

Explanation: The current density (number of free electrons per m^3) in metallic conductor is of the order of 10^{28}.

Ans. 35. Option (B) is correct.

Explanation : Equivalent resistance of the circuit $= (5 + 5) \parallel (5 + 5) = 5\,\Omega$

Total circuit current $= \frac{10}{5} = 2\,\text{A}$

Current in each branch is 1 A

So, potential difference between points A and B *i.e.* across the 5 Ω resistor is $1 \times 5 = 5$ V.

Ans. 36. Option (A) is correct.

Explanation :

$$\text{B} = \mu_0 ni = 4\pi \times 10^{-7} \times 5 \times 10 \times 10^2$$

$$= 2\pi \times 10^{-3}\text{T}$$

Ans. 37. Option (B) is correct.

Explanation :

$$\text{S} = \frac{i_g \text{G}}{i - i_g} = \frac{100 \times 0.01}{10 - 0.01} = 0.1\Omega$$

Ans. 38. Option (A) is correct.

Explanation :

$$e.m.f. = -\frac{d\phi}{dt}$$
$$= \frac{d\left(5t^2 + 2t + 3\right)}{dt}$$
$$= -(10t + 2) = -32$$
$$e.m.f._{t=3} = -(10 \times 3 + 2) = -32$$

Ans. 39. Option (A) is correct.

Explanation :

Given,

Power associated with secondary,

$$P_s = 12\ W$$

Secondary voltage, $V_s = 24\ V$

Current in the secondary,

$$I_s = \frac{P_s}{V_s} = \frac{12}{24} = 0.5A$$

Peak value of the current in the secondary,

$$I_0 = I_s\sqrt{2} = (0.5)(1.414) = 0.707 \text{ or } \frac{1}{\sqrt{2}}\text{ A.}$$

Ans. 40. Option (A) is correct.

Explanation : Heat produced by AC is Heat produced by DC is I^2R

$$I_{RMS}^2 = I^2R$$
$$\therefore \quad I = I_{RMS} = \frac{I_0}{\sqrt{2}} = 0.707I_0$$

Ans. 41. Option (A) is correct.

Explanation : Induced e.m.f.

$$\varepsilon = \frac{df}{dt} = \frac{dBA}{dt} = A_0\frac{dB}{dt}$$
$$= A_0\left(\frac{4B_0 - B_0}{t}\right) = \frac{3A_0B_0}{t}$$

Ans. 42. Option (B) is correct.

Explanation :

Given $\frac{L}{R} = 2.0 \times 10^{-3}$ …(i)

And $\frac{L}{R + 60} = 0.5 \times 10^{-3}$ …(ii)

Dividing eq (i) by eq (ii)

$$\frac{R + 60}{R} = 4$$
$$\Rightarrow \quad R + 60 = 4R$$
$$\Rightarrow \quad 3R = 60$$
$$\Rightarrow \quad R = \frac{60}{3} = 20\,\Omega$$

Substitute this value in (1)

$$\frac{L}{20} = 2.0 \times 10^{-3}$$
$$\Rightarrow \quad L = 20 \times 2.0 \times 10^{-3}$$
$$= 40 \times 10^{-3} = 40mH$$

Ans. 43. Option (A) is correct.

Explanation : Given inductive reactance

$$X_L = 2\pi fL$$
$$= 2 \times 3.14 \times 50 \times 15 \times 10^{-3}$$
$$= 4.71\,\Omega$$

The rms current in the circuit is

$$I = \frac{V}{X_L} = \frac{220}{4.71} = 46.71\,\Omega$$

Ans. 44. Option (A) is correct.

Explanation :

$$R = \frac{V}{i} = \frac{10}{2} = 5\Omega$$
$$Z = \frac{10}{1} = 10\Omega$$
$$(R)^2 + (\omega L)^2 = Z^2$$
$$\Rightarrow \quad (5)^2 + (\omega L)^2 = 10^2$$
$$\Rightarrow \quad 25 + (\omega L)^2 = 100$$
$$\Rightarrow \quad (\omega L)^2 = 100 - 25 = 75$$
$$\Rightarrow \quad \omega L = 5\sqrt{3} \qquad ...(i)$$
$$\omega = 2\pi f = 2\pi\frac{50}{\pi} = 100$$

Substitute value in equation (i)

$$\Rightarrow \quad 100L = 5\sqrt{3}$$
$$\Rightarrow \quad L = \frac{5\sqrt{3}}{100} = \frac{\sqrt{3}}{20}H$$

Ans. 45. Option (A) is correct.

Explanation : $\vec{E} = -\vec{\nabla}V$
So, the electric field is always perpendicular to equipotential surface. Negative gradient of electric potential is electric field. So, direction of electric field must be in the direction of the decreasing order of electric potential.

Ans. 46. Option (A) is correct.

Explanation : Electron has negative charged and moves towards the higher potential. By rubbing two materials, transferring of electron take place from the material in which electrons are less tightly bound to the other material in which electrons are more tightly bound. Material lost electrons becomes positively charged and materials gains electrons becomes negatively charged.
So, both assertion and reason are true. Reason is also the correct explanation of Assertion.

Ans. 47. Option (A) is correct.

Explanation : Kirchhoff's junction rule is applicable at any point of an electrical circuit and there is no limitation of number of lines meeting at that point. So, the assertion is true.
While steady current is flowing there is no accumulation of charge at the junction. Total incoming charge = total outgoing charge. So, the reason is also true and explains the assertion.

Ans. 48. Option (A) is correct.

Explanation : Current carrying wire creates magnetic field. This magnetic field has no effect on a stationary charge. But when the charge also moves, it creates a current. This current produces a magnetic field. Two fields interact and the charge is deflected. So, the assertion is true. Moving charge creates a current which produces a magnetic field. So, the reason is also true. Reason is the correct explanation of A.

Ans. 49. Option (B) is correct.

Explanation : Current or moving charged particle creates magnetic field irrespective of direct current or alternating current. So assertion is false. Alternating current changes direction with time. So, the reason is true, but cannot explain the assertion.

Section-C

Ans. 50. Option (B) is correct.

Explanation : The phenomenon of electromagnetic induction is used in this problem. Whenever the number of magnetic lines of force (magnetic flux) passing through a circuit change (or a moving conductor cuts the magnetic flux), an emf is produced in the circuit (or emf induces across the ends of the conductor) is called induced emf. The induced emf persists only as long as there is a change or cutting of flux.
When cylindrical bar magnet is rotated about its axis, no change in flux linked with the circuit takes place, consequently no emf induces and hence, no current flows through the ammeter A. Hence the ammeter shows no deflection.

Ans. 51. Option (D) is correct.

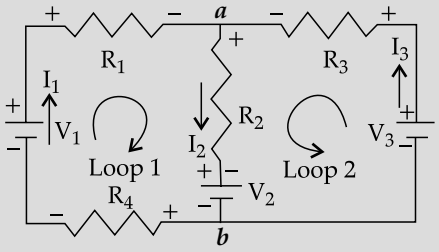
Explanation : When coil A moves towards coil B with constant velocity, so rate of change of magnetic flux due to coil B in coil A will be constant that gives constant current in coil A in same direction as in coil B by Lenz's law.

Case Study

Ans. 52. Option (C) is correct.

Explanation : Apply Kirchhoff's current junction law at point-b

$$(+I_1)+(-I_2)+(+I_3) = 0$$
$$I_1 - I_2 + I_3 = 0$$



Ans. 53. Option (D) is correct.

Explanation: According to the Kirchhoff's current law, sum of the currents entering the junction is equal to the sum of the currents leaving the junction.

Therefore, at node **B**

Entering current = leaving current

$$I_2 = I_1 + I_3$$
$$\Rightarrow \quad -I_1 + I_2 - I_3 = 0$$

Ans. 54. Option (C) is correct.

Explanation: According to the Kirchhoff's second law, the sum of potential difference across the components is zero in any closed loop of a mash.

Therefore, in loop 1, by following the sign conventional rule

$$V_1 - I_1R_1 - I_2R_2 - V_2 - I_1R_4 = 0$$

Ans. 55. Option (A) is correct.

Explanation : Similar to the previous, by following the sign convention and applying the Kirchhoff's voltage law in loop 2,

$$V_3 - I_3R_3 - I_2R_2 - V_2 = 0.$$

■■■

Solutions of Question Paper 3

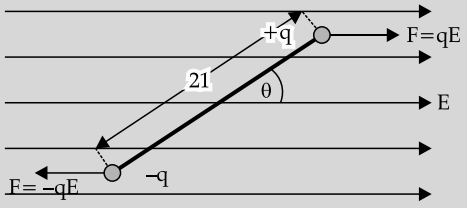
Section-A

Ans. 1. Option (A) is correct.

Explanation : Since electron is about 1800 times lighter than proton, so on applying an electric field electron will be accelerated fast. Additionally, electrons are the mobile charge and can be free to move if sufficient energy to give, whereas protons are bound to the nuclei. So, cause of charging is actual transfer of electrons.

Ans. 2. Option (C) is correct.

Explanation : Torque τ on a dipole in a uniform electric field = force × perpendicular distance.



$\tau = qE(2l \sin\theta) = 2ql E \sin\theta = pE \sin\theta$

Where, $p = 2ql$ Nm.

In vector form

$$\vec{\tau} = \vec{p} \times \vec{E}$$

Ans. 3. Option (B) is correct.

Explanation : Since

$$dV = -E.ds$$

$$\Rightarrow (V_f - V_i) = -E.ds$$

$$\Rightarrow (V_i - V_f) = E.ds$$

This indicates that on moving along the line of force V decreases as $V_i > V_f$.

Ans. 4. Option (A) is correct.

Explanation : Capacitance of parallel plate capacitor is given by:

$$C = \frac{K\varepsilon_0 A}{d}$$

where,

C = capacitance of parallel plate capacitor

K = dielectric constant of dielectric material

A = area of each plate

d = distance between the plates

Therefore, C increases as A increases and d decreases.

Ans. 5. Option (B) is correct.

Explanation : Work done by moving a charge q from a point P_1 having potential V_1 to another point P_2 having potential V_2 is:

$$W = q(V_2 - V_1)$$

In terms of force and displacement, work done is:

$$W = \int_{P_1}^{P_2} F ds$$

$$= \int_{P_1}^{P_2} (qE)\, ds$$

$$= q\int_{P_1}^{P_2} E ds, \quad \text{as } \int E ds = V$$

$$= q[V]_{V_1}^{V_2} = q(V_2 - V_1)$$

The equation indicates that whatever path is chosen from point P_1 to point P_2, the integral will have only one value.

Ans. 6. Option (A) is correct.

Explanation : Current in the circuit = I = V/R If r = internal resistance of the cell, then V = E – Ir

$$r = \frac{E - V}{I} = \frac{E - V}{V/R} = \frac{E - V}{V} R$$

Ans. 7. Option (A) is correct.

Explanation : Let the internal resistance of cell = r and current drawn from it = i. Then, the terminal potential difference V = E – Ir

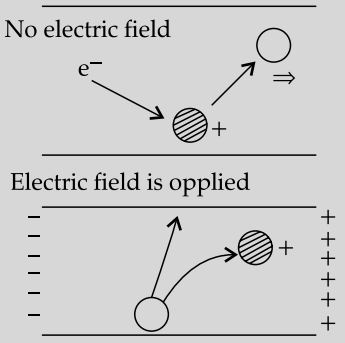
Since, i is increasing, the terminal potential difference will decrease.

Ans. 8. Option (A) is correct.

Explanation : Electric current is the flow of electron and in current carrying wire, as many electrons enter at one end, the same number of electrons leave at other end. Therefore, current carrying wire is never charged.

Ans. 9. Option (C) is correct.

Explanation : It is curved because there is motion of charge in an electric field.



Ans. 10. Option (C) is correct.

Explanation : According to ohm's law, current flowing through a conductor is directly proportional to the applied potential difference across the conductor.

For diode, expression of current is

$$I = I_0 \left(e^{\frac{qV}{kT}} - 1 \right).$$

Thus, current is not directly proportion to applied potential difference. Hence, diode is non-ohmic.

Ans. 11. Option (A) is correct.

Explanation : Kirchhoff's second law states that in any closed loop of a mash, the sum of potential difference across the components is zero. In other word, total energy gained per unit charge is equal to the energy lost per unit charge. Therefore, this law is based on the conservation of energy.

Ans. 12. Option (C) is correct.

Explanation :

$$B = B_1 - B_2$$

$$10.0 \times 10^{-3} = \frac{\mu_0 i_1}{2\pi r} - \frac{\mu_0 i_2}{2\pi r}$$

$$\Rightarrow \quad 0.01 = \frac{\mu_0}{2\pi r}(i_1 - i_2) \quad ...(i)$$

In 2nd case

$$B = B_1 + B_2$$

$$30 \times 10^{-3} = \frac{\mu_0 i_1}{2\pi r} + \frac{\mu_0 i_2}{2\pi r}$$

$$0.03 = \frac{\mu_0}{2\pi r}(i_1 + i_2) \quad ...(ii)$$

e.q. (i) divide by eq. (ii)

$$\frac{i_1 - i_2}{i_1 + i_2} = \frac{0.01}{0.03} = \frac{1}{3}$$

$$3(i_1 - i_2) = i_1 + i_2$$

$$3i_1 - 3i_2 = i_1 + i_2$$

$$3i_1 - i_1 = i_2 + 3i_2$$

$$2i_1 = 4i_2$$

$$\frac{i_1}{i_2} = \frac{4}{2}$$

$$\frac{i_1}{i_2} = 2$$

Ans. 13. Option (A) is correct.

Explanation : The magnetism of a magnet is produced due to spin of electrons. Each electron is revolving around the nucleus of an atom. The revolving electron is equivalent to a tiny loop of current and exhibit orbital magnetic dipole moment $\overrightarrow{M_o}$. Additionally, electron spins around its axis. Another dipole moment is there, which is know as spin magnet $\overrightarrow{M_s}$. the net magnetic dipole moment is the vector sum of these, i.e., $\overrightarrow{M_o} + \overrightarrow{M_s}$.

Ans. 14. Option (C) is correct.

Explanation : Magnetic field is given by $B = \frac{\mu_0 i}{2\pi r}$ *i.e.,* $B \propto \frac{1}{r}$, which indicates that magnetic field around a long straight current carrying wire is cylindrical symmetry.

Ans. 15. Option (D) is correct.

Explanation : Here, centripetal force is provided by magnet force, *i.e.,*

$$\frac{mv^2}{r} = qvB$$

$$r = \frac{mv}{qB}$$

$$r \propto \frac{v}{B}$$

Ans. 16. Option (A) is correct.

Explanation : Torque is given by $\tau = NIBA \sin\theta$

Since the magnetic field is radial; $\theta = 90°$

$\Rightarrow \tau = NIBA$

Ans. 17. Option (C) is correct.

Explanation : Moving coil galvanometer is worked on the principle that when a current carrying coil is placed in magnetic field, it experiences a torque. Since torque is proportional to the current, therefore $i \propto \frac{k\theta}{NBA}$. This states that deflection of the coil is directly proportion to current.

Ans. 18. Option (D) is correct.

Explanation :

$$|\varepsilon| = \left|\frac{-d\phi}{dt}\right|$$

$$|\varepsilon| = |-(12t - 5)|$$

$$|\varepsilon| = 12t - 5$$

at $t = 0.25$ Sec

$$|\varepsilon| = 12\ (0.25) - 5$$

$$|\varepsilon| = 2$$

$$\therefore i = \frac{\varepsilon}{R} = \frac{2}{10} = 0.2\ A$$

Ans. 19. Option (A) is correct.

Explanation :

Since, $e = \frac{d\phi}{dt}$,

but, $e = iR$ and $i = \frac{dq}{dt}$

$$\Rightarrow \frac{dq}{dt} \cdot R = \frac{d\phi}{dt}$$

$$\Rightarrow \quad dq = \frac{d\phi}{R}$$

This clearly states that electromagnetic induction, the induced charge depends only on change of flux and resistance of coil, and independent from time.

Ans. 20. Option (C) is correct.

Explanation : A dynamo is an electrical generator that produces direct current with the use of a commutator. It is capable of delivering power in many places like industries, factories and foundation upon which many other electric-power conversion devices were based. Thus, dynamo converts mechanical energy into electrical energy.

Ans. 21. Option (A) is correct.

Explanation :

$$\phi = BA\cos\theta$$
$$= 4 \times 2 \times \cos 60^\circ$$
$$= \frac{4 \times 2 \times 1}{2} = 4\text{weber}.$$

Ans. 22. Option (D) is correct.

Explanation : Here, power loss *i.e.*, $\frac{V^2}{R}$ and i^2R occurs in form of heat. For long distance, length of wire is large and have very high resistance $R \propto l$. Therefore, there is a loss in power as resistance is inversely proportion to power loss. So, it is more economical due to power loss.

Ans. 23. Option (D) is correct.

Explanation :

$$\text{Power} = \frac{\text{work}}{\text{time}} = \frac{W}{t},$$

Ans. 24. Option (A) is correct.

Explanation : Since,

$$X_L = \omega L = 2\pi f L$$
$$\Rightarrow \quad X_L \propto f$$

Ans. 25. Option (B) is correct.

Explanation : When an AC voltage of 220 V is applied to the capacitor C, the charge on the plates is in phase with the applied voltage.

Section-B

Ans. 26. Option (A) is correct.

Explanation : Since, dielectric constant of metal is ∞.
The electric force between the charges in any medium is given by

$$= \quad F_m = \frac{F_{air}}{\varepsilon_r}$$
$$\Rightarrow F_m = \frac{F}{\infty}$$
$$\Rightarrow F_m = 0.$$

Ans. 27. Option (D) is correct.

Explanation : Direction of area element is normal to X-Y plane, *i.e.*, z axis.
Therefore, $\vec{dS} = 10\hat{k}$.
Now, using the relationship between electric flux ϕ and electric field $\vec{E}$:

$$d\phi = \vec{E} \cdot \vec{dS} = \left(\hat{i} + 2\hat{j} + 4\hat{k}\right) \cdot \left(10\hat{k}\right)$$
$$= 40 \text{ units}$$

Ans. 28. Option (D) is correct.

Explanation : The potential difference between two points of equipotential surface i.e.

$$V_2 - V_1 = 0 = \frac{W}{q} \Rightarrow W = 0$$

Therefore, no work done is done in moving a charge from one point to another on an equipotential surface.

Ans. 29. Option (C) is correct.

Explanation : We know that

$$E = \frac{dV}{dx} = \frac{d\left(3x^2\right)}{dx} = 6x$$

Here $x = 1$ m
Hence, E = 6 V/m.

Ans. 30. Option (A) is correct.

Explanation : Since, two copper wires are connected in series, current i flow through them is same. Both wires are made of same material, so $n_1 = n_2$
As, $i = neAv_d$

$$\Rightarrow \quad \frac{v_{d_1}}{v_{d_2}} = \frac{A_2}{A_1}$$
$$\Rightarrow \quad \frac{v_{d_1}}{v_{d_2}} = \frac{1}{3} = \frac{A_2}{A_1}$$
$$\Rightarrow \quad \frac{A_1}{A_2} = \frac{3}{1}$$

Ans. 31. Option (B) is correct.

Explanation : Given that resistance of wire 12 Ω. It is bent and form circle, then resistance f each semicircle is 6 Ω. Now, measuring the resistance across its diameter, these two resistances are in parallel.
Their effective resistance

$$= \frac{6R \times 6R}{6R + 6R} = 3R$$

Ans. 32. Option (B) is correct.

Explanation :

As $P = V \times i = i^2R = \frac{V^2}{R}$

R for heater A

$$R_A = \frac{V^2}{P} = \frac{(220)^2}{500} = 96.8\ \Omega$$

R for heater B

$$R_B = \frac{V^2}{P} = \frac{(220)^2}{1000} = 48.4\ \Omega$$

$\Rightarrow \quad R_A > R_B$

When two heaters are connected in parallel, voltage remains same for two resisters and power is calculated using the following formula:

$$P = \frac{V^2}{R} \text{ or } P \propto \frac{1}{R}$$

$\Rightarrow \quad P_A < P_B$

Therefore, power dissipation is small in heater A as compare to heater B.

Heat generated $H = P \times t$, where t is time in seconds.

$\Rightarrow \quad H_A < H_B$

Ans. 33. Option (A) is correct.

Explanation : As

$$P = V \times i = i^2R = \frac{V^2}{R}$$

R for 40 W bulb

$$R_{40} = \frac{V^2}{P} = \frac{(220)^2}{40} = 1210\ \Omega$$

R for 60 W bulb

$$R_{60} = \frac{V^2}{P} = \frac{(220)^2}{60} = 806.67\ \Omega$$

$\Rightarrow R_{40} > R_{60}$

When two bulbs are connected in series, current flow through them is same and power is calculated using the following formula:

$$P = i^2R \text{ or } P \propto R$$

$$\Rightarrow \frac{P_{40}}{P_{60}} = \frac{R_{40}}{R_{60}}$$

Since, $R_{40} > R_{60}$ therefore, $P_{40} > P_{60}$

Therefore, power dissipation is large in 40 W bulb as compare to 60 W bulb. 40 W bulb is brighter than 60 W.

Ans. 34. Option (C) is correct.

Explanation : Magnetic field due to current carrying circular loop of radius a at a point on the axis at a distance *x* from the centre is given by

$$B = \frac{\mu_0}{4\pi} I \times 2\pi \frac{a^2}{\left(a^2 + x^2\right)^{3/2}}$$

$$\Rightarrow 54 \times 10^{-6} = \frac{10^{-7} \times I \times 2\pi \times \left(3 \times 10^{-2}\right)^2}{\left[\left(3 \times 10^{-2}\right)^2 + \left(4 \times 10^{-2}\right)^2\right]^{3/2}}$$

$\Rightarrow I = 11.94A$

Magnetic field at the centre =

$$B = \frac{\mu_0}{4\pi} \frac{I \times 2\pi}{a}$$
$$= \frac{10^{-7} \times 11.94 \times 2\pi}{3 \times 10^{-2}}$$
$$= 250\mu T$$

Ans. 35. Option (A) is correct.

Explanation : Using Ampere's law

$$\int B \cdot dl = \mu_0 i$$
$$B \times 2\pi r = \mu_0 i$$

Here, *i* is zero, for $r < R$, where R is radius of the tube

$\therefore \quad B = 0$

Ans. 36. Option (A) is correct.

Explanation :

$$B = \mu_0 ni$$

$$\Rightarrow i = \frac{B}{\mu_0 n} = \frac{20 \times 10^{-3}}{4\pi \times 10^{-7} \times 70 \times 100}$$

$$= 2.27 A$$

Ans. 37. Option (B) is correct.

Explanation : Charge is entered at point A making an angle 30°with the velocity v. one component of it is along the field and other component is perpendicular to it. Its perpendicular component v sin 30° will create circular motion, whereas its component along the field v cos 30° will have linear motion. Thus, resultant will have helical path.

Ans. 38. Option (D) is correct.

Explanation :

$$\frac{T_2^2}{T_1^2} = \frac{3M + M}{3M - M} = 2M$$

$$\Rightarrow \quad T_2 = \sqrt{2} T_1 = 3\sqrt{2}$$

Ans. 39. Option (C) is correct.

Explanation : In stable equilibrium, Potential energy U is defined as

$$U = 0MB$$

$$= -(0.4)(0.16)$$

$$= -0.064 J$$

Ans. 40. Option (C) is correct.

Explanation : Here,

$$T_1 = \frac{60}{10} = 6 \sec,$$

and $$T_2 = \frac{60}{4} = 15 \sec$$

$$\frac{M_1}{M_2} = \frac{T_2^2 + T_1^2}{T_2^2 - T_1^2}$$

$$= \frac{15^2 + 6^2}{15^2 - 6^2} = \frac{225 + 36}{225 - 36} = \frac{29}{21}$$

Ans. 41. Option (A) is correct.

Explanation : we know that

$$B = \frac{H}{\cos\theta} = \frac{1}{\cos 60^\circ} = \frac{1}{1/2} = 2$$

Ans. 42. Option (B) is correct.

Explanation :

$$\mu_r = 1 + \chi$$

$$= 1 + 5000$$

$$= 5001$$

$$\because \mu = \mu_r \mu_0 = 5001\left(4\pi \times 10^{-7}\right)$$

$$= 6.28 \times 10^{-3}$$

Ans. 43. Option (A) is correct.

Explanation : Mutual inductance of two coils

$$M = \sqrt{M_1 M_2}$$

$$= \sqrt{9mH \times 4mH} = 6mH$$

Ans. 44. Option (A) is correct.

Explanation : We know that

$$L = \frac{\mu_0 N^2 A}{I} \propto \frac{N^2}{I}$$

$$\Rightarrow \frac{L_1}{L_2} = \frac{\left(1/3\right)^2}{1/3} = \frac{1}{3}$$

Ans. 45. Option (A) is correct.

Explanation : Magnitude of charge on one electron, $e = 1.6 \times 10^{-19}$ Coulomb.

According to the quantization of charge, charges of the particle (q) are integral multiple of charge of an electron/proton (e). *i.e.*, $q = ne$. Therefore, number of charges in a coulomb,

$$n = \frac{q}{e} = \frac{1}{1.6 \times 10^{-19}}$$

$$= 0.625 \times 10^{19}$$

Clearly shows that one coulomb of charge is bigger than the charge on electron and quantization of charge is the correct reason for it. So, both assertion and reason are true.

Ans. 46. Option (D) is correct.

Explanation : Potential difference between two points is defined as work done (W) in moving unit positive charge from one point A having potential V_A to other point B having potential V_B.

The work done is also explained as:

$$W = \int_A^B F ds$$

We know that $F = qE$

$$= \int_A^B (qE) ds$$

$$= q\int_A^B E ds$$

$$= q[V]_{V_A}^{V_B} = q\left[V_B - V_A\right]$$

As, electric field at a point (x,y), *i.e.*

$$E(x, y) = \frac{dV}{ds}.$$

It concludes that whatever path S is selected on moving charge from A to B, the integral will have only one value. It means potential difference between two points is independent of path. So, assertion is not true.

Electric field is a conservative field *i.e.* line integral of an electric field along a closed path is zero.

$$\int_A^B \vec{E}\cdot\overrightarrow{ds} + \int_B^A \vec{E}\cdot\overrightarrow{dl} = 0$$

So, assertion is incorrect and reason is correct.

Ans. 47. Option (A) is correct.

Explanation : When a potential difference is measured using a voltmeter, voltmeter draws some current and when it is connected across the cell, there is a internal potential drop due to the internal resistance of the cell. Hence, measuring potential will not be accurate.

In potentiometer, there is no current drawn from external circuit.

Therefore, both assertion and reason are correct and reason is also the correct explanation of A.

Ans. 48. Option (A) is correct.

Explanation : The coil of moving coil galvanometer is suspended in a very strong radial magnetic field. Earth's magnetic field is too weak compared to that and hence its effect is negligible. So, assertion and reason both are true and the reason explains the assertion properly.

Ans. 49. Option (A) is correct.

Explanation : In absence of magnetic field, moving electron will not be deflected. This possibility is true. So, assertion is true.

$$\vec{F} = q\left(\vec{v}\times\vec{B}\right).$$

So, force on electron is directly proportional to the strength of the magnetic field. So, reason is true. Reason properly explains the assertion.

Section-C

Ans. 50. Option (D) is correct.

Explanation : Gauss's law states that the electric flux passing through any closed surface is $\frac{1}{\varepsilon_0}$ times of charge enclosed. Here, charge is outside the enclosed surface. Therefore, net electric flux emerging out through the surface is zero.

Another way of explaining is that the charge is placed outside the surface and the number of field lines entering the surface is equal to the number of field line going out. So, net flux through the close surface is zero.

Ans. 51. Option (C) is correct.

Explanation : When magnetic flux is normal to the field, $\theta = 0°$. Therefore,

$$\phi = BA\cos\theta$$

$$= 0.5\times10\times10^{-2}\times\cos 0°$$

Ans. 52. Option (A) is correct.

Explanation : The direction of the electrostatic force is outward from the positive charge and towards the negative charge. Hence, the electric field lines are inward for negative charge. Additionally, for a point charge, electric lines of force are never circular, they are radial in nature.

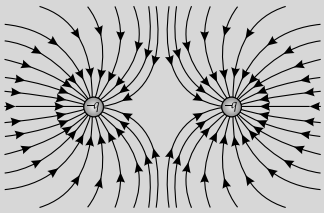
Ans. 53. Option (B) is correct.

Explanation : Since, electric field lines start from a positive charge and terminate on a negative charge. If field lines form closed loops, the origin points and termination points must be same which is not possible.

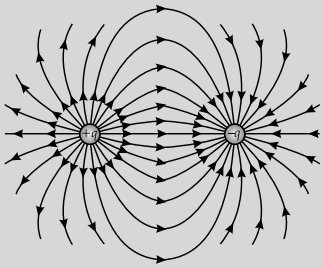
Ans. 54. Option (D) is correct.

Explanation : Field lines due to two like charges and two unlike charges having same magnitudes are shown in figure below. It is clear from the figure that field lines are the curved lines in these two cases, but do not form closed loops.

(a) Field lines due to two like charges



(b) Field lines due to two unlike charges



Ans. 55. Option (A) is correct.

Explanation : If electric field line is not perpendicular to the surface, then it will have two components:
(1) electric field component parallel to the surface and
(2) electric field component perpendicular to the surface.
Where, perpendicular component will not affect the surface charge, whereas electric field parallel component will push the charges at rest into motion. This violet the approximation in electrostatics. Therefore, electric field cannot be any other direction. It has to be in perpendicular direction.

■■■

Solutions of Question Paper 4

Section-A

Ans. 1. Option (C) is correct.

Explanation : Charge on conductor B remains same and it induces equal and opposite charge on uncharged conducting sphere.

Ans. 2. Option (B) is correct.

Explanation : Electric field due to point charge $E \propto \frac{1}{r^2}$ while, electric field due to dipole is $E \propto \frac{1}{r^3}$.

This clearly indicates that electric field due to dipole decreases more rapidly.

Ans. 3. Option (A) is correct.

Explanation : After connecting with the wire, they have equal potential

So, $V_1 = V_2$

$\frac{KQ_1}{3} = \frac{KQ_2}{1}$, Hence, Q_1 is the charge of sphere having radius 3 cm.

So, $Q_1 = 3Q_2$

When they are connected, $Q_1 + Q_2 = 4 \times 10^{-2}$ C

So, $Q_2 = 1 \times 10^{-2}$C and $Q_1 = 3 \times 10^{-2}$ C

Ans. 4. Option (C) is correct.

Explanation :

- Electric field due to a point charge $E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$.
- Electric potential due to a dipole $V = \frac{1}{4\pi\varepsilon_0}\frac{p\cos\theta}{r^2}$, where p = magnitude of dipole moment.
- Electric potential due to a point charge $V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$
- From Coulomb's law, Force between two charged particles $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{r^2}$

Ans. 5. Option (A) is correct.

Explanation : Since both the proton and electron are accelerated through the same potential, work done by an electric field will be same. This work done is equal to the kinetic energy, which is also the same for electron and proton.

$$\Rightarrow \quad \frac{1}{2}mv^2 = eV$$

$$\Rightarrow \quad v = \sqrt{\frac{2eV}{m}}.$$

Since potential is same for electron and proton.

Therefore, $v \propto \sqrt{\frac{1}{m}}$

As the mass of an electron is less than the mass of a proton, therefore electron will acquire a higher velocity.

Ans. 6. Option (A) is correct.

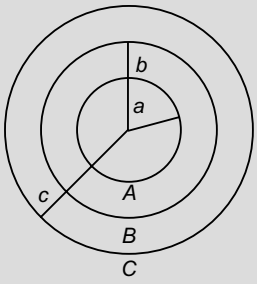
Explanation : If C_{medium} is the value of the capacitance of a capacitor in a medium and C_{air} is the capacitance, the dielectric constant K is defined as $K = \frac{C_{medium}}{C_{air}}$.

Ans. 7. Option (A) is correct.

Explanation : The capacitance of a parallel plate capacitor is inversely proportional to the distance between the plates i.e. $C \propto \frac{1}{d}$. So, on decreasing d, C will increase. Since C is inversely proportional to V as $C = \frac{Q}{V}$. Therefore, V will decrease.

Ans. 8. Option (D) is correct.

Explanation : Given $c = a + b$



$$V_A = \frac{\sigma a Q}{\varepsilon_0} - \frac{\sigma b}{\varepsilon_0} + \frac{\sigma c}{\varepsilon_0} = \frac{\sigma}{\varepsilon_0}[c - (b - a)]$$

$$V_B = \frac{-\sigma b}{\varepsilon_0} + \frac{1}{4\pi\varepsilon_0} \cdot \frac{\sigma \times 4\pi a^2}{b} + \frac{\sigma c}{\varepsilon_0}$$

$$= \frac{\sigma}{\varepsilon_0}\left[c - \frac{(b^2 - a^2)}{b}\right]$$

$$V_C = \frac{\sigma c}{\varepsilon_0} - \frac{1}{4\pi\,\varepsilon_0} \cdot \frac{\sigma \times 4\pi b^2}{c} + \frac{1}{4\pi\varepsilon_0} \cdot \frac{\sigma \times 4\pi a^2}{c}$$

$$= \frac{\sigma}{\varepsilon_0}\left[c - \frac{(b^2 - a^2)}{c}\right]$$

$$= \frac{\sigma}{\varepsilon_0}[c - (b - a)]$$

$$V_A = V_C \neq V_B$$

Ans. 9. Option (C) is correct.

Explanation : Ohms law is defined at the constant temperature, which states that current flowing through a conductor is directly proportional to the applied potential difference across the conductor.
Additionally, if conductor is under any strain, the conductor becomes non-ohmic and graph between V and I may not be straight.

Ans. 10. Option (B) is correct.

Explanation : Specific resistance ρis defined as the resistance R offered per unit length L and unit cross-sectional area A *i.e.* $\rho = \frac{RA}{L}$.

Ans. 11. Option (C) is correct.

Explanation : Kirchhoff's first law states that the sum of incoming current at any node in a circuit is equal to the sum of outgoing current. Therefore, the algebraic sum of all current meeting at a node must equal zero.

Ans. 12. Option (C) is correct.

Explanation : Since, pole strength, magnetic moment and moment of inertia are the properties, which depend on the dimension of the body whereas intensity of magnetization depends on the nature of the material. therefore, by cutting a bar magnet into two parts, intensity of magnetization remains same.

Ans. 13. Option (B) is correct.

Explanation : Magnetic dipole moment is a vector quantity and its direction is from south pole to north pole.

Ans. 14. Option (B) is correct.

Explanation : Faraday's law states that when the magnetic flux linking a circuit change, an electromotive force is induced in the circuit, which is proportional to the rate of change of the flux. Therefore, moving coil produces induced emf.

Ans. 15. Option (D) is correct.

Explanation : When a cylindrical bar magnetic is rotated about its axis, the lines of force remain same, resulting in no change in the flux through a coil. Thus, there is no current induced in a coil.

Ans. 16. Option (A) is correct.

Explanation : When a current is changed in a coil, the magnetic flux is also changed. This flux is due to its own current. Therefore, the property is accordance with the self-induction.

Ans. 17. Option (B) is correct.

Explanation : Direction of induced current in a wire in a magnetic field is given by Fleming's right-hand rule, which stats that if fore finger, middle finger and thump of our right hand are extended perpendicular to each other, then

- fore finger is pointed towards the direction of magnetic field.
- middle finger is pointed towards the direction of induced current.
- thump is pointed towards the direction of motion or applied force.

Ans. 18. Option (D) is correct.

Explanation : Work done $W = \vec{F} \cdot \vec{r}$

$\vec{F} = 0.2E\hat{i}$

$\vec{r} = 2\cos\theta\,\hat{i} + 2\sin\theta\,\hat{j} = \hat{i} + \sqrt{3}\,\hat{j}$

Now $W = 0.2E = 4$

$E = 20$ N/C

Ans. 19. Option (A) is correct.

Explanation : Field being non-uniform, the poles of the needle will experience non-uniform forces. Hence, the needle experiences a force as well as a torque.

Ans. 20. Option (B) is correct.

Explanation : On heating above Curie temperature, Ferromagnetic domains get randomly arranged and it transforms into paramagnetic substance.

Ans. 21. Option (C) is correct.

Explanation : Since, all charges are equal in magnitude and equidistant from point O then magnitude of electric field intensity will be equal. Electric field intensity is vector quantity. So direction of vectors of all three will be 120° apart from each other, so by adding these three vectors we get zero.

Ans. 22. Option (D) is correct.

Explanation : In series combination, charge is same on each capacitor, hence

$$q_b = q_d = q_f$$

Ans. 23. Option (B) is correct.

Explanation : Power factor of the ac circuit is given by

$$\cos\phi = \frac{R}{Z} = \frac{R}{\sqrt{R^2 + X^2}}$$

When circuit contains only resistance, then

$$Z = R$$

$$\therefore \quad \cos\phi = 1$$

When circuit contains only inductance then

$$R = 0$$

$$\therefore \quad \cos\phi = 0$$

Ans. 24. Option (A) is correct.

Explanation : Lenz's law states that the induced current opposes the change in magnetic flux. So, the current in inner loop will be in opposite direction i.e. anti-clockwise.

Ans. 25. Option (C) is correct.

Explanation : Given that

$V = V_0$ for $0 \le t \le \frac{T}{2}$

$= 0$ for $\frac{T}{2} \le t \le T$

$$V_{rms} = \sqrt{\frac{\int_0^T V^2 dt}{T}}$$

$$\Rightarrow V_{rms} = \sqrt{\frac{\int_0^{T/2} V_0^2 dt}{T} + \frac{\int_{T/2}^{T} 0 dt}{T}}$$

$$\Rightarrow V_{rms} = \sqrt{\frac{\int_0^{T/2} V_0^2 dt}{T}} = \sqrt{\frac{V_0^2 [t]_0^{T/2}}{T}}$$

$$= \sqrt{\frac{V_0^2 \times T/2}{T}}$$

$$\Rightarrow V_{rms} = \frac{V_0}{\sqrt{2}}$$

Section-B

Ans. 26. Option (A) is correct.

Explanation : According to the quantization of charge, charges of the particle (q) are integral multiple of charge of an electron/proton (e). *i.e.*, $q = ne$. Therefore, number of elements in 5 coulomb,

$$n = \frac{q}{e} = \frac{5}{1.6 \times 10^{-19}} = 3.125 \times 10^{19}.$$

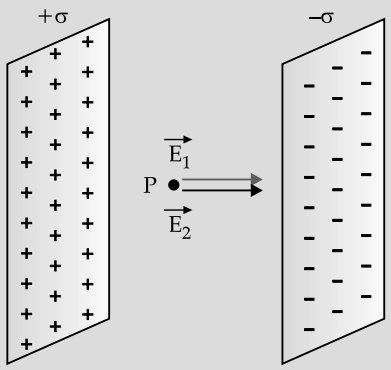
Ans. 27. Option (C) is correct.

Explanation : Given that a charge Q is placed at the center of the cube, the flux ϕ coming out each through each surface of the cube is same. Since cube has 6 faces, therefore according to Gauss's law, $6\phi = \frac{Q}{\varepsilon_0} \Rightarrow \phi = \frac{Q}{6\varepsilon_0}$.

Ans. 28. Option (C) is correct.

Explanation : Let there are two infinite sheets carry equal and opposite of densities $\pm\sigma$.

At any point, say P, between the sheet, the electric fields are: $E_1 = \frac{\sigma}{2\varepsilon_0}$ (away from the sheet due to positive charge) and $E_2 = \frac{\sigma}{2\varepsilon_0}$, (towards the sheet due to negative charge).



Since E_1 and E_2 are in the same direction, the resultant at P due to both sheets is

$$\Rightarrow \vec{E} = \vec{E_1} + \vec{E_2} = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0}$$

$$\Rightarrow \vec{E} = \frac{\sigma}{\varepsilon_0}$$

Ans. 29. Option (A) is correct.

Explanation :

Let the initial capacitance = C

and distance d. Later capacitance = C′

As capacitance of capacitor is inversely proportional to distance between the plates *i.e.*

$$C \propto \frac{1}{d}$$

$$\Rightarrow \frac{C}{C'} = \frac{1/d}{1/2d}$$

$$\Rightarrow \frac{C}{C'} = 2$$

$$\Rightarrow C' = \frac{C}{2}$$

Ans. 30. Option (A) is correct.

Explanation : The potential difference between two points of equipotential surface is zero, *i.e.*,

$$\Delta V = 0$$

$$\Rightarrow V_2 - V_1 = \frac{W}{q} = 0$$

$$\Rightarrow W = 0$$

This indicates that work done in moving a charge in an equipotential surface is zero.

Ans. 31. Option (B) is correct.

Explanation : If three parallel plate capacitors are connected in parallel, the potential across these capacitors is same. Let Q_1, Q_2 and Q_3 are the charges on the three capacitors, respectively, such that

$$Q = Q_1 + Q_2 + Q_3$$
$$C_P V = C_1 V + C_2 V + C_3 V$$
$$C_P = C_1 + C_2 + C_3$$

Next, if C_1, C_2 and C_3 are connected in series, current flow across them is same, so charge is same. Let V_1, V_2 and V_3 are the potential difference across the three capacitors, respectively, such that

$$V = V_1 + V_2 + V_3$$
$$\frac{Q}{C_s} = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3}$$
$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

This clearly shows that C_s always be less then C_p.

Ans. 32. Option (C) is correct.

Explanation :

$$V_0 = \frac{q}{C_0} \quad ...(1)$$

$$V = \frac{q}{C} \quad ...(2)$$

Divide eq. 2 by eq. 1

$$\frac{V}{V_0} = \frac{C_0}{C}$$
$$\Rightarrow \quad \frac{C_0}{C} = \frac{90}{15} = 6$$

From the definition, it is defined that

$$C = kC_0$$
$$\Rightarrow \quad k = 6$$

Ans. 33. Option (C) is correct.

Explanation : It is observed that in series combination charge is same on both the condenser so :

$$Q_1 = Q_2 + Q_3$$

Also, the voltages in series will be :

$$V = V_1 + V_2$$

Voltages in parallel combination :

$$V_2 = V_3$$

Ans. 34. Option (D) is correct.

Explanation : As,

$$i = \frac{dQ}{dt} = \frac{d\left(2t^2 + 4t + 4\right)}{dt} = 4t + 4$$

At $t = 2$ seconds,

$$i = (4 \times 2) + 4 = 12\text{A}$$

Ans. 35. Option (A) is correct.

Explanation : We know that,

$$\frac{P}{Q} = \frac{l}{100 - l}$$
$$\Rightarrow P = Q \times \frac{l}{100 - l}$$

As standard resistance of 1Ω is in the right gap

$$\Rightarrow P = 1 \times \frac{40}{60} = 0.67\Omega$$

Ans. 36. Option (A) is correct.

Explanation : A charged particle enters in a region in an unaccelerated manner if magnetic force and electric field acting on it cancel each other. Therefore, $q\vec{E} = q\left(\vec{v} \times \vec{B}\right)$, it indicates that $\vec{E}$ must be perpendicular to $\vec{B}$. Additionally, it is not necessary that $\vec{v}$ is perpendicular to $\vec{E}$ or $\vec{E}$ is perpendicular to $\vec{vB}$.

Ans. 37. Option (B) is correct.

Explanation : Given that $v = 10^6$ m/s, R = 0.10 m/s

$m_e = 9.1 \times 10^{-31}$ kg, $q = 1.6 \times 10^{-19}$C

As we know that,

$$R = \frac{mv}{qB},$$
$$\Rightarrow \quad 0.10 = \frac{9.1 \times 10^{-31} \times 10^6}{1.6 \times 10^{-19} \times B}$$
$$\Rightarrow \quad B = \frac{9.1 \times 10^{-31} \times 10^6}{1.6 \times 10^{-19} \times 0.10}$$
$$\Rightarrow \quad B = 5.7 \times 10^{-5}\text{T}$$

Ans. 38. Option (D) is correct.

Explanation : Let l_1 and l_2 be the length two part of the conductor and ρ be the resistance per unit length of the conductor. Therefore, the resistance of first portion and second portion i.e., $R_1 = l_1\rho$ and $R_2 = l_2\rho$. Since, potential difference across the end equal, so,

$$I_1R_1 = I_2R_2$$

or

$$I_1l_1\rho = I_2l_2\rho \qquad ...(1)$$

$$I_1l_1 = I_2l_2$$

The magnetic field at the center of the loop,

$$= B_1 - B_2$$

$$= \frac{\mu_0}{4\pi}\frac{I_1l_1\sin 90^\circ}{r^2} - \frac{\mu_0}{4\pi}\frac{I_2l_2\sin 90^\circ}{r^2}$$

$$= 0$$

Ans. 39. Option (C) is correct.

Explanation : In stable equilibrium, Potential energy U is defined as

$$U = -MB$$

$$= -(0.6)(0.6)$$

$$= -0.096\ J$$

Ans. 40. Option (C) is correct.

Explanation : work done is defined as,

$$W = -MB(1 - \cos\theta)$$

$$= 10 \times 0.3\ (1 - \cos 60^\circ)$$

$$= 3\left(1 - \frac{1}{2}\right) = \frac{3}{2} = 1.5$$

Ans. 41. Option (A) is correct.

Explanation :

As, $\mu = \mu_0\mu_r$

$$= \left(4\pi \times 10^{-7}\right) \times 2000$$

$$= 8\pi \times 10^{-4}$$

Ans. 42. Option (B) is correct.

Explanation : Given that magnetic field intensity $= 5 \times 10^3$A/m
and, magnetic flux density$= 2\pi$ Tesla
the relative permeability, *i.e.*,

$$\mu_r = \frac{B}{\mu_0 H}$$

$$= \frac{2\pi}{\left(4\pi \times 10^{-7}\right) \times 5 \times 10^3} = 10^3$$

Ans. 43. Option (C) is correct.

Explanation : E.m.f is defined as:

$$\varepsilon = M\frac{dI}{dt}$$

$$= 0.002 \times I_0 \cos\omega t \times \omega$$

$$\Rightarrow \quad \varepsilon_{max} = 0.002 \times I_0 \times \omega$$

$$\Rightarrow \quad = 0.002 \times 5 \times 20\pi$$

$$\Rightarrow \quad = 0.200\pi$$

Ans. 44. Option (A) is correct.

Explanation : Total resistance = internal resistance + external resistance = 110Ω.

Therefore, current developed

$$= 220/110 = 2\ A$$

Power developed in the external resistance

$$= I^2R_{ext}$$

$$= 4 \times 105 = 420\ W$$

Ans. 45. Option (B) is correct.

Explanation : Coulomb force on a charged particle is the vector sum of forces experienced on that charge due to other charges. It is the principle of superposition. Hence, assertion is true.

Coulomb's law states that

$$F = \frac{1}{4\pi\varepsilon_0}\frac{|q_1||q_2|}{r_{12}^2}\hat{r}_{12} + \frac{1}{4\pi\varepsilon_0}\frac{|q_1||q_3|}{r_{13}^2}\hat{r}_{13} + ... + \frac{1}{4\pi\varepsilon_0}\frac{|q_1||q_2|}{r_{1n}^2}\hat{r}_{1n}$$

Therefore, Reason is true.

Ans. 46. Option (A) is correct.

Explanation : When a conducting slab is completely filled between the plates of the capacitor, its capacitance changes accordingly $C_{medium} = KC_{air}$, where C_{medium} = Capacitance of a capacitor on loading a medium between the plates and C_{air} = capacitance of parallel plate capacitor. Since the dielectric constant K of a conductor is infinity. Therefore $C_{medium} = \infty$. Assertion is true.

Electric field ΔE is related to potential difference ΔV using the following formula $E = -\frac{\Delta V}{\Delta s}$, where, Δs is the distance between the capacitor. If the electric field inside a conductor is zero, so, ΔV is also zero.

When this conductor is filled between the plate of capacitor, its electric field changes as $E_{medium} = -\frac{E_{air}}{K}$. If an electric field is zero, K becomes infinite. Therefore, it is a correct explanation of assertion.

Ans. 47. Option (B) is correct.

Explanation : Since, the resistance of voltmeter is infinite, no current flows through the circuit when a voltmeter is connected across the terminal of the cell. Hence, voltmeter gives the reading of the emf of the cell. Assertion is true.

Emf of a cell is defined as the work done by a cell in forcing per coulomb of charge to flow in circuit. If internal resistance of cell is r, there is some potential drop across the cell, which is ir. When a cell is connected through the resistance R and applied terminal potential is V, emf of a cell is

$$E = i(R + r)$$
$$\Rightarrow \quad E = iR + ir$$
$$\Rightarrow \quad E = V + ir$$
$$\Rightarrow \quad V = E - ir$$

Where, V is terminal potential across the terminals. Therefore, reason is true. So, both assertion and reason are true but reason is not the correct explanation of resistance.

Ans. 48. Option (D) is correct.

Explanation : Magnetic needle can rotate in horizontal plane only. But at poles, there is no horizontal component of Earth's magnetic field.

So, the needle will remain horizontal and will point in any direction. Hence the assertion is false.

At poles, Earth has only vertical components of its magnetic field. Hence, the reason is true.

Ans. 49. Option (D) is correct.

Explanation : At resonance, $X_L = X_C$, so the circuit impedance becomes minimum and resistive and hence the current becomes maximum. So, the assertion is false.

At resonance, $X_L = X_C$, so the circuit impedance becomes resistive. In resistive circuit voltage and current are always in same phase. Hence, reason is true.

Section-C

Ans. 50. Option (C) is correct.

Explanation : Given figure shows that slope of the line corresponding to T_1 is greater than the slope of the line at T_2, *i.e.*, $\tan\theta_1 > \tan\theta_2$, which indicates that $T_1 > T_2$.

Ans. 51. Option (C) is correct.

Explanation : The given figure represents that magnetic field lines move away from the substance. The diamagnetic material has susceptibility $\chi = 0$, causing the repelling of magnetic field lines, Hence, given material is diamagnetic material.

Case study:

Ans. 52. Option (B) is correct.

Explanation : Electric potential at a point is defined using the following formula as $V = \frac{W}{Q}$, which states that the amount of work done in bringing a unit positive charge from infinity to that point is known as electric potential.

Ans. 53. Option (C) is correct.

Explanation : Potential difference = 7 V

We know that

$$K.E. = \frac{1}{2}mv^2$$

here, $\frac{1}{2}mv^2 = eV$

K.E. $= e \times 7V$

K.E. $= 7eV$

Ans. 54. Option (B) is correct.

Explanation : Proton has positive charge, in electric field positive charge moves from higher potential to lower potential.

Ans. 55. Option (A) is correct.

Explanation : Given that

$Q = 10\mu C = 10 \times 10^{-6} C$

$W = 20 \times 10^{-5} J$

Since, $V = \frac{W}{Q}$,

$= \frac{20 \times 10^{-5}}{10 \times 10^{-6}}$

$= 20V$

■■■

Solutions of Question Paper 5

Section-A

Ans. 1. Option (C) is correct.

Explanation: From the question, as dipole moment is along direction of field, in such case angle between p and E zero, so the potential energy will be

$U = -pE\cos 0°$

$= -pE =$ minimum

It is observed that in uniform electric field, net force $F_{net} = 0$

Ans. 2. Option (D) is correct.

Explanation: Length of the diagonal of a cube having each side b is $b\sqrt{3}$

The distance of centre of cube from each vertex is $\frac{\sqrt{3}}{2}b$

As there are 8 vertices with charge $(-q)$ at each corner, so

$$U = 8 \times \frac{1}{4\pi\varepsilon_0} \times (-q) \times \frac{q}{\left(\frac{\sqrt{3}}{2}b\right)}$$

$$U = \frac{-4q^2}{\sqrt{3}\pi\varepsilon_0 b}$$

Ans. 3. Option (A) is correct.

Explanation: Considering electric field intensity

$E = 9 \times 10^9 \times 2pr/(r^2 - l^2)^2$

Here,

$p = (500 \times 10^{-6}) \times (10 \times 10^{-2}) = 5 \times 10^{-5}$

Now, $r = 25$ cm $= 0.25$ m

$l = 5$ cm $= 0.05$ m

Using the above expression and putting the values:

$E = 9\times10^9\times2\times5\times10^{-5}\times0.25/[(0.25)^2-(0.05)^2]^2$

$= 6.25\times10^7$ N/C

Ans. 4. Option (D) is correct.

Explanation: In electric dipole, field

$E_{equatorial} = kp/r^3$

$E \propto p$, so $E \propto r^{-3}$

Ans. 5. Option (A) is correct.

Explanation:

$E = q^2/2C$

$q' = q$

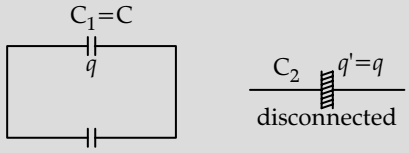
$C' = 2C$

$E' = E/2$

Hence, total electrostatic energy of resulting system decreases by a factor of 2.

Ans. 6. Option (B) is correct.

Explanation:



$q = CV \Rightarrow V = \frac{q}{C}$

- When a dielectric slab is inserted, new capacitance $C_2 = CK$
- Initial energy stored in capacitor,

$$U_1 = \frac{q^2}{2C}$$

- Final energy stored in capacitor,

$$U_2 = \frac{q^2}{2KC}$$

Change in stored energy

$$\Delta U = U_2 - U_1$$

$$\Delta U = \frac{q^2}{2C}\left[\frac{1}{K} - 1\right]$$

$$= \frac{1}{2}CV^2\left[\frac{1}{K} - 1\right]$$

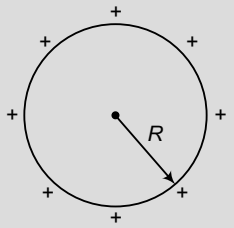
- New potential difference between plates.

$$V' = \frac{q}{CK} = \frac{V}{K}$$

- Charge on the capacitor is not conserved.

Ans. 7. Option (B) is correct.

Explanation: It is observed that in a conducting sphere, there is no charge



$E_{in} = E_{centre} = 0$

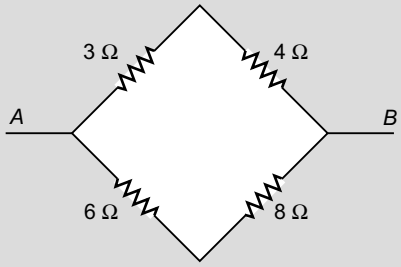
$V_{in} = V_{centre}$ = constant

$= KQ/R = Q/4\pi\varepsilon_o R$

Ans. 8. Option (A) is correct.

Explanation: In the Wheatstone bridge, the circuit is balanced as $\frac{P}{Q} = \frac{R}{S}$ or, $\frac{3}{4} = \frac{6}{8}$.

If we re-draw the above circuit, we see that:



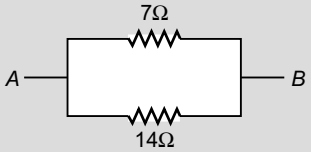
Resistances 3 Ω and 4 Ω are in series, so the equivalent resistance is

$$3\ \Omega + 4\ \Omega = 7\ \Omega = R_1$$

Also, resistances 6 Ω and 8 Ω are in series, so the equivalent resistance is

$$6\ \Omega + 8\ \Omega = 14\ \Omega = R_2$$

Now after having equivalent resistances, if we further reduce the above circuit, we see that the equivalent resistances are in parallel.



So, Equivalent resistance is:

$1/R_{th} = 1/R_1 + 1/R_2$

$1/R_{th} = 1/7\ \Omega + 1/14\ \Omega = 3/14\ \Omega$

or $R_{th} = 14/3\ \Omega$

Ans. 9. Option (C) is correct.

Explanation: Equivalent Current $i = e/T$

$= e/(1/n) = en$

Now $B_c = \mu_0 i/2r = \mu_0 ne/2r$

Ans. 10. Option (B) is correct.

Explanation: Time period of rotation of the particle:

$T = 2\pi m/qB$, which is independent of V and R.

Ans. 11. Option (B) is correct.

Explanation: Magnetic field due to current carrying element is given by $B=\mu_0 i/2\pi r$. Since, r is the distance between wire and measuring point. Thus, the magnetic field B is independent of the diameter of wire. Hence, the magnetic field will be same.

Ans. 12. Option (B) is correct.

Explanation: Induced emf,

$$e = -L\,(di/dt)$$

As average e.m.f. induced in a coil is 8 V, so

$8 = L \times (4 - 2)/0.05$ or $L = 0.2$ H

Ans. 13. Option (B) is correct.

Explanation:

Now $I_P/I_S = N_s/N_p$

$I_p = I_s \times (N_s/N_p)$

$I_P = 2 \times 25 = 50$ A

Ans. 14. Option (A) is correct.

Explanation: It is noted that current will be maximum at resonance, hence the resonant frequency will be:

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.5 \times 8 \times 10^{-6}}}$$

$$= 500 \text{ rad/s}$$

Ans. 15. Option (C) is correct.

Explanation: When a cylindrical bar magnet is dropped inside a hollow cylindrical metallic pipe the magnetic flux across the pipe changes, and due to induction, eddy current is produced. The direction of eddy current is in such a way so that it can oppose the cause, i.e., motion of magnet. So upward force acts on bar magnet and decreases the acceleration, which in turn takes more time to fall magnet through the pipe, as compared to simple metallic piece in place of magnet.

Ans. 16. Option (A) is correct.

Explanation:

$$\varepsilon = L\frac{di}{d\tau}$$

$$200 = L \times \frac{5}{0.1}$$

$$\therefore \quad L = 4H$$

Ans. 17. Option (D) is correct.

Explanation: Since the S-pole of the magnet is approaching the 1st coil, S-pole will be developed at the right end of the coil to oppose the movement of the magnet according to Lenz's law. Since the N-pole of the magnet is moving away from the 2nd coil, S-pole will be developed at the left end of the coil to oppose the movement of the magnet according to Lenz's law.

Ans. 18. Option (B) is correct.

Explanation:

$$|\varepsilon| = L\frac{di}{dt}$$

$$\therefore \quad L = \frac{|\varepsilon|}{di\ /\ dt}$$

Unit of L is Henry.

Unit of ε is volt.
Unit of di/dt is ampere / second.
∴ 1 Henry = 1 volt-sec/ampere

Ans. 19. Option (A) is correct.

Explanation:

$$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

$$= \frac{1}{10}\sqrt{\frac{2}{32 \times 10^{-6}}}$$

$$= 25$$

Ans. 20. Option (C) is correct.

Explanation: P = VI.

The amplitude of power is equal to multiplication of V and I. So it must be maximum amplitude as compared to V and I. So curve A shows the power consumption over a cycle.

The graph 'A' is symmetric with X-axis, *i.e.*, area of graph on positive and negative sides are equal. So net area of power graph is zero. So power consumption in circuit is zero.

As the average power of device is zero, so phase difference between current and voltage is 900 and hence X is either an inductor or capacitor.

Ans. 21. Option (A) is correct.

Ans. 22. Option (C) is correct.

Explanation: In core type transformer, the primary and secondary winding are wound on both the limbs as shown in fig. (A).

In Shell type transformer, the winding are sandwiched on the central limb as shown in fig. (D)

Ans. 23. Option (A) is correct.

Explanation:

$$\alpha = \frac{R_2 - R_1}{R_1(T_2 - T_1)}$$

$$= \frac{2.7 - 2.1}{2.1(100 - 27.5)}$$

$$= 0.0039°C^{-1}$$

Ans. 24. Option (A) is correct.

Explanation: When 1Ω and 2Ω are in parallel, the equivalent resistance is

$$R_{12} = \frac{2}{3}\ \Omega$$

When 3Ω and R_{12} are joined in series, the equivalent resistance is

$$R_{eq} = \frac{11}{3}\ \Omega$$

Ans. 25. Option (B) is correct.

Explanation: If R is increased current in main circuit will decrease. So, in turn potential difference across AB will decrease.

As R of AB is constant so potential gradient,

k = V / AB will decrease. So, to balance potential across AB equal to potential of secondary circuit (E′) the length AJ′ must be larger than earlier AJ. So the point J shifts towards B.

Section-B

Ans. 26. Option (D) is correct.

Explanation: It is observed that on equipotential surfaces, electric field results as normal to the charged surface not allowing the work done.

Ans. 27. Option (A) is correct.

Explanation: In spherical shell, the electric field is zero as in a shell every charge lies on outer surface, so from Gauss law, electric field inside a shell will be zero.

Ans. 28. Option (D) is correct.

Explanation: It is observed that field along the axis of dipole will be:
$E = (1/4\pi\varepsilon_0) \times 2p/d^3 = (1/4\pi\varepsilon_0) \times 2(q \times r)/d^3$
With this, $E \propto qr/d^3$

Ans. 29. Option (C) is correct.

Explanation: On applying common potential:

$V = (C_1V_1 + C_2V_2)/C_1 + C_2$

Now $20 = (2 \times 200 + C_2 \times 0)/(2 + C_2)$

Capacity of second capacitance will be $C_2 = 18\ \mu F$

Ans. 30. Option (D) is correct.

Explanation: According to the Gauss' theorem, the electric flux through a close surface in Q/ε_0 .

Ans. 31. Option (A) is correct.

Explanation: The capacitance of parallel plate capacitor:

$$C = \varepsilon_0 KA/d$$

Now $C_1/C_2 = (K_1/K_2) \times (d_2/d_1)$

Further $2/C_2 = (1/2.8) \times [(0.4/2)/(0.4)]$

On solving, we see that $C_2 = 11.2\mu F$

Ans. 32. Option (D) is correct.

Explanation:

$M = 1$ J/T, $\theta = 60°$, $B = 0.2$ T

$\tau = MB \sin\theta$

$\tau = 1 \times 0.2 \times \sin 60$

$$\tau = 0.2 \times \left(\frac{\sqrt{3}}{2}\right) = 0.1\sqrt{3}$$

$$= \sqrt{3} \times 10^{-1}\ \text{Nm}$$

Ans. 33. Option (C) is correct.

Explanation: From the above circuit, total resistance

$$= (80/2) + 20 = 60\ \Omega$$

The main current $i = 2/60 = (1/30)$ A

Now, the voltage across voltmeter and 80 Ω resistance.

$$V = R' \times i = 40 \times \frac{1}{30}\ V = 1.33\ V$$

Ans. 34. Option (A) is correct.

Explanation: Force on the conductor B:

$F = (\mu_0/4\pi) \times 2 \times (i_1 i_2/a) \times l$

$$\Rightarrow F = \frac{10^{-7} \times 2 \times 2 \times 10 \times 2}{(10 \times 10^{-2})}$$

$$= 8 \times 10^{-5}\ \text{N}$$

Ans. 35. Option (B) is correct.

Explanation: According to Ampere's circuital law, $B(2\pi r) = \mu_o \times 0$ or $B = 0$ as $I = 0$ (inside) So, inside a hollow metallic pipe carrying current, the magnetic field is zero. But for external points, the

whole current behaves as if it were concentrated at the axis only. Thus, the magnetic field is produced outside the pipe only.

Ans. 36. Option (B) is correct.

Explanation: Energy stored is given as, $U = (½) \times Li^2$

Also, $U_2/U_1 = (i_2/i_1)^2 = (1/2)^2 = 1/4$

$$U_2 = (¼) \times U_1$$

Ans. 37. Option (A) is correct.

Explanation: Now, it is known that,

$$\tan \varphi = (X_C - X_L)/R$$

$$= \frac{\frac{1}{2\pi fC} - 2\pi fL}{R}$$

So $\tan 45^o = [(1/2\pi fC) - 2\pi fL]/R$

Hence $C = 1/[2\pi f(2\pi fL + R)]$

Ans. 38. Option (B) is correct.

Explanation: In an *LC* circuit, resonance takes place when the circuit is driven from external source at angular frequency ω_0 where inductive and capacitive reactance are equal in magnitude.

$$X_L = X_C$$

$$\omega_0 L = \frac{1}{\omega_0 C}$$

or, $$\omega_0 = \frac{1}{\sqrt{LC}}$$

or, $$2\pi f_0 = \frac{1}{\sqrt{LC}}$$

or, $$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

Ans. 39. Option (C) is correct.

Explanation: In a purely resistive circuit, all circuit power is dissipated by the resistor(s). Voltage and current are in phase with each other.

Ans. 40. Option (C) is correct.

Explanation: No current will be induced since the field lines are lying in the plane of the closed loop.

Ans. 41. Option (B) is correct.

Explanation: When 3Ω and 2Ω are in parallel, the equivalent resistance is

$$R_{23} = \frac{6}{5}\Omega$$

When 1Ω and R_{23} are joined in series, the equivalent resistance is

$$R_{eq} = \frac{11}{5}\Omega$$

Ans. 42. Option (B) is correct.

Explanation: Capacitance of each of the three capacitors is 9 pF.

Equivalent capacitance = C_{eq}

$1/C_{eq} = 1/9 + 1/9 + 1/9$

$\therefore C_{eq} = 3p\text{F}$

Supply voltage, V=120 V

Potential difference (V′) across each capacitor is equal to one-third of the supply voltage *i.e.* 40V.

Ans. 43. Option (C) is correct.

Ans. 44. Option (A) is correct.

Explanation: By Gauss' theorem of electrostatics, the flux crossing a closed surface is equal to the net charge enclosed by the surface divided by ε_0.

In case of a dipole, net charge inside the Gaussian surface is $+q - q = 0$

Since the net charge of a dipole is zero, the total flux crossing the surface is also zero.

Ans. 45. Option (A) is correct.

Explanation: If the magnet moves quicker, the rate of change of flux is also higher, hence the EMF induced is more in case (i).

Ans. 46. Option (A) is correct.

Explanation: $C = \frac{A\varepsilon_0}{d}$

In the expression, there is no involvement of charge. So, capacitance is independent of charge. Hence the assertion is true.

It depends on permittivity of the surrounding medium and the area of the plate. So, reason is also true.

Reason explains the assertion.

Ans. 47. Option (C) is correct.

Explanation: Galvanometer to ammeter conversion takes place by connecting a low value resistance known as "shunt" in parallel with it. The assertion is true.

When two resistors are connected in parallel then the effective resistance becomes lower than the lowest value of the two resistors. Hence the reason is false.

Ans. 48. Option (B) is correct.

Explanation: Inertia is defined as the tendency of an object to resists its change of state of motion. Induced e.m.f. in a coil is changed by the change in current or magnetic flux. The property by which a coil opposes these parameters to incur any change in induced e.m.f. is known as self-inductance. Hence, self inductance may be called the inertia of electricity. So, the assertion and reason both are true but reason cannot explain why so happens.

Ans. 49. Option (A) is correct.

Explanation: Transformer has two coils. If current fluctuates in one coil, e.m.f. is induced in the other coil. For DC supply current does not change, so there is no induced e.m.f. Hence both assertion and reason are true and reason explains the assertion.

Section-C

Ans. 50. Option (C) is correct.

Explanation: The point *O* is equidistant from all the charges at the end point of pentagon. So, due to symmetry, the forces due to all the charges are cancel out each other. So, electric field at the centre is zero.

Ans. 51. Option (B) is correct.

Explanation: Electric lines of forces diverge out from positive charge. So, A and C are positive charges and B is negative charge.

Case Study

Ans. 52. Option (D) is correct.

Explanation: At power plant, a step-up transformer increases the voltage of generated power by thousands of volts, so that it can be sent of long distances through high-voltage transmission power lines.

At substations, step-down transformers lower the voltage of incoming power to make it acceptable for high-volume delivery to nearby end-users.

Ans. 53. Option (D) is correct.

Explanation: Super-conducting materials are capable of conducting without resistance. So, this eliminates the line loss and the cable is capable of sending more electricity than conventional cable. Using super-conducting cables, one can get rid of the need of costly transformers.

Ans. 54. Option (B) is correct.

Explanation: At generating station, normally voltage is stepped up to around thousands of volts. Power losses increase with the square of current. Therefore, keeping voltage high, current becomes low and the loss is minimized.

Ans. 55. Option (A) is correct.

Explanation: Transformers generate waste heat when they are in operation and oil is the coolant of choice. It transfers the heat through convection to the transformer housing.

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Self Assessment Paper

Solutions of Question Paper 1

Section-A

Ans. 1. Option (A) is correct.

Explanation : Coulomb force, also called electrostatic force or Coulomb interaction, attraction or repulsion of particles or objects because of their electric charge.

Ans. 2. Option (B) is correct.

Explanation : Coulomb's law states that : The magnitude of the electrostatic force of attraction or repulsion between two-point charges is directly proportional to the product of the magnitudes of charges and inversely proportional to the square of the distances between them.

Ans. 3. Option (A) is correct.

Explanation : Net force on charge q_1, by other charges q_2 and q_3 is along the + x-direction, so nature of force between q_1 and q_2 and q_1 and q_3 is attractive. This is possible when charge q_1 is negative. Now, if a positive charge Q is placed at $(x, 0)$, then, the force on q_1 will increase. The direction will be along positive x-axis.

Ans. 4. Option (C) is correct.

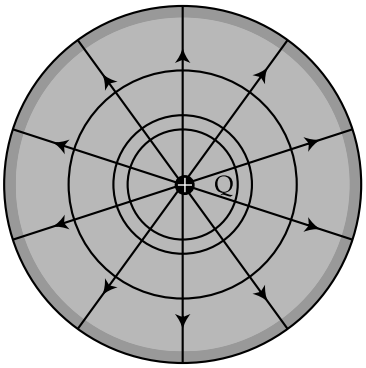
Explanation : For an equipotential surface,

$$V_A = V_B$$

So, work done = 0

Ans. 5. Option (A) is correct.

Explanation : Concentric spherical shells and the distance between the shells increases with the decrease in electric field. It does not depend on the polarity of the charge.



Ans. 6. Option (B) is correct.

Explanation : Inside the sphere,

$$E = 0$$

Again $E = -dV/dr$

So, $dV/dr = 0$

This is possible when V is constant.

Ans. 7. Option (D) is correct.

Explanation : Kirchhoff's laws are valid for both linear and non-linear circuits.

Ans. 8. Option (B) is correct.

Explanation :

Case 1: $P/Q = 10/90 = \frac{1}{9}$ ...(i)

Case 2: $(P+20)/Q = 20/80 = \frac{1}{4}$ ...(ii)

Dividing equation (i) by (ii)

$$\frac{P}{(P + 20)} = \frac{4}{9}$$

$\therefore$ $P = 16\ \Omega$

Putting in equation (i)

$$Q = 144\ \Omega$$

Ans. 9. Option (D) is correct.

Explanation : The work done to rotate the loop in magnetic field,

$W = MB(\cos\theta_1 - \cos\theta_2)$.

When current carrying coil is rotated, there will be no change in angle between magnetic moment and magnetic field.

Here, $\theta_1 = \theta_2 = \alpha$

$\Rightarrow W = MB(\cos\alpha - \cos\alpha) = 0$.

Ans. 10. Option (B) is correct.

Explanation : $F = qvB\sin\theta$

When $q = 1$ C, $v = 1$ m/s, $F = 1$ N, $\theta = 90°$, then $B = 1$ T

Ans. 11. Option (D) is correct.

Explanation : The magnetic field inside the long current carrying solenoid is uniform. Therefore, magnitude of force on the electron of charge $(-e)$ is given by $F = -evB\sin\theta = 0$ $(\theta = 0°)$ as magnetic field and velocity are parallel. The electron will continue to move with uniform velocity along the axis of the solenoid.

Ans. 12. Option (B) is correct.

Explanation : When a charged particle perpendicularly enters a magnetic field to the direction, the path of the motion is circular. In circular motion, the direction of velocity changes at every point (the magnitude remains constant). Therefore, the linear momentum changes at every point. But kinetic energy remains constant since the magnitude of velocity does not change.

Ans. 13. Option (A) is correct.

Explanation :

$$\frac{M_{square}}{M_{circular}} = \frac{NIA_{square}}{NIA_{circular}} = \frac{\pi R^2}{a^2}$$

Ans. 14. Option (A) is correct.

Explanation : Magnetic dipole moment vector is directed from South pole to north pole.

Ans. 15. Option (B) is correct.

Explanation : Time period of oscillation of a magnetic needle is $T = 2\pi\sqrt{\frac{I}{MB}}$

Ans. 16. Option (A) is correct.

Explanation : Field being non-uniform, the poles of the needle will experience non-uniform forces. Hence, the needle experiences a force as well as a torque.

Ans. 17. Option (B) is correct.

Explanation : As we know that,

$$L = \mu_r\mu_0\frac{N^2A}{l}$$

As L is constant for a coil,

$$L \propto A \text{ and } L \propto \frac{1}{l}$$

As μ_r and N are constant here so, to increase L for a coil, area A must be increased and l must be decreased.

Important point : The self and mutual inductance of capacitance and resistance depend on the geometry of the devices as well as permittivity/ permeability of the medium.

Ans. 18. Option (A) is correct.

Explanation : $\mu_r = L/L_0$

$= 2.8/(2 \times 10^{-3}) = 1400$

Ans. 19. Option (B) is correct.

Explanation : The resonant frequency of *L*-*C*-*R* series circuit is $v_o = \frac{1}{2\pi\sqrt{LC}}$

So to reduce resonant frequency, we have either to increase L or to increase C.

To increase capacitance, another capacitor must be connected in parallel with the first.

Ans. 20. Option (A) is correct.

Explanation :

$\frac{1}{RC}$ and $\frac{R}{L}$ has dimension of frequency

Ans. 21. Option (B) is correct.

Explanation :

Initial capacitance $= C_1 = \frac{A\varepsilon_0 k}{d}$

Finally the capacitance $= C_2 = \frac{A\varepsilon_0 3k}{(d/2)}$

So, $C_2 = 6C_1$

Ans. 22. Option (A) is correct.

> ***Explanation :*** In balanced condition of a Wheatstone bridge, there is no current flow through the galvanometer. This is also called null condition.

Ans. 23. Option (B) is correct.

> ***Explanation :*** Magnetic field inside a solenoid is $B = \mu_0 ni$.
>
> Magnetic field at the end of a solenoid is $\frac{1}{2}\ \mu_0 ni$.

Ans. 24. Option (C) is correct.

> ***Explanation :*** Magnetic field inside solenoid $B = \mu_0 ni$. It is independent of length and area of cross-section.

Ans. 25. Option (A) is correct.

> ***Explanation :*** Let us consider an electric dipole. The electric lines of force exist outside only and not inside the dipole.
> Let us take a magnetic dipole. The magnetic lines of force exist outside as well as inside the dipole.
> So, it can be said that magnetic lines of force are continuous and electric lines of force are discontinuous.

Section-B

Ans. 26. Option (C) is correct.

> ***Explanation :*** A toroid is a coil of insulated or enamelled wire wound on a donut-shaped form made of powdered iron. A toroid is used as an inductor in electronic circuits.

Ans. 27. Option (A) is correct.

> ***Explanation :*** On Earth, flowing of liquid metal in the outer core of the planet generates electric currents. The rotation of Earth on its axis causes these electric currents to form a magnetic field which extends around the planet.

Ans. 28. Option (B) is correct.

> ***Explanation :*** A toroid has more inductance, for a given number of turns, than a solenoid with a core of the same material and similar size. This makes it possible to construct high-inductance coils of reasonable physical size and mass.

Ans. 29. Option (B) is correct.

> ***Explanation :*** On Earth, flowing of liquid metal in the outer core of the planet generates electric currents.

Ans. 30. Option (A) is correct.

> ***Explanation :*** In a toroid, all the magnetic flux is contained in the core material. This is because the core has no ends from which flux might leak off.

Ans. 31. Option (D) is correct.

> ***Explanation :*** Audible vibration or hum in transformers is caused by vibration of the windings and core layers from the forces between the coil turns and core laminations. The toroidal transformer's construction helps quiet this noise. For this reason, many sound system engineers prefer to use a toroidal transformer instead of a traditional laminated transformer.

Ans. 32. Option (B) is correct.

> ***Explanation :*** The average magnetic field strength in the Earth's outer core was measured to be 25 Gauss.

Ans. 33. Option (B) is correct.

> ***Explanation:*** Standard toroidal transformers typically offer a 95% efficiency, while standard laminated transformers typically offer less than a 90% rating.

Ans. 34. Option (C) is correct.

> ***Explanation:*** Based upon the study of lava flows throughout the world, it has been proposed that the Earth's magnetic field reverses at an average interval of approximately 300,000 years.

Ans. 35. Option (A) is correct.

Explanation: According to the Faraday's law of electromagnetic induction, time verying magnetic field in a coil causes an emf to be induced in the coil.

Ans. 36. Option (A) is correct.

Explanation: If a coil of insulated wire connected to a battery is brought to galvanometer, an electromagnetic induction takes place and a current is induced in the galvanometer coil which causes the deflection.

Ans. 37. Option (C) is correct.

Explanation: Lenz's law states that - the direction of current induced is such that it opposes the change that has induced it. So, Lenz's law decides the direction (the polarity) of the induced e.m.f.

Ans. 38. Option (C) is correct.

Explanation: Resistors of resistance box are made of coiled wires. So, there is an inductive effect also. Presence of inductance increases the impedance. Therefore to reduce the chance of occurrence of inductance in the resistor coils, they are double folded, so that current in opposite directions cancel the inductance effect. Thus inductance is nullified.

Ans. 39. Option (A) is correct.

Explanation: If the magnet moves quicker, the rate of change of flux is also higher, hence the EMF induced is more in case (i).

Ans. 40. Option (B) is correct.

Explanation: When the two coils are brought closer, the total flux increases. By Lenz's law a current will be induced in both the loops such that it opposes this change in flux. So, the current in each loop will decrease to increase the flux.

Ans. 41. Option (A) is correct.

Explanation: $\varepsilon = -L\, di/dt$

Or, $\quad -50 = L\left(\dfrac{2-7}{0.1}\right)$

Or, $\quad 50 = 50\ L$

$\therefore \quad L = 1\ H$

Ans. 42. Option (A) is correct.

Explanation: Since potential is same every point of an equipotential surface, no work is done to move a charge from one point to another.

Ans. 43. Option (A) is correct.

Explanation: For hollow sphere, potential at the surface = potential at the centre.

Ans. 44. Option (C) is correct.

Explanation: By convention a current or a field (electric or magnetic) emerging out of the plane of the paper is depicted by a dot ⊙. A current or a field going into the plane of the paper is depicted by a cross ⊗.

Ans. 45. Option (C) is correct.

Explanation: Even when power is off capacitor may have stored charge which may discharge through human body and thus one may get a shock.

So, assertion is true.

Breakdown of capacitors requires high voltage. So, reason is false.

Ans. 46. Option (A) is correct.

Explanation: Kirchhoff's voltage law says that the sum of the voltages around any closed loop is zero. A closed loop starts from a node, traces a path through the circuit and returns to the same node. Since the total work done in moving a charge around this close path is zero, hence the electric field is conservative. So, the assertion is true.

Potential difference between two points in a circuit does not depend on the path. This is true for conservative field. Hence the reason is also true and it explains the assertion.

Ans. 47. Option (C) is correct.

Explanation: In balanced condition, if the galvanometer and the voltage source are interchanged, the balanced condition remains same since in both the cases R_1R_4 remains equal to R_2R_3 . The assertion is true.

The balanced condition of Wheatstone bridge depends on the value of the resistances. R_1R_4 should be equal to R_2R_3. So, if the resistance values are changed, the balanced condition also gets disturbed. So, the reason is false.

Ans. 48. Option (B) is correct.

Explanation: Change in flux induces emf in conductor which generates eddy current. So assertion is true.

Electric potential determines the flow of charge. So reason is also true. But reason is not the proper explanation of generation of eddy current.

Ans. 49. Option (A) is correct.

Explanation: The core of an electromagnet should be such that it gets magnetized easily. Also, it loses magnetism easily as soon as the magnetizing field is removed. Soft iron has this property. So, soft iron is used as the core electromagnet. So the assertion is true. Coercivity is a measure of the ability of a ferromagnetic substance to withstand external magnetic field without becoming demagnetized. For soft iron, it should be very low. Coercivity is low for soft iron. So, reason is also true. Also, reason properly explains the assertion.

Section-C

Ans. 50. Option (A) is correct.

Explanation: Magnetic flux is the dot product of magnetic field vector and the area vector. Hence, it is a scalar quantity. Its SI unit is Weber.

Ans. 51. Option (C) is correct.

Explanation: Magnetic field produced by the magnet = $B = (\mu_0/4\pi)(2M/r^3)$

Flux produced = $\phi = NBA$

Induced e.m.f. = $\varepsilon = -d\phi/dt$

Resistance of the coil is no where present in the expressions.

Case Study

Ans. 52. Option (A) is correct.

Explanation: Power factor correction is the method to reduce the lagging power factor in inductive loads by fixing a high value capacitor across the phase and neutral close to the load.

Ans. 53. Option (B) is correct.

Explanation: When the voltage and current are in phase with each other in an AC circuit, the energy from the source is fully converted into another form to drive the load and in this case, power factor is unity. When the power factor drops, the system becomes less efficient.

Ans. 54. Option (B) is correct.

Explanation: Power capacitors are huge non-polarized metal film electrolytic type capacitors.

Ans. 55. Option (B) is correct.

Explanation: Power factor corrector capacitors have leading power factor so that they neutralize the lagging power factor of the inductive load.

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Self Assessment Paper

Solutions of Question Paper 2

Section-A

Ans. 1. Option (B) is correct.

Explanation : The tribo-electric effect is a type of contact electrification on which certain materials become electrically charged after they come into frictional contact with a different material.

Ans. 2. Option (C) is correct.

Explanation : As we know that, an equipotential surface is always perpendicular to the direction of electric field. Positive charge experiences the force in the direction of electric field. When a positive charge is released from rest in uniform electric field, its velocity increases in the direction of electric field. So K.E. increases, and the P.E. decreases due to law of conservation of energy.

Ans. 3. Option (C) is correct.

Explanation : The work done by the electrostatic force is given by

$$W_{12} = q\,(V_2 - V_1)$$

As the potential difference between A and B in all three figures are equal, 20 V, so work done by any charge in moving from A to B surface will be equal.

Ans. 4. Option (A) is correct.

Explanation : As we know that the equivalent emf in parallel combination of cells is :

$$\varepsilon_{eq} = \frac{(\varepsilon_1 r_2 + \varepsilon_2 r_1)}{(r_1 + r_2)}$$

so, it is clear that part 'c' and 'd' are incorrect by formula. According to this formula only option (A), is correct.

Ans. 5. Option (C) is correct.

Explanation : To calculate resistance, R

$$R = S\left[\frac{l_1}{(100 - l_1)}\right]$$

$$= 100\left[\frac{2.9}{97.1}\right]$$

$$= 2.98\ \Omega$$

So to get balance point near to 50 cm (middle) we have to take S = 3 Ω, as here R : S = 2.9 : 97.1 implies that S is nearly 33 times to R.

In order to make ratio R and S = 1 : 1, we must take the resistance S = 3 Ω.

Ans. 6. Option (B) is correct.

Explanation : Given that,

emf of primary cells are 5 V and 10 V

The potential drop across potentiometer wire must be slightly more than that larger emf of 10 V.

So, the battery should be of 15 V and about 4 V potential is dropped by using rheostat or resistances.

Ans. 7. Option (A) is correct.

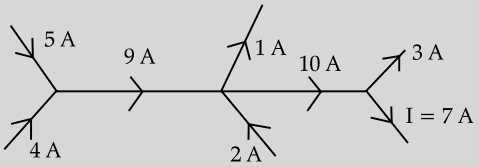
Explanation : Kirchhoff's current law is based on the law of conservation of charge.

Ans. 8. Option (A) is correct.

Explanation : Charge carries electrical energy so capacitor store electrical energy.

Ans. 9. Option (C) is correct.

Explanation: As per Kirchhoff's first law,
(+ 5A) + (+ 4A) + (– 1A) + (+ 2A) + (– 3A) + (– I) = 0 or, I = 7A.



Ans. 10. Option (C) is correct.

Explanation : Wheatstone bridge is suitable for measurement of medium value resistances because to ensure sensitivity, other resistors must be of comparable values.

Ans. 11. Option (A) is correct.

Explanation : In Biot-Savart's law, magnetic field B || $idl \times r$ and idl due to flow of electron is in opposite direction of v and by direction of cross product of two vectors, B.

$$dB = \frac{I.dl \sin\theta}{r^2}$$

or $$dB = \frac{I \times dl}{r}$$

According to Biot-Savart law, if magnetic field is not perpendicular to the motion of charge, then it will not move in helical path, which is not possible for motion of a charge in magnetic field. So, the magnetic field is perpendicular to the direction of flow of charge.

Ans. 12. Option (B) is correct.

Explanation : According to Gauss's law of electrostatic field,

$$\oint E.ds = \frac{q}{\varepsilon_0}$$

So, it does not contradict for electrostatic field as the electric field lines do not form continuous path.

According to Gauss's law of magnetic field, $\oint B.ds = 0$

It is clear that it contradicts for magnetic field because there is magnetic field inside the solenoid, and no field outside the solenoid carrying current, but the magnetic field lines form the closed paths.

Ans. 13. Option (A) is correct.

Explanation : In this case, the direction of the induced electromotive force/ induced current is determined by the Lenz's law. According to the Lenz's law, the direction of induced emf or current in a circuit is such that it opposes the cause that produces it. This law is based upon law of conservation of energy.
When the current in coil B (at $t = 0$) is counter-clockwise and the coil A is considered above it. The counter-clockwise flow of the current in coil B is equivalent to North Pole of magnet and magnetic field lines are eliminating upward to coil A. When coil A starts rotating at $t = 0$, the current in coil A is constant along clockwise direction by Lenz's rule.

Ans. 14. Option (A) is correct.

Explanation : The electric current in a liquid as due to flow of electrons only.

Ans. 15. Option (A) is correct.

Explanation :

$$I = \frac{dQ}{dt} = 2 - 16t$$

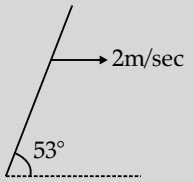
$$\text{Heat} = R\int_0^{1/8} (2 - 16t)^2 .dt$$

On solving, we will get

Heat produced = R/6 joules

Ans. 16. Option (A) is correct.

Explanation :



$$\hat{v} - 2\hat{i}$$

$$\hat{B} = (3\hat{j} + 4\hat{k})$$

$$\hat{i} = 3\hat{i} + 4\hat{j}$$

$$\text{e.m.f.} = \left(\vec{V} \times \vec{B}\right).\vec{I}$$

$$\Rightarrow \left[2\hat{i} \times (3\hat{j} + 4\hat{k})\right].\left(3\hat{i} + 4\hat{j}\right)$$

$$\Rightarrow \left[6\hat{k} + (-8\hat{j})\right].\left(3\hat{i} + 4\hat{j}\right)$$

$\Rightarrow$ –32 Volt

Ans. 17. Option (D) is correct.

Explanation : $V_{rms} = V_0/\sqrt{2} = 0.707\, V_0$

Ans. 18. Option (D) is correct.

Explanation : Given

$$T = 1\mu s = 10^{-6}\ s$$

$$f = \frac{1}{T} = \frac{1}{10^{-6}} = 10^6\ Hz$$

Ans. 19. Option (C) is correct.

Explanation : In a pure resistive circuit, current and voltage are always in phase.

Ans. 20. Option (C) is correct.

Explanation : Since in pure resistive circuit the current and voltage are in phase, the power dissipation is maximum.

Ans. 21. Option (A) is correct.

Explanation: Heat produced = $H = i^2Rt$

$H \propto R$

Since resistance of filament >> Resistance of wire, so more heat is produced in filament. Filament is made of material having high resistance like tungsten, so that heat produced is more.

Ans. 22. Option (A) is correct.

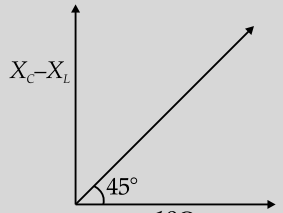
Explanation: The force on a charged particle moving in a uniform magnetic field always acts in direction perpendicular to the direction of motion of the charge.

So work done by the magnetic field,

$W = FS\cos\theta = FS\cos 90° = 0$

Ans. 23. Option (C) is correct.

Explanation:



$$\cos\phi = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \quad \frac{1}{\omega_C} - \omega_L = 10\Omega$$

$$\Rightarrow \quad \frac{1}{100C} - 100 \times 0.1 = 20$$

$$\Rightarrow \quad \frac{1}{100C} = 20$$

$$\Rightarrow \quad C = \frac{1}{20 \times 100}$$

$$\boxed{C = 500\ \mu F}$$

Ans. 24. Option (B) is correct.

Explanation: Given alternating voltage $V = 4\sqrt{2}\ \sin 314t$.

Where peak value = $V_0 = 4\sqrt{2}$ volt.

$V_{RMS} = V_0/\sqrt{2} = 4$ volt.

Ans. 25. Option (C) is correct.

Explanation: In both *ac* and *dc,* heat generated is proportional to the square of current. Polarity change of *ac* is immaterial in the case of heat generation. Hence, they can be measured by hot wire instrument.

Section-B

Ans. 26. Option (B) is correct.

Explanation : Mass and charge both have only magnitude, but no direction.

Ans. 27. Option (D) is correct.

Explanation: In one second, 10^9 electrons move out of the body. Therefore, the charge given out in one second is $1.6 \times 10^{-19} \times 10^9\ C = 1.6 \times 10^{-10}\ C$. The time required to accumulate a charge of 1 C can then be estimated to be $1\ C \div (1.6 \times 10^{-10}\ C/s) = 6.25 \times 10^9\ s = 6.25 \times 109 \div (365 \times 24 \times 3600)$ years = 198 years.

Ans. 28. Option (B) is correct.

Explanation : Unit of force is Newton.
Unit of charge is coulomb.
Unit of distance is metre.
$k = Fr^2/Q_1Q_2$
So, unit of K is Nm^2/C^2

Ans. 29. Option (A) is correct.

Explanation : This is according to the superposition principle.

Ans. 30. Option (B) is correct.

Explanation : $F = qE$

So, E = 1, when F = 1 and Q = 1.

Ans. 31. Option (B) is correct.

Explanation : $V = Q/4\pi\varepsilon_0 r$

Ans. 32. Option (A) is correct.

Explanation : $V = p \cos\theta / 4\pi\varepsilon_0 r^2$
For equatorial plane, $\theta = \pi/2$
$\therefore V = 0$

Ans. 33. Option (C) is correct.

Explanation : To enable the tyres to conduct charge (produced by friction) to the ground; as too much of static electricity accumulated may result in spark and result in fire.

Ans. 34. Option (B) is correct.

Explanation : $V = Q/4\pi\varepsilon_0 r$
Since $r = 0, V = \infty$

Ans. 35. Option (B) is correct.

Explanation : Relaxation time (τ) is inversely proportional to resistivity (ρ). As temperature increases, resistivity increases, so relaxation time decreases.

Ans. 36. Option (C) is correct.

Explanation : Tin-lead alloy has low melting point as well as the have the high resistance.

Ans. 37. Option (C) is correct.

Explanation : Semiconductor has negative temperature coefficient of resistivity. So, its resistivity decreases with temperature.
Metal has positive temperature coefficient of resistivity. So its resistivity increases with increase in temperature.

Ans. 38. Option (C) is correct.

Explanation : Appliances based on heating effect of current works both on a.c. and d.c. since change in direction of current does not affect the heating effect.

Ans. 39. Option (A) is correct.

Explanation : In potentiometer, when the balance point is obtained, no current flows through the galvanometer.

Ans. 40. Option (A) is correct.

Explanation : According to Biot-Savart law

$$\vec{B} = \frac{\mu_0}{4\pi} x \frac{q(\vec{v} X \vec{r})}{r^3}$$

So, $\vec{B}$ is perpendicular to both $\vec{v}$ and $\vec{r}$.

Ans. 41. Option (B) is correct.

Explanation : The flow of protons is considered as the direction of current.
The direction of current for flow of electrons is considered in the opposite direction.
So, they will repel each other.

Ans. 42. Option (B) is correct.

Explanation : $B = \mu_0 NI/2r$
$\therefore \quad B \propto I$
$B \propto 1/r$

Ans. 43. Option (B) is correct.

Explanation : There is no effect of magnetic field on a stationary charge.

Ans. 44. Option (B) is correct.

Explanation : Radius = $R = mv/QB$
So, $R \propto v$
$\therefore \quad v_1/v_2 = R_1/R_2$
Since $v_1/v_2 = 3:2$
$\therefore \quad R_1/R_2 = 3:2$

Ans. 45. Option (A) is correct.

Explanation : Let us consider an electric dipole. The electric lines of force exists outside only and not inside the dipole.
Let us now consider a magnetic dipole. The magnetic lines of force exist outside as well as inside the dipole.
So, it can be said that magnetic lines of force are continuous and electric lines of force are discontinuous.
So assertion and reason both are true and reason explains the assertion too.

Ans. 46. Option (C) is correct.

Explanation : Work done in moving a charge between any two points in a uniform electric field = charge × potential difference. So, it is independent of the path followed by the charge. Hence the assertion is true.
Electrostatic forces are conservative type. Hence, the reason is false.

Ans. 47. Option (C) is correct.

Explanation : Electric potential and electric potential energy are two different quantities. Hence the assertion is true.
Electric potential is defined as the potential energy per unit charge. Hence

$$V = P.E./q$$

So, the reason is false

Ans. 48. Option (D) is correct.

Explanation : Power rating describes the heat dissipation capability of the resistor. If the heat generated is more than the power rating of the resistor, it will burn. So assertion is true. Resistance value is temperature dependent. So, the reason is also false.

Ans. 49. Option (A) is correct.

Explanation : Kirchhoff's junction rule is applicable at any point of an electrical circuit and there is no limitation of number of lines meeting at that point. So the assertion is true.

While steady current is flowing there is no accumulation of charge at the junction. Total incoming charge = total outgoing charge. So the reason is also true and explains the assertion.

Section-C

Ans. 50. Option (B) is correct.

Explanation: The frequency of A.C. in India is 50 Hz.

Ans. 51. Option (D) is correct.

Explanation: Inverter Converts D.C. to A.C.

Case Study

Ans. 52. Option (A) is correct.

Explanation: Improved mirror galvanometer was developed by William Thomson, later to become Lord Kelvin, in 1858.

Ans. 53. Option (B) is correct.

Explanation: The fundamental problem was that the transmitting/receiving a signal through a lengthy submarine cable was very low. Instead of increasing the magnitude of the current transmission, Lord Kelvin modified the existing galvanometer so that it became capable to measure the weakest current.

Ans. 54. Option (C) is correct.

Explanation: The galvanometer, was a means of detecting electric current. It consisted of a needle that was deflected by the magnetic field created by the electric current.

Ans. 55. Option (B) is correct.

Explanation: The mirror galvanometer consists of a long fine coil of silk-covered copper wire. In the heart of that coil, within a little air-chamber, a small round mirror is hung by a single fibre of floss silk, with four tiny magnets cemented to its back.

■■■

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Self Assessment Paper

Solutions of Question Paper 3

Section-A

Ans. 1. Option (B) is correct.

Explanation : $F_g = F_e$

$$G\frac{m^2}{d^2} = k\frac{(\Delta e)^2}{d^2}$$

$$(\Delta e)^2 = \frac{Gm^2}{k}$$

$$= \frac{(6.627 \times 10^{-11}) \times (1.67 \times 10^{-27})^2}{9.8 \times 10^9}$$

$$(\Delta e)^2 = 2.1 \times 10^{-74}\ C^2$$

$$\therefore \quad \Delta e \approx 10^{-37}\ C$$

Ans. 2. Option (C) is correct.

Explanation : The relation between electric field intensity E and potential (V) is,

$$E = -\frac{dV}{dr}$$

Where, Electric field intensity, E = 0 inside the sphere

So that, $\frac{dV}{dr} = 0$

This means that V = constant. So, if E = 0 inside charged sphere, the potential is constant or V = 100 V everywhere inside the sphere and it verifies the shielding effect also.

Ans. 3. Option (A) is correct.

Explanation : For equipotential surface, these surfaces are perpendicular to the field lines. So there must be electric field, which cannot be without charge.

So the algebraic sum of all charges must not be zero. Equipotential surface at a great distance means that space of charge is negligible as compared to distance. So the collection of charges is considered as a point charge.

Electric potential due to point charge is,

$$V = k_e\frac{q}{r}$$

which explains that electric potentials due to point charge is same for all equidistant points. The locus of these equidistant points, which are at same potential, forms spherical surface.

Ans. 4. Option (D) is correct.

Explanation : Now $V = 6x - 8xy - 8y + 6yz$

$$\vec{E} = -\left(\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k}\right)$$

$$\partial V/\partial x = \frac{\partial}{\partial x}(6x - 8xy - 8y + 6yz)$$

$$= (6 - 8y - 0 + 0)_{1,1,1} = -2$$

$$\partial V/\partial y = \frac{\partial}{\partial y}(6x - 8xy - 8y + 6yz)$$

$$= (0 - 8x - 8x + 6z)_{1,1,1} = -10$$

$$\partial V/\partial z = \frac{\partial}{\partial z}(6x - 8xy - 8y + 6yz)$$

$$= (0 - 0 - 0 + 6y)_{1,1,1} = 6$$

$$\vec{E} = 2\hat{i} + 10\hat{j} - 6\hat{k}$$

$$E = \sqrt{(2)^2 + (10)^2 + (6)^2}$$

$$= \sqrt{4 + 100 + 36} = \sqrt{140}$$

$$E = 2\sqrt{35}\ N/C$$

$$F = qE = 2 \times 2\sqrt{35} = 4\sqrt{35}\ N$$

Ans. 5. Option (A) is correct.

Explanation : As we know that,

$$I = Ane v_d$$

So current,

$$I \propto v_d$$

And, current (I) also depend on n, the number of free electrons which increases on increasing temperature which makes more collision between electrons and increases resistance or decrease current.

Ans. 6. Option (A) is correct.

Explanation : As we know that,

$$R = \rho\left(\frac{l}{A}\right)$$

The maximum resistance will be achieved when the value of $\frac{l}{A}$, is maximum, so that 'A' must be minimum and it is minimum when area of cross section is 1 cm $\times \frac{1}{2}$ cm.

Ans. 7. Option (C) is correct.

Explanation : According to Coulomb's law, the force of repulsion between the two positive ions each of charge q, separated by a distance d is given by

$$F = (1/4\pi\varepsilon_o) \times (q)(q)/d^2$$

$$F = q^2/4\pi\varepsilon_o d^2$$

$$q^2 = 4\pi\varepsilon_o F d^2$$

$$q = \sqrt{4\pi\varepsilon_0 F d^2}$$

Since, $q = ne$ or $n = q/e$

$$n = \sqrt{4\pi\varepsilon_0 F d^2}/e = \sqrt{4\pi\varepsilon_0 F d^2/e^2})$$

Ans. 8. Option (C) is correct.

Explanation : $E_0 = 0$

Now $E_{AKB} + E_{ACDB} = 0$

$E_{ACDB} = (-)\ E_{AKB}$

$= -E$ (along KO)

$= E$ (along OK)

Ans. 9. Option (D) is correct.

Explanation : Slope of I-V characteristic of an Ohmic conductor remains constant throughout.

Ans. 10. Option (B) is correct.

Explanation : Equivalent resistance of the circuit = (5 + 5) || (5 + 5) = 5 Ω

Total circuit current = 10/5 = 2 A

Current in each branch is 1A

So, potential difference between points A and B i.e. across the 5 Ω resistor is $1 \times 5 = 5$ V.

Ans. 11. Option (A) is correct.

Explanation : $E = 50$ V/cm $= 50/10^{-2}$ V/m

Now $e/m = 1.76 \times 10^{11}$ C/kg

As, $eE = ma$

or $a = eE/m$

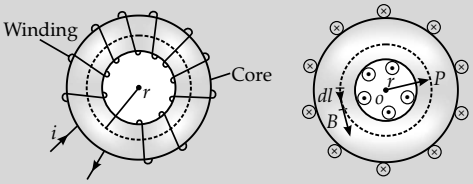
$= 1.76 \times 10^{11} \times 5 \times 10^3$

$= 88 \times 10^{13}$

$= 8.8 \times 10^{14}\ m/s^2$

Ans. 12. Option (C) is correct.

Explanation : As we know that a toroid can be considered as a ring shaped closed solenoid. So that it is like an endless cylindrical solenoid.



So, the magnetic field is only confined inside the body of a toroid in the form of concentric magnetic lines of force.

For any point inside, the empty space surrounded by toroid and outside the toroid, the magnetic field B is zero because the net current enclosed in these spaces is zero. So that, the magnetic moment of toroid is zero. In general, if we take r as a long distance outside the toroid, the $m \propto \frac{1}{r^3}$ but this case is not possible here.

Ans. 13. Option (C) is correct.

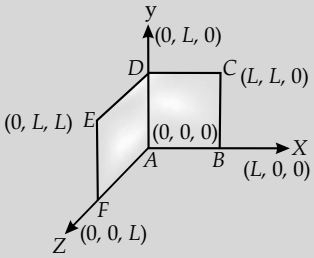
Explanation : Magnetic flux is defined as the total number of magnetic lines of force passing normally through an area placed in a magnetic field and is equal to the magnetic flux linked with that area.

Square lies in X-Y plane in $\vec{B}$ so $\vec{A} = L^2\hat{k}$

$$Q = B.A$$
$$= B_0(2\hat{i} + 3\hat{j} + 4\hat{k}).(L^2\hat{k})$$
$$= B_0[2 \times \hat{i}\hat{k} + 3 \times \hat{j}\hat{k} + 4 \times \hat{k}.\hat{k}]$$
$$= B_0L^2[0 + 0 + 4]$$
$$= 4B_0L^2 Wb.$$

Ans. 14. Option (B) is correct.

Explanation : The loop can be considered in two planes :



(i) Plane of *ABCDA* is in *X-Y* plane. So its vector $\vec{A}$ is in *Z*-direction. Hence,

$$A_1 = |A|\hat{k} = L^2\hat{k}$$

(ii) Plane of *DEFAD* is in *Y-Z* plane

So $A_2 = |A|\hat{i} = L^2\hat{i}$

$\therefore$ $A = A_1 + A_2 = L^2(\hat{i} + \hat{k})$

$B = B_0(\hat{i} + \hat{k})$

So, $Q = B.A = B_0(\hat{i} + \hat{k}) \cdot L^2(\hat{i} + \hat{k})$

$= B_0L^2 [\hat{i}.\hat{i} + \hat{i}.\hat{k} + \hat{k}.\hat{i} + \hat{k}.\hat{k}]$

$= B_0L^2[1 + 0 + 0 + 1]$

($\Re$ cos90 0)

$= 2B_0L^2 Wb$

Ans. 15. Option (C) is correct.

Explanation : For calculating common potential:

$$V = (V_1C_1 + V_2C_2)/(C_1 + C_2)$$

Putting values

$$= \frac{500 \times 20 + 200 \times 10}{20 + 10}$$
$$= 400 \text{ V}$$

Ans. 16. Option (C) is correct.

Explanation :

$\because$ $V \propto \frac{1}{K}$

So, $\frac{V_2}{V_1} = \frac{K_1}{K_2}$

Here, $V_1 = V, K_1 = 1$

and $V_2 = \frac{1}{8} V_1$

So, $K_2 = 8$

Ans. 17. Option (A) is correct.

Explanation : Energy stored

$$U = (1/2) CV^2$$
$$= (1/2) \times 50 \times 10^{-6} \times (10)^2$$
$$= 2.5 \times 10^{-3} J$$

Ans. 18. Option (C) is correct.

Explanation : As internal resistance of generator is already equal to external resistance *Rg*. So to deliver maximum power, *i.e.*, to make reactance equal to zero, the reactance in external circuit will be $-X_g$. In order to deliver maximum power, the generator to the load, the total reactance must be equal to zero, *i.e.*, $X_L + X_g = 0, X_L = -X_g$.

Ans. 19. Option (C) is correct.

Explanation : The voltmeter in AC circuit reads value $<v^2>$ and meter is calibrated to rms value $<v^2>$ which is multiplied by $\sqrt{2}$ to get V_{rms}. In other words, voltmeter connected to the AC main read root mean square value of AC voltage, *i.e.*, $\sqrt{(v^2)}$.

Ans. 20. Option (C) is correct.

Explanation : In a charged capacitor, the energy resides in between the plates.

Ans. 21. Option (A) is correct.

Explanation : Since no charge resides in the surface of a hollow sphere, the electric field is also zero inside.

Ans. 22. Option (D) is correct.

Explanation : Fuse wire should melt and disconnect the circuit from mains supply if the current increases beyond a rated value. For this reason, its resistance should be high for more heat generation and melting point should be low for fast melting.

Ans. 23. Option (D) is correct.

Explanation : Resistance of super-conductor falls to zero at critical temperature.

Ans. 24. Option (C) is correct.

Explanation : $\vec{F} = q(\vec{v} \times \vec{B})$

So, the force is mass independent.

Ans. 25. Option (A) is correct.

Explanation : In electromagnetic induction, magnetic energy, mechanical energy are converted into electrical energy. So, Faraday's laws of electromagnetic induction are direct consequences of law of conservation of energy.

Section-B

Ans. 26. Option (A) is correct.

Explanation : Average value of current over a complete cycle is

$$\frac{\int_0^T i_0 \sin \omega t dt}{\int_0^T dt}$$

$$= \frac{I_0}{T}\int_0^T \sin \omega t dt$$

$$= \frac{I_0}{T\omega}\int_0^{2\pi} \sin \theta d\theta$$

$$= 0$$

Ans. 27. Option (D) is correct.

Explanation :

$[R] = [ML^2T^{-3}A^{-2}]$

$[C] = [M^{-1}L^{-2}T^4A^2]$

$[RC] = [T]$

Ans. 28. Option (C) is correct.

Explanation : Energy in form of heat is dissipated in resistor.

Ans. 29. Option (B) is correct.

Explanation :

$$\text{Ratio} = \frac{X_C}{X_L} = \frac{\left(\frac{1}{\omega_C}\right)}{\omega_L} = \frac{1}{\omega^2 LC}$$

Ans. 30. Option (A) is correct.

Explanation : In series resonant, circuit $X_C = X_L$. So, total reactance is zero.

Ans. 31. Option (D) is correct.

Explanation : The plate may be heated by passing direct current.

The plate may be heated by passing alternating current also since change in direction of current does not matter in heating.

If the plate is placed in time varying magnetic field eddy current develops which also generate heat.

Ans. 32. Option (D) is correct.

Explanation : LED is a semiconductor device which emits light when forward biased.

Ans. 33. Option (B) is correct.

Explanation : $\phi = LI$

Where ϕ = flux. Unit is weber.

L = self inductance. Unit is henry.

I = current. Unit is ampere.

So, Henry = weber / ampere

Ans. 34. Option (C) is correct.

Explanation : Energy stored in capacitor = U = $Q^2/2C$
Unit of energy (U) is Joule.
Unit of Capacitance (C) is Farad.
Unit of charge (Q) is Coulomb.
So, Farad = C^2/J

Ans. 35. Option (B) is correct.

Explanation : Comparing the following two equations:
Induced emf = $\varepsilon = -L\, di/dt$, where L is inductance and di/dt is change in current with time.
Force = F = Mdv/dt, where M is mass and dv/dt is change in velocity with time.
So, inductance is equivalent to mass *i.e.* the inertia.

Ans. 36. Option (B) is correct.

Ans. 37. Option (B) is correct.

Ans. 38. Option (B) is correct.

Explanation : A current loop having N number of turns, and the cross sectional area A, carrying current I, when placed in and along the direction of external magnetic field B, experiences a torque given by:

$$\tau = NIAB$$

The pivoted spring of spring constant k would oppose the above torque with restoring torque C given by: $C = k\phi$
Here, ϕ is the angular deflection

$$k\phi = NIAB$$

$$\therefore \quad \phi = NIAB/k$$

Ans. 39. Option (B) is correct.

Explanation : Internal resistance of an ammeter should be as low as possible so that the voltage across it is negligible.

Ans. 40. Option (C) is correct.

Explanation : Internal resistance of a voltmeter should be as high as possible so that it draws negligible amount of current from the circuit.

Ans. 41. Option (A) is correct.

Explanation : Magnetic field developed by a current carrying wire is
$B = \mu_0 I / 2\pi r$.
Force exerted by the field on the other wire of length l is $F = BIL = \mu_0 I^2 l / 2\pi r$
$\therefore$ Force per unit length = $\mu_0 I^2 / 2\pi r$

Ans. 42. Option (B) is correct.

Explanation : The force acting =

$$F = BiL \sin\theta$$

Force is maximum when $\sin\theta = 1$ *i.e.*

$$\theta = \pi/2$$

Ans. 43. Option (C) is correct.

Explanation : As the higher the internal resistance better is the voltmeter. Voltmeter, C has the highest internal resistance. So, this will offer the best accuracy.

Ans. 44. Option (A) is correct.

Explanation : The torque acting =

$$\vec{\tau} = \vec{M} \times \vec{B} = = MB \sin\theta$$

So, torque is proportional to $\sin\theta$

Ans. 45. Option (A) is correct.

Explanation : When an electric dipole is placed in a uniform electric field at an angle q with the field, the dipole experiences a torque.
The torque produced by two parallel forces qE acting as couple = τ

$$\tau = qE\,(2l \sin\theta)$$

In case of non-uniform field, force acting on both the ends of the dipole will not be equal. So, there will be a combination of couple and a net force. In this way, dipole will have both rotational as well as linear motion.
So, both assertion and reason are true. Reason also explains the assertion.

Ans. 46. Option (A) is correct.

Explanation : $\vec{E} = -\vec{\nabla} V$
So, The electric field is always perpendicular to equipotential surface.

Negative gradient of electric potential is electric field. So, direction of electric field must be in the direction of the decreasing order of electric potential.

Ans. 47. Option (A) is correct.

Explanation : The metallic body of electrical appliance is connected to the 3rd pin which is an earth pin.

By any chance if the metallic body gets connected to the LIVE line, current flows to earth through this pin without giving any shock to the user.

Hence assertion is true.

Electric bulb does not have any metallic enclosure and hence there is no requirement of earth pin. So, the reason is also true and properly explains the assertion.

Ans. 48. Option (B) is correct.

Explanation : Magnetic field inside a solenoid is $B = \mu_0 ni$.

Magnetic field at the end of a solenoid is $\frac{1}{2} \mu_0 ni$.

So, the assertion is true.

Magnetic field within a sufficiently long solenoid is uniform. So reason is also true. But it does not explain the assertion.

Ans. 49. Option (B) is correct.

Explanation : Magnetic poles exist in pairs. So assertion is true.
The bar magnet does not exert a torque on itself in its own magnetic field. Torque is proportional to cross product of $\vec{M}$ and $\vec{B}$. The angle between $\vec{M}$ and $\vec{B}$ being 0, the cross product is 0. So, there will be no torque. So reason is also true. But R cannot explain A.

Section-C

Ans. 50. Option (C) is correct.

Explanation : $\delta = \tan^{-1} \frac{B_V}{B_H} = \tan^{-1} 1$

$= 45°$

Ans. 51. Option (A) is correct.

Explanation : The lines of magnetic field from a bar magnet are closed lines. By convention, outside the magnet the field direction is taken from the north pole to south pole of the magnet. So, inside the bar magnet the direction is from south to north pole.

Case Study

Ans. 52. Option (C) is correct.

Explanation : Magnetic effects are generally smaller than electric effects.

Ans. 53. Option (A) is correct.

Explanation : 10^{-3} N = mass in kg × g in m/s^2
Or, 10^{-3} = mass × 10
$\therefore$ Mass = 10^{-4} kg = 100 mg

Ans. 54. Option (B) is correct.

Explanation : The spring shrinks due to force acting between two current carrying wires.

Ans. 55. Option (C) is correct.

Explanation : Mercury, DC voltage source, key is essential components for the Roget's spiral to work.

■■■

Time : 90 minutes
Maximum Marks : 35

PHYSICS
CBSE
Self Assessment Paper

Solutions of Question Paper 4

Section-A

Ans. 1. Option (D) is correct.

Explanation : A simple apparatus to detect charge on a body is the gold-leaf electroscope. It consists of a vertical metal rod housed in a box, with two thin gold leaves attached to its bottom end. When a charged object touches the metal knob at the top of the rod, charge flows onto the leaves and they diverge. Thus the presence of charge in a body is detected.

Ans. 2. Option (B) is correct.

Ans. 3. Option (B) is correct.

Explanation :

Since $\overrightarrow{F_{12}} = \frac{q_1 q_2}{r_{12}^2}\hat{r}_{12}$

$\overrightarrow{F_{21}} = \frac{q_1 q_2}{r_{21}^2}\hat{r}_{21}$

$\overrightarrow{F_{12}} = -\overrightarrow{F_{21}}$

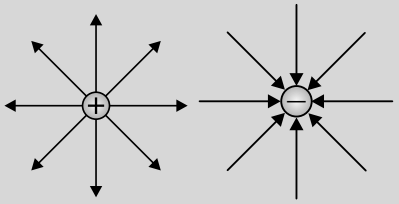
Coulomb's law agrees with the Newton's third law.

Ans. 4. Option (A) is correct.

Ans. 5. Option (B) is correct.

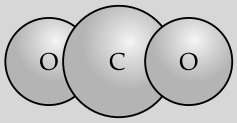
Ans. 6. Option (C) is correct.

Explanation :



Ans. 7. Option (A) is correct.

Explanation : Structure of CO_2 molecule:



The centres of positive and negative charges coincide.

Ans. 8. Option (A) is correct.

Explanation : $\vec{P} = \varepsilon_0 \chi_e \vec{E}$

The dipole moment per unit volume is called polarisation and is denoted by $\vec{P}$.

χ_e is a constant characteristic of the dielectric and is known as the electric susceptibility of the dielectric medium.

Ans. 9. Option (A) is correct.

Explanation : The maximum electric field that a dielectric medium can withstand without break-down (of its insulating property) is called its dielectric strength.

Ans. 10. Option (D) is correct.

Explanation : Since the electrons are moving from A to B, the direction of current will be from B to A.

No. of electrons = $N = 1 \times 10^6$

So, total charge = Q

$= 1 \times 10^6 \times 1.6 \times 10^{-19}$ C

Current = I = Q/t
$= 1 \times 10^6 \times 1.6 \times 10^{-19} / 2 \times 10^{-6}$
$= 0.8 \times 10^{-7}$ A

Ans. 11. Option (A) is correct.

Explanation : Time period =
$T = 2\pi \times 5 \times 10^{-11} / (\pi \times 10^6) = 10^{-16}$s
Equivalent current = Q/T
$= 1.6 \times 10^{-19} / 10^{-16} = 1.6 \times 10^{-3}$ A

Ans. 12. Option (A) is correct.

Explanation : Direction of current will be B to A since electrons are moving from A to B.
Total current = $I_{electron} + I_{proton}$
$= 10^{19} \times 1.6 \times 10^{-19} + 10^{19} \times 1.6 \times 10^{-19}$
$= 3.2$ A

Ans. 13. Option (C) is correct.

Explanation :
$$B = \frac{\mu_0}{4\pi} \times \frac{I}{r} \times (\sin\phi_1 + \sin\phi_2)$$
$B \propto I$.
Hence graph (C) is not correct.

Ans. 14. Option (A) is correct.

Explanation : $B = \frac{\mu_0}{2} \times \frac{nI}{R}$

Initial radius = R_1
Length of wire = $2\pi R_1$
Final radius = R_2
Length of wire = $2 \times 2\pi R_2$
$2\pi R_1 = 2 \times 2\pi R_2$
$\therefore \quad R_2 = R_1/2$
Initially, $B_1 = \frac{\mu_0}{2} \times \frac{I}{R}$

Finally, $B_2 = \frac{\mu_0}{2} \times \frac{2I}{\frac{R_1}{2}} = 2B_1$

Ans. 15. Option (B) is correct.

Explanation : Ammeter has low resistance to pass more current through it and to obtain actual value of current voltmeter has high resistance.

Ans. 16. Option (C) is correct.

Explanation :
$\vec{F} = Q[5 \times 10^3 \hat{i} \times (5\hat{i} + 10\hat{j})]$
$= 2 \times 1.6 \times 10^{-19} [50 \times 10^3 \hat{k}]$
$= 16 \times 10^{-16} \hat{k}$ N

Ans. 17. Option (B) is correct.

Explanation : Potential difference across 2μF capacitor is $\frac{10 \times 3}{2+3} = 6$ V
Potential difference across 3 μF capacitor is $\frac{10 \times 2}{2+3} = 4$ V .

Ans. 18. Option (A) is correct.

Explanation : Specific resistance is material dependent. It does not depend on the shape and size.

Ans. 19. Option (D) is correct.

Explanation : Magnetic moment,
$M = nIA$
So, it is independent of the magnetic field in which it is lying.

Ans. 20. Option (B) is correct.

Explanation :
Current = Charge crossing per second
$= 1.6 \times 10^{19} \times 5 \times 10^{19} = 8$ A
Direction of current will be opposite to the motion of the electron *i.e.* clockwise.

Ans. 21. Option (B) is correct.

Explanation :
$$\omega = \frac{1}{\sqrt{LC}}$$
$$= \frac{1}{\sqrt{30 \times 10^{-6} \times 3 \times 10^{-3}}}$$
$$= \frac{10^4}{3} \text{ rad/s}$$

Ans. 22. Option (C) is correct.

Explanation : Three inductors are in parallel So, the equivalent inductance is L/3.

Ans. 23. Option (B) is correct.

Ans. 24. Option (B) is correct.

Ans. 25. Option (C) is correct.

Explanation :

$V_{XY} = (2 \times 2) + 3 + (1 \times 2) = 9\ V$

Section-B

Ans. 26. Option (A) is correct.

Explanation : It is observed that charges are at the outer surface of a conducting hollow sphere of radius R. On considering spherical surface of radius $r <$ R, then as per Gauss's law

$\oint E ds = (1/\varepsilon_o) \times$ charge inside

$E \times 4\pi r^2 = 1/\varepsilon_o \times 0$

E = 0, hence intensity of electric field inside a hollow conducting sphere is zero.

Ans. 27. Option (A) is correct.

Explanation : It is observed that in non-uniform electric field, intensity is more, where the field lines are denser, so $E_A > E_B$.

Ans. 28. Option (B) is correct.

Explanation : It is observed that electric potential due to dipole is normally be,

$V = k \times p \cos\theta / r^2$

So, $V \propto 1/r^2$

Ans. 29. Option (C) is correct.

Explanation : In an electric dipole, when angle $\theta = 0$, then potential energy $= -pE \cos\theta = -pE$

Ans. 30. Option (C) is correct.

Explanation : In an isolated capacitor Q is constant, so an electrostatic force between metal plates is given as:

$F = QE = Q \times \sigma/2\varepsilon_0 = Q^2/2A\varepsilon_0$

Which is independent of the distance between the plates.

Ans. 31. Option (C) is correct.

Explanation :

As $C \propto 1/d$

So $C_1/C_2 = d_2/d_1$

Also $C_2/10 = 8/4$

Hence capacity of parallel capacitor

$C_2 = 20\mu F$

Ans. 32. Option (D) is correct.

Explanation : Total capacitance of the combination

$C' = C/n$ (here, $n = 3$)

$= 6 \times 10^{-12}/3 = 2 \times 1\ 0^{-12}\ F$

Ans. 33. Option (C) is correct.

Explanation : Equivalent capacitance will be:

$1/C_{eq} = 1/3 + 1/10 + 1/15$ or $C_{eq} = 2\ \mu F$

Now charge on each capacitor

$Q = C_{eq} \times V$

$\Rightarrow \quad 2 \times 100 = 200\ \mu C$

Ans. 34. Option (C) is correct.

Explanation :

$I = E/(R + r)$

$E = I \times (R + r)$

Putting the values, $2.1 = 0.2 \times (10 + r)$

Solving for resistance r, $10 + r = 21/2$

$r = 10.5 - 10 = 0.5\ \Omega$

Ans. 35. Option (C) is correct.

Explanation :

Since, $\alpha = \dfrac{R_2 - R_1}{R_1 (T_2 - T_1)}$

$125 \times 10^{-5} = \dfrac{2 - 1}{1 (T_2 - 300)}$

or, $T_2 = \dfrac{100000}{125} + 300 = 1100\ K$

Ans. 36. Option (C) is correct.

Explanation : Using an ammeter, current through the circuit can be measured easily.

Ans. 37. Option (C) is correct.

Explanation : In the figure, points A, B, C, D and E are all equidistant from point charge $+q$, hence all these points are equipotential. In an equipotential surface, no work is done to a charge from one place to another, so work done along path AB, AC, AD, and AE will be zero.

Ans. 38. Option (A) is correct.

Explanation : If a bulb B and AC source are connected in series with self-inductance coil, then in such case the brightness of the bulb decreases when an iron rod is inserted in the coil which further increases impedance of the circuit.

Ans. 39. Option (D) is correct.

Explanation :

$$E = -L \times (dI/dt)$$

$$5 = -L \times (2-3)/(1 \times 10^{-3}) = 1000\ L$$

or, $L = 5 \times 10^{-3}\ H = 5\ mH$

Ans. 40. Option (C) is correct.

Explanation :

As $L \propto N^2/l$ so $L_2/L_1 = (N_2/N_1)^2(l_1/l_2)$

As $N_2 = 2N_1$ and $l_2 = 2l_1$

$L_2/L_1 = 4(1/2) = 2$

$L_2 = 2L_1$

Ans. 41. Option (C) is correct.

Explanation : Now induced e.m.f. :

$$E = -L \times (di/dt) = 5 \times (1/5) = 1\ V$$

Ans. 42. Option (A) is correct.

Explanation : Q or quality factor of resonant circuit is a measure of quality of resonant circuit. In an LCR circuit, the quality factor

$$Q = \frac{\omega_0}{\Delta\omega} = \frac{\omega}{R/L} = \frac{\omega L}{R}$$

Ans. 43. Option (B) is correct.

Explanation : As $X_C = 1/2\pi f C$

It is observed that at very high frequencies, the capacitor has low capacitive reactance.

Ans. 44. Option (A) is correct.

Explanation : In an LCR resonance circuit, maximum current is limited by value of resistance; source voltage and circuit current are in phase. In such case, phase angle between voltage and current of a series resonance circuit is a function of frequency for fixed supply voltage which is zero. At resonant frequency V, I and V_R are all in phase with each other At resonance LCR series circuit behaves as pure resistive circuit. For resistive circuit, $\phi = 0°$.

Ans. 45. Option (A) is correct.

Explanation: When an electric dipole is placed in a uniform electric field at an angle θ with the field, the dipole experiences a torque.

The torque produced by two parallel forces qE acting as couple $= \tau$

$$\tau = q\text{E}\ (2l \sin\theta)$$

In case of non-uniform field, force acting on both the ends of the dipole will not be equal. So, there will be a combination of couple and a net force. In this way, dipole will have both rotational as well as linear motion.

So, both assertion and reason are true. Reason also explains the assertion.

Ans. 46. Option (A) is correct.

Explanation: Alternator is basically a generator in which a coil rotates in a strong magnetic field and according to laws of electromagnetic induction e.m.f. is generated. So, assertion and reason both are true and reason explains the assertion.

Ans. 47. Option (C) is correct.

Explanation: Fuse wire should melt and disconnect the circuit from mains supply if the current increases beyond a rated value. For this reason, its resistance should be high for more heat generation and melting point should be low for fast melting. So assertion is correct.

Fuse wire is not for small current flow. Fuse wire may be of various current rating depending on the type of appliance being used and the capacity of the wiring. So, the reason is false.

Ans. 48. Option (A) is correct.

Explanation: Current carrying wire creates magnetic field. This magnetic field has no effect on a stationary charge. But when the charge also moves, it creates a current. This current produces a magnetic field. Two fields interact and the charge is deflected. So, the assertion is true. Moving charge creates a current which produces a magnetic field. So, the reason is also true. Reason is the correct explanation of A.

Ans. 49. Option (C) is correct.

Explanation: In electromagnetic induction, magnetic energy, mechanical energy are converted into electrical energy. So, Faraday's laws of electromagnetic induction are direct consequences of law of conservation of energy. Hence assertion is true.

In a L-R circuit, L/R parameter has the dimension of time. Hence the reason is false.

Section-C

Ans. 50. Option (A) is correct.

Explanation:

$$\vec{E} = -\vec{\nabla}V$$

$$= -\left(\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k}\right)$$

$$= (2xy + z^3)\hat{i} + x^2\hat{j} + 3xz^2\hat{k}$$

Ans. 51. Option (A) is correct.

Explanation: RΩ is connected in series with the potentiometer wire.

So, total resistance = (R + 8)Ω

Current = 2/(R + 8) A

Potential drop across the potentiometer wire

$$= \frac{2}{R+8} \times 8V$$

Potential gradient in mV/cm is

$$\frac{\frac{16}{R+8} \times 1000}{4 \times 100} = 1$$

Solving, R = 32Ω

Case Study

Ans. 52. Option (C) is correct.

Explanation: Phenomenon involved in tuning a radio set to a particular radio station is resonance.

The capacitor has to be tuned in tandem corresponding to the frequency of a station. So, that the LC combination of the radio set resonates at the frequency of the desired station.

Ans. 53. Option (C) is correct.

Explanation: A simple radio receiver is a simple crystal set with a coil and capacitor combination. Desired frequency is tuned by tuning the coil - capacitor combination. Tuning means to make capacitive reactance (X_C) equal to the inductive reactance (X_L), so that the resonance occurs.

Ans. 54. Option (B) is correct.

Explanation: The resonant frequency is given by $\omega_0 = 1/\sqrt{LC}$

Ans. 55. Option (C) is correct.

Explanation: At resonance, capacitive reactance (X_C) is equal to the inductive reactance (X_L). Circuit is totally resistive and the current amplitude becomes maximum.

■■■

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Self Assessment Paper

Solutions of Question Paper 5

Section-A

Ans. 1. Option (B) is correct.

Explanation : $I_{RMS} = I_{PEAK}/\sqrt{2}$

Ans. 2. Option (A) is correct.

Explanation : For an ideal inductor phase difference between current and applied voltage $= \frac{\pi}{2}$,

$\therefore$ Power $P = V_{rms}\, I_{rms} \cos\frac{\pi}{2} = 0$

Ans. 3. Option (C) is correct.

Explanation : When a capacitor is fully charged, the voltage across the two plates of capacitor is same as source. Therefore, it acts as open circuit. Hence, there will be no current flow in the circuit.

Ans. 4. Option (D) is correct.

Explanation : The voltage across L and C are out of phase. Hence, the voltage across the LC combination is zero.

Ans. 5. Option (C) is correct.

Explanation : LC oscillations is not realistic for two reasons:
(i) Every inductor has some resistance. The effect of this resistance is to introduce a damping effect on the charge and current in the circuit and the oscillations finally die away.
(ii) Even if the resistance were zero, the total energy of the system would not remain constant. It is radiated away from the system in the form of electromagnetic waves.

Ans. 6. Option (C) is correct.

Explanation : Mutual induction is the principle of working of transformer.

Ans. 7. Option (C) is correct.

Explanation : Electric flux depends only on the charge enclosed.

Ans. 8. Option (D) is correct.

Explanation :

$$\vec{E} = -\vec{\nabla}V$$

$$\vec{E} = -\left[\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial x}\hat{j} + \frac{\partial V}{\partial x}\hat{k}\right]$$

$$\vec{E} = -8x\hat{i}\ \text{V/m}$$

Ans. 9. Option (D) is correct.

Explanation : Potential energy of the dipole

$$V = -\int T.dB$$

$$= -\int_{\pi/2}^{\theta} PE\sin\theta d\theta$$

$$= -PE\left[\cos\theta\right]_{\pi/2}^{\theta}$$

$$= -PE\,(\cos\theta - 0)$$

$$= -PE\cos\theta$$

and torque $= PE\sin\theta$

Ans. 10. Option (B) is correct.

Explanation : The variation of resistivity of metal with temperature is parabolic in nature.

Ans. 11. Option (B) is correct.

Explanation : If the e.m.f. and internal resistance of the cell be E and r respectively, then

Current through 2Ω resistor = $E/(2 + r)$

$= 0.9A$

$\therefore \quad E = 0.9 \times (2 + r)$

Current through 7Ω resistor

$= E/(7+r) = 0.3A$

$\therefore E = 0.3 \times (7 + r)$

$0.9 \times (2 + r) = 0.3 \times (7 + r)$

Or, $6r = 3$

$\therefore \quad r = 0.5\Omega$

Ans. 12. Option (B) is correct.

Explanation : $Q(t) = at^2 + bt$

$$\text{current } I = \frac{dQ}{dt} = \frac{d}{dt}(at^2 + bt)$$

$$= 2at + b$$

as $a = 3, b = 4$

$I = 6t + 4$

at $t = 4$ seconds

$I = 28$

Ans. 13. Option (A) is correct.

Explanation : When a cell is short circuited, current flowing is zero and terminal potential is equal to the potential of the cell. Hence, EMF is zero.

Ans. 14. Option (D) is correct.

Explanation : In parallel equivalent internal resistance becomes low, hence the current increases.

Ans. 15. Option (B) is correct.

Explanation : Let, a wire loop is rotated in a magnetic field from its initial position where it is perpendicular to magnetic field. Thus, maximum flux passing through the loop. When it starts to rotate, flux coming out starts to decrease. When it is parallel to magnetic field, the flux becomes zero and then follow the same process. In the process, the direction of inducted emf. is same.

After reaching its initial position it changes the direction

So, in one revolution, frequency is 2.

Ans. 16. Option (D) is correct.

Explanation : From the formula $C = K\varepsilon_0 A/d$, it is clear that the capacity of parallel plate condenser depends on the separation distance between the plates.

Ans. 17. Option (B) is correct.

Explanation : Energy stored

$$U = \int CV\, dV = (1/2)\, CV^2$$

Ans. 18. Option (B) is correct.

Explanation : The capacity of a parallel plate condenser

$$C = \varepsilon_0 A/d$$

If the separation between the plates is halved, then

$$C' = \frac{\varepsilon_1 A}{d/2} = 2 \times \frac{\varepsilon_0 A}{d} = 2C$$

Ans. 19. Option (A) is correct.

Explanation : In series combination:

$1/C_s = 1/3 + 1/9 + 1/18 = 1/2$

or $C_s = 2\ \mu F$

In Parallel combination :

$$C_p = 3 + 9 + 18 = 30\ \mu F$$

Ratio of equivalent capacitance

$$C_s/C_p = 2/30 = 1/15$$

Ans. 20. Option (B) is correct.

Explanation : Since, the resistance $R = \frac{\Delta V}{\Delta I}$, in the graph CD has negative slope, so in this, resistance R is negative.

Ans. 21. Option (C) is correct.

Explanation : On applying the formula:

$$r = \left(\frac{E}{V} - 1\right) R$$

Putting the values to get voltage across the cell V as:

$$0.1 = \left(\frac{2}{V} - 1\right) \times 3.9$$

Now voltage will be V = 1.95 volts

Ans. 22. Option (D) is correct.

Explanation : In an ideal voltmeter, the resistance is considered as infinite.

Ans. 23. Option (A) is correct.

Explanation : $B = \mu_0 i/2\pi r$

Further $B \propto 1/r$

when r is doubled, B is halved, hence the magnetic field will be 0.2 T.

Ans. 24. Option (A) is correct.

Explanation : As observed in an ac circuit, the capacitance will have current from potential in forward biased direction.

Ans. 25. Option (D) is correct.

Explanation : It is known that power is the rate at which the work is done in the circuit, *i.e.*,

P = rate of work done in a cycle,

P = W/T

$P = (E_0 I_0 \cos\phi)\,(T/2/T) = (E_0 I_0/2)\cos\phi$

where $\cos\phi$ is power factor of ac circuit.

Section-B

Ans. 26. Option (A) is correct.

Explanation :

As the enclosed charge $= +4q - 2q = 2q$

Therefore, the electric flux, $\phi = 2q/\varepsilon_0$

Ans. 27. Option (A) is correct.

Explanation : When you place a positive charge near a conducting plane, then electric field lines from positive charges will enter into the conducting plane

(from the side where positive charge is kept) and emerge from opposite side of the plane.

In both cases, the direction of electric field lines will always be perpendicular to the surface of the plane.

Ans. 28. Option (A) is correct.

Explanation : As the side or diameter of hemi-sphere is plane surface, and whole hemi-sphere is charged with positive charge so, the electric field line of forces emerging outward will be perpendicular to the plane surface or diameter.

Ans. 29. Option (B) is correct.

Explanation : As all charges are positive (or of same signs) so electric field lines on R.H.S. of Gaussian surface will be due to q_2 and q_4 only.

On L.H.S. of Gaussian surface, the electric field lines on 'E' will be due to q_1, q_2, q_3, q_4 and q_5.

Ans. 30. Option (A) is correct.

Explanation : For equipotential surface, these surfaces are perpendicular to the field lines. So there must be electric field, which cannot be without charge.

So the algebraic sum of all charges must not be zero. Equipotential surface at a great distance means that space of charge is negligible as compared to distance. So the collection of charges is considered as a point charge.

Electric potential due to point charge is,

$$V = k_e \frac{q}{r}$$

which explains that electric potentials due to point charge is same for all equidistant points. The locus of these equidistant points, which are at same potential, forms spherical surface.

Ans. 31. Option (C) is correct.

Explanation : As we know that, an equipotential surface is always perpendicular to the direction of electric field. Positive charge experiences the force in the direction of electric field.

When a positive charge is released from rest in uniform electric field, its velocity increases in the direction of electric field. So K.E. increases, and the P.E. decreases due to law of conservation of energy.

Ans. 32. Option (C) is correct.

Explanation : The work done in rotating a dipole in an electric field from θ_1 to θ_2 is given by

$W = PE(\cos\theta_1 - \cos\theta_2)$

$P = 4 \times 10^{-6}$ cm, $E = 10^{-2}$ NC^{-1}, $\theta_1 = 180°$, $\theta_2 = 0°$

$W = 4 \times 10^{-6} \times 10^{-2} (\cos 180° - \cos 0°)$

$W = -(8 \times 10^{-8})$ J

Ans. 33. Option (A) is correct.

Explanation : $E_1 = 1$ V, $E_2 = 1.5$ V, $R_1 = 0.1\ \Omega$, $R_2 = 0.2\ \Omega$

EMF of an equivalent cell

$E = (E_1R_2 + E_2R_1)/(R_1 + R_2)$

$E = (1 \times 0.2 + 1.5 \times 0.1)/(0.1 + 0.2)$

$E = 1.17$ V

Ans. 34. Option (B) is correct.

Explanation : By using $Q = nq$

$n = 7$ so, $Q = 7q$

Ans. 35. Option (B) is correct.

Explanation : Since electron is moving parallel to the direction of the magnetic field of the conductor force.

$$F = qvB \sin\theta$$
$$= qvB \sin 0$$
$$F = 0$$

Ans. 36. Option (A) is correct.

Explanation : As we know that the equivalent emf in parallel combination of cells is :

$$\varepsilon_{eq} = \frac{(\varepsilon_1 r_2 + \varepsilon_2 r_1)}{(r_1 + r_2)}$$

so, it is clear that part '*c*' and '*d*' are incorrect by formula and ε_{eq} is greater than ε_1.

Ans. 37. Option (C) is correct.

Explanation : to calculate resistance, R -

$$R = S\left[\frac{l_1}{(100 - l_1)}\right]$$
$$= 100\left[\frac{2.9}{97.1}\right]$$
$$= 2.98\ \Omega$$

So to get balance point near to 50 cm (middle) we have to take $S = 3\ \Omega$, as here R : S =2.9 : 97.1 implies that S is nearly 33 times to R.

In order to make ratio R and S = 1 :1, we must take the resistance S =3 Ω.

Ans. 38. Option (B) is correct.

Explanation : **Case 1:** $P/Q = 10/90 = 1/9$ ...(i)

Case 2: $(P+20)/Q = 20/80 = ¼$ ...(ii)

Dividing equation (i) by (ii)

$$P/(P+20) = 4/9$$

$\therefore$ $P = 16\ \Omega$

Putting in equation (i)

$$Q = 144\ \Omega$$

Ans. 39. Option (A) is correct.

Explanation : For a circular loop of radius R, carrying current I in *x*-*y* plane, the magnetic moment $M = I \times \pi R_2$.

It acts perpendicular to the loop along *z*-direction.

When half of the current loop is bent in *y*-*z* plane, then magnetic moment due to half current loop is *x*-*y* plane,

$M_1 = I(\pi R_2/2)$ acting along *z*-direction.

Magnetic moment due to half current loop in *y*-*z* plane, $M_2 = I(\pi R_2/2)$ along *x*-direction.

Net magnetic moment due to entire bent current loop,

$$M_{net} = \sqrt{M_1^2 + M_2^2}$$
$$= \sqrt{2}\,\frac{I\pi R^2}{2}$$
$$= \frac{M}{\sqrt{2}}$$

Therefore, $M_{net} < M$ or M diminishes.

Ans. 40. Option (C) is correct.

Explanation : As, $W = MB(1 - \cos\theta)$

$$W = MB(1 - \cos 60)$$
$$W = MB/2 \quad \text{...(i)}$$

Now, torque = MB sin θ

τ = MB Sin 60

$\tau = (\sqrt{3}/2)MB$ ...(ii)

From equation (i) and (ii),

$\tau = W\sqrt{3}$

Ans. 41. Option (D) is correct.

Explanation : The magnetic field inside the long current carrying solenoid is uniform. Therefore, magnitude of force on the electron of charge ($-e$) is given by $F = -evB \sin\theta = 0$ ($\theta = 0°$) as magnetic field and velocity are parallel. The electron will continue to move with uniform velocity along the axis of the solenoid.

Ans. 42. Option (B) is correct.

Explanation : According to Gauss's law of electrostatic field,

$$\oint E.ds = \frac{q}{\varepsilon_0}$$

So it does not contradict for electrostatic field as the electric field lines do not form continuous path.

According to Gauss's law of magnetic field,

$$\oint B.ds = 0$$

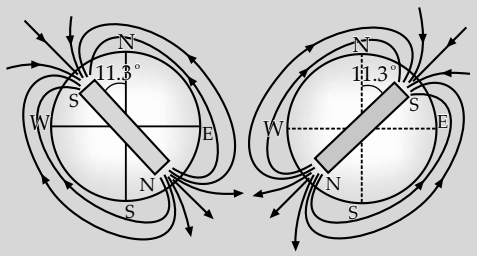
It is clear that it contradicts for magnetic field because there is magnetic field inside the solenoid, and no field outside the solenoid carrying current, but the magnetic field lines form the closed paths.

Ans. 43. Option (A) is correct.

Explanation : The magnetic field lines of the Earth resemble that of a hypothetical magnetic dipole located at the centre of the Earth.

The axis of the dipole does not coincide with the axis of rotation of the Earth and it is tilted at some angle (angle of declination).

In this situation, the angle of declination is approximately 11.3° with respect to the later. So, there is two possibilities arises as shown :



So that the declination varies between 11.3° W to 11.3° E.

Ans. 44. Option (C) is correct.

Explanation : Say, the unknown resistance = X

Case 1: $10/X = L_1/(200-L_1)$

Or, $XL_1 = 2000 - 10L_1$ ...(i)

Case 2: $X/10 = (L_1 + 50)/(150-L_1)$

Or, $XL_1 = 150X - 10L_1 - 500$ ...(ii)

Comparing equation (i) and (ii)

$X = 2500/150 = 16.7\ \Omega$

Ans. 45. Option (A) is correct.

Explanation: Current carrying wire creates magnetic field. This magnetic field has no effect on a stationary charge. But when the charge also moves, it creates a current. This current produces a magnetic field. Two fields interact and the charge is deflected. So, the assertion is true. Moving charge creates a current which produces a magnetic field. So, the reason is also true. Reason is the correct explanation of A.

Ans. 46. Option (C) is correct.

Explanation: Compass needle points the magnetic north-south direction. So the assertion is true.

Earth's magnetic meridian is along its axis through magnetic north-south direction. Earth's axis of rotation is along its geographic north-south direction. The angle between these two axes is 11.3°. Hence, the reason is false.

Ans. 47. Option (C) is correct.

Explanation: Induced e.m.f. in a rotating loop in a magnetic field depends on the area of the loop, number of turns, speed of rotation and magnetic field strength. It does not depend on the material of the coil. So, when two identical loops of

copper and aluminium are rotated with same speed in the same magnetic field, the induced e.m.f. will be same. So, the assertion is true.
Resistance of the two loops cannot be equal. Resistance of copper loop is less than that of the aluminium loop. So, the reason is false.

Ans. 48. Option (C) is correct.

Explanation: Mutual inductance depends on size, number of turns, relative position and relative orientation of the 2 coils. So, when coils are wound on each other, the mutual inductance will be maximum.

So, assertion is true, But the reason is false.

Ans. 49. Option (C) is correct.

Explanation: In both *ac* and *dc,* heat generated is proportional to the square of current. Polarity change of *ac* is immaterial in the case of heat generation. Hence they can be measured by hot wire instrument. Hence, the assertion is true.
Hot wire instruments are based on the principle of heating effect of current. Hence the reason is false.

Section-C

Ans. 50. Option (B) is correct.

Explanation : Capacitors C_2, C_3, C_4 are in parallel. So,

$C_{234} = C_2 + C_3 + C_4 = 6\mu F$

C_1, C_{234} and C_5 are in series.

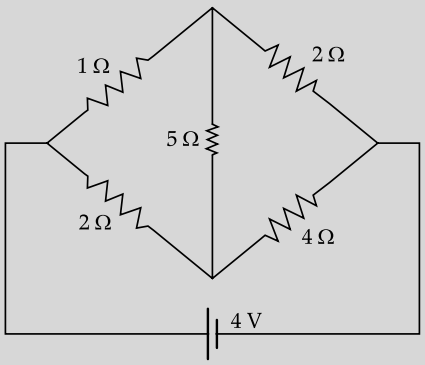
So, $1/C_{EQ} = \frac{1}{2} + \frac{1}{6} + \frac{1}{2} = \frac{7}{6}$

$\therefore C_{EQ} = \frac{6}{7}\mu F$

Case Study

Ans. 51. Option (A) is correct.

Explanation : The given network is in a form of wheatstone bridge.



In balanced condition, the equivalent resistance = R

$$\frac{1}{R} = \frac{1}{1+2} + \frac{1}{2+4}$$

$\therefore \quad R = 2\Omega$

Current $= \frac{V}{R} = \frac{4}{2} = 2A$

Case Study

Ans. 52. Option (B) is correct.

Ans. 53. Option (D) is correct.

Explanation: Core loss is present even when no load is connected. So, these are also known as no-load loss.

Ans. 54. Option (A) is correct.

Explanation: If the currents in primary and secondary windings of the transformer are I_1 and I_2 respectively and the resistances of these windings are R_1 and R_2 then the copper losses that occurred in the windings are $I_1^2R_1$ and $I_2^2R_2$ respectively. So, the entire copper loss will be $I_1^2R_1 + I_2^2R_2$.
This loss is also called variable or ohmic losses because this loss changes based on the load.

Ans. 55. Option (A) is correct.

■■■

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Self Assessment Paper

Solutions of Question Paper 6

Section-A

Ans. 1. Option (A) is correct.

Explanation : The magnitude of the electric force F is directly proportional to the amount of an electric charge, q_1, multiplied by the other, q_2, and inversely proportional to the square of the distance 'r' between their centres.

Ans. 2. Option (C) is correct.

Explanation : When a neutral body gains electrons, it becomes negatively charged. It means that the quantity of negative charges present is more than the quantity of positive charge present.

Ans. 3. Option (D) is correct.

Explanation : When a body is negatively charged by conduction, it gains electrons. Hence, its mass increases. When a body is positively charged by conduction, it loses electrons. Hence, its mass decreases.

Ans. 4. Option (D) is correct.

Explanation : The electric potential at a point on the equatorial line of a electric dipole is zero.

Ans. 5. Option (D) is correct.

Explanation : As capacitor offer infinite resistance for DC circuit. So current from cell will not flow across branch of 4 μF and 10 Ω. So current will flow across 2 ohm branch.
So, Potential Difference (PD) across 2Ω resistance V = RI = 2 × 1 = 2 Volt. As battery, capacitor and 2 branches are in parallel. So PD will remain same across all three branches. As current does not flow through capacitor branch, so no potential drop will be across 10 Ω.
So PD across 4 μF capacitor = 2 Volt
Q = CV = 2 μF × 2 V = 8 μC

Ans. 6. Option (C) is correct.

Explanation : Capacitance of a parallel plate capacitor filled with dielectric of constant k_1 and thickness d_1 is,

$$C_1 = \frac{k_1 \varepsilon_0 A}{d_1}$$

Similarly, for other capacitance of a parallel plate capacitor filled with dielectric of constant k_2 and thickness d_2 is,

$$C_2 = \frac{k_2 \varepsilon_0 A}{d_2}$$

Both capacitors are in series so equivalent capacitance C is related as :

$$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} = \frac{d_1}{k_1 \varepsilon_0 A} + \frac{d_2}{k_2 \varepsilon_0 A}$$

$$= \frac{1}{\varepsilon_0 A}\left[\frac{k_2 d_1 + k_1 d_2}{k_1 k_2}\right]$$

So, $$C = \frac{k_1 k_2 \varepsilon_0 A}{(k_1 d_2 + k_2 d_1)} \quad \ldots(i)$$

$$C' = \frac{k \varepsilon_0 A}{d} = \frac{k \varepsilon_0 A}{(d_1 + d_2)} \quad \ldots(ii)$$

where, $d = (d_1 + d_2)$
Comparing eqns. (i) and (ii), the dielectric constant of new capacitor is :

$$k = \frac{k_1 k_2 (d_1 + d_2)}{(k_1 d_2 + k_2 d_1)}$$

Ans. 7. Option (A) is correct.

Explanation: For a balanced Meter Bridge $P/Q = L_1/(100 - L_1)$.
There is no parameter related to the radius of the wire. So, the null deflection of galvanometer does not depend on the radius of the wire. So, even if the radius of the wire is doubled, the null deflection of the galvanometer will not be changed.

Ans. 8. Option (C) is correct.

Explanation : Say, the unknown resistance = X
Case 1: $10/X = L_1/(200\text{-}L_1)$
Or, $xL_1 = 2000 - 10L_1$ ...(i)
Case 2: $X/10 = (L_1 + 50)/(150\text{-}L_1)$
Or, $xL_1 = 150X - 10L_1 - 500$ ...(ii)
Comparing equation (i) and (ii)
$X = 2500/150 = 16.7\ \Omega$

Ans. 9. Option (C) is correct.

Explanation : $B_2 = n^2B_1$
Here $n = 2$, $B_1 = B$.
$\therefore \quad B_2 = 4B$

Ans. 10. Option (A) is correct.

Explanation : $B \propto I$, $B \propto 1/r$
So, if I and r remains constant, then magnetic field at P = Magnetic field at Q.

Ans. 11. Option (B) is correct.

Explanation : Magnetic field at the end of a current carrying solenoid is half of the magnetic field inside it.

Ans. 12. Option (D) is correct.

Explanation : As net current is zero, magnetic field at the empty space surrounded by toroid and outside the toroid is zero.

Ans. 13. Option (A) is correct.

Explanation : At Equator,
angle of dip $\delta = 0°$
At poles, angle of dip $\delta = 90°$
$\Rightarrow$ At Equator $B_e = B \cos 0° = B$
At Poles, $B_p = B \sin 90° = B$

$$\frac{B_e}{B_p} = \frac{B}{B} = \frac{1}{1}$$

Ans. 14. Option (D) is correct.

Explanation : Angle of inclination or dip is the angle between the direction of intensity of total magnetic field of the Earth and a horizontal line in the magnetic meridian.
If the total magnetic field of the Earth is modelled by a point magnetic dipole at the centre, then it is in the same plane of geographical equator, thus the angle of dip on the geographical equator will be different at different points. It may be positive or negative or may be zero at some points.

Ans. 15. Option (A) is correct.

Explanation : Relative permeability of diamagnetic magnetic material is less than 1.

Ans. 16. Option (D) is correct.

Explanation : $B_H = B \cos \theta$
$B_V = B \sin \delta$
$\therefore \quad B = \sqrt{B_V^2 + B_H^2}$

Ans. 17. Option (C) is correct.

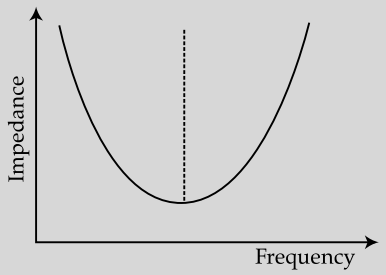
Explanation : Now $Q_1 = CV$
$Q_2 = CV$
As per conservation of charge
$CV_1 + CV_2 = Q_1 + Q_2$
Also $CV_1 + CV_2 = 2CV$
Hence $V_1 + V_2 = 2V$

Ans. 18. Option (A) is correct.

Explanation : Eddy current is produced when a metal is kept in a time varying magnetic field.

Ans. 19. Option (D) is correct.

Explanation : The frequency vs. impedance graph of a series LCR circuit is as follows:



With increase in frequency, the impedance decreases at first, becomes minimum and then increases.

Ans. 20. Option (A) is correct.

Explanation : The resistance of the cable of radius 9 mm is:

$$R = \rho \frac{l}{\pi \times (9 \times 10^{-3})^2}$$

Further, the resistance of each insulated copper wire of radius 3 mm is

$$R' = \rho \frac{l}{\pi \times (3 \times 10^{-3})^2}$$

So, the equivalent resistance of cable

$$R_{eq} = \frac{R'}{6} = \frac{1}{6} \times \left(\rho \frac{l}{\pi \times (3 \times 10^{-3})^2} \right)$$

On solving above equations, resultant resistance of cable is $R_{eq} = 7.5\ \Omega$

Section-B

Ans. 21. Option (B) is correct.

Explanation : Torque is given by $\tau = pE \sin\theta$

$\tau = pE \sin\theta = qlE \sin\theta$

or, $q = \tau / lE \sin\theta$

$= 4/(2 \times 10^{-2} \times 0.5 \times 2 \times 10^5) = 2$ mC

Ans. 22. Option (A) is correct.

Explanation : Net flux $= Q/\varepsilon_o$

$(Aa) \times 4\pi a^2 = Q/\varepsilon_o$

or, $Q = 4\pi\varepsilon_o A a^3$

Ans. 23. Option (C) is correct.

Explanation : Net flux $= \dfrac{Q_{enclosed}}{\varepsilon_0}$

It depends only on net charge enclosed by the surface.

Ans. 24. Option (A) is correct.

Explanation : From the figure, points A and B are at equal potential, because they are at equidistance from O. So potential difference between A and B will be zero.

Hence $W = Q \times \Delta V = 0$

Ans. 25. Option (C) is correct.

Explanation : Electric potential decreases in the direction of electric field.

Ans. 26. Option (B) is correct.

Explanation : Total energy = energy density × volume

$= (1/2)\ \varepsilon_0 E^2 A d$

Ans. 27. Option (D) is correct.

Explanation : To shift the balance point of a potentiometer to a higher length, the potential gradient of the wire is to be decreased. This can also be achieved by decreasing the current of the main circuit. So, this is a true statement.

Ans. 28. Option (B) is correct.

Explanation : $V = 1/4\pi\varepsilon_0 \times Q/R$

$= Q \times 10^{11}$ volt …(i)

$E = 1/4\pi\varepsilon_0 \times Q/R^2$

$= V/R = Q \times 10^{11} \times 4\pi\varepsilon_0 \times 10^{11}$ from ...(i)

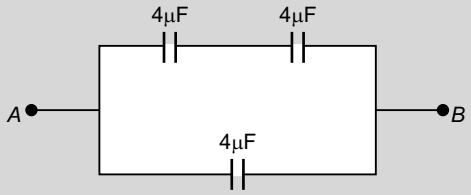
$= 4\pi\varepsilon_0 \times Q \times 10^{22}$ volt/m

Ans. 29. Option (B) is correct.

Explanation : From the above options, two capacitors each of 4μF should be connected in series combination and one 4μF capacitor is to be connected in parallel.

By doing this the C_{series} will be 2μF and on parallel combination will give an effective capacitance of 6μF as

$2\mu F + 4\mu F = 6\mu F$



Ans. 30. Option (C) is correct.

Explanation :

$C_1V = C_1V' + C_2V'$

$\therefore \quad V' = \dfrac{C_1V}{C_1 + C_2}$

Ans. 31. Option (B) is correct.

Explanation : Resistance $R = \rho l/A$

$l' = nl$ and $A' = \dfrac{A}{n}$, $R' = \dfrac{\rho l'}{A'}$

$R' = \dfrac{\rho nl}{A/n} = \dfrac{\rho l}{A} n^2$

$R' = Rn^2$

Ans. 32. Option (B) is correct.

Explanation : A potentiometer is an accurate and versatile device to make electrical measurements of E.M.F. because the method involves zero deflection without any current in galvanometer.

Ans. 33. Option (B) is correct.

Explanation : $P = V^2/R_{eq}$

Now putting values :

$$30 = \frac{10^2 \times (5 + R)}{5R}$$

or, $5R/(R+5) = 10/3$

or, $3R = 2R + 10$ or $R = 10\ \Omega$

Ans. 34. Option (C) is correct.

Explanation : $R_2/R_1 = (l_2/l_1)^2$

$$R_2 = R_1 \left(\frac{1.1}{1}\right)^2 = 1.21\ R_1$$

The new resistance R_2 = 1.21 times of R_1 and specific resistance will remain same.

Ans. 35. Option (A) is correct.

Explanation : In the circuit shown, potential difference across 2 Ω resistor = 6 volts

Now current through 5 Ω resistor = 6/6 = 1 Ampere

Hence power dissipated in 5 Ω resistor $= (1)^2 \times 5 = 5$ watts

Ans. 36. Option (A) is correct.

Explanation: Resistance of galvanometer G = 100 Ω

Current for full scale deflection,

$$I_g = 30\ mA = 30 \times 10^{-3}\ A$$

Voltmeter Range, V = 30 V

Required resistance

$$R = \frac{V}{I_g} - G$$

$$= \frac{30}{30 \times 10^{-3}} - 100$$

$$R = 900\ \Omega$$

Converting galvanometer to voltmeter for the given range, resistance R to be connected in series.

Ans. 37. Option (C) is correct.

Explanation : G = 60 Ω, I_g = 1.0 A, I = 5 A

Now, $I_g \times G = (I - I_g) \times S$

$$S = \frac{I_g G}{I - I_g} = \frac{1 \times 60}{(5 - 1)}\ \Omega = 15\ \Omega$$

Putting 15 Ω in parallel.

Ans. 38. Option (A) is correct.

Explanation : Given:

$$B = 3.57 \times 10^{-2}\ T$$

$$e/m = 1.76 \times 10^{11}\ C/kg$$

Frequency of revolution of charge in magnetic field is given as $f = eB/2\pi m$

Putting values

$$= \frac{(1.76 \times 10^{11}\ C/kg) \times 3.57 \times 10^{-2}\ T}{(2 \times 3.14)}$$

$= 10^9$ Hz

= 1 GHz

Ans. 39. Option (C) is correct.

Explanation : $qvB = qE$

$v = E/B = 20/0.5 = 40$ m/s

Ans. 40. Option (B) is correct.

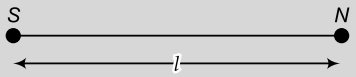
Explanation :

$$M = IA = \left(\frac{qv}{2\pi R}\right) \times \pi R^2$$

$$= (qvR)/2$$

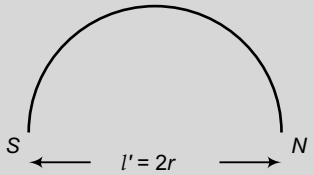
Ans. 41. Option (B) is correct.

Explanation :



Magnetic moment $M = m \times l$

On bending of wire, pole strength remains same & when it is in form of semicircular arc, separation between poles in 2*r*.



Now, $\pi r = l$ or $r = l/\pi$

For new magnetic moment:

$M' = m \times 2r = m \times (2l/r) = 2M/\pi$

Ans. 42. Option (D) is correct.

Explanation : Since, magnetic field density

$$B = \frac{\phi_B}{A}$$

$$= \frac{\text{Weber}}{m^2}$$

$$= \text{Tesla}$$

$$= \frac{\text{Volt} \times s}{m^2}$$

$$= \frac{\text{Newton}}{\text{A-m}}$$

Ans. 43. Option (B) is correct.

Explanation : If a bar magnet is cut along its axis having length l, then

New pole strength

$$m' = m/2$$

New length $l' = l$

Now new magnetic moment will be:

$M' = (m/2) \times l = ml/2 = M/2$

If the bar magnet is cut perpendicular to its axis, then

New pole strength $m' = m$

New length $l' = l/2$

So, new magnetic moment :

$M' = m \times l/2 = ml/2 = M/2$

Ans. 44. Option (C) is correct.

Explanation : Mutual inductance is given as, $M = K\sqrt{L_1 \times L_2}$

Now given, $K = 1$, $L_1 = 2$ mH, $L_2 = 8$ mH

Applying in formula, $M = 1 \times \sqrt{2 \times 8} = \sqrt{16} = 4$ mH

Ans. 45. Option (A) is correct.

Explanation: When two bodies are rubbed, electrons move from one body to another. The body which loses electrons becomes positively charged. The body which receives the electron becomes negatively charged. So, the assertion is true.

Law of conservation of electric charge states that electric charge can neither be created nor destroyed. In a closed system, the amount of charge remains same. Hence the reason is also true and properly explains the assertion.

Ans. 46. Option (B) is correct.

Explanation: If σ be the surface charge density of the two spheres of radius r and R, then electric fields for the two spheres are respectively:

$$E_1 = \frac{\kappa 4\pi r^2 \sigma}{r^2} = \kappa 4\pi\sigma$$

$$E_2 = \frac{\kappa 4\pi R^2 \sigma}{R^2} = \kappa 4\pi\sigma$$

So electric field intensities are equal. The assertion is true.

Surface charged density is charge per unit area = Total charge/area.

So reason is also true.

But the reason does not explain the assertion.

Ans. 47. Option (C) is correct.

Explanation: Resistance of galvanometer is low. So, to protect it from damage a high resistance is connected in series with it which limits the flow of current through it. So the assertion is true.

From Ohms law, I = V/R. So as resistance increases, the current decreases. Hence the reason is false.

Ans. 48. Option (C) is correct.

Explanation: Charge carries flows through whole cross-section. So, the filed exists both inside and outside. So, the assertion is true and the reason is false.

Ans. 49. Option (A) is correct.

Explanation: Gauss's theorem of magnetism is different from that for electrostatics because electric charges may not exist in pair but magnetic poles always exist in pair. So assertion is true. Magnetic monopole does not exist. Magnetic poles always exist in pair. So reason is also true and reason clearly explains the assertion.

Section-C

Ans. 50. Option (D) is correct.

Explanation: Input voltage, $V_p = 220$ V
Output voltage, $V_s = 440$ V
Input current, $I_p = ?$
Output voltage, $I_s = 2$ A
Efficiency of transformer $\eta = 80\%$
Efficiency of transformer
η = Output power/Input power
$\eta = V_s I_s / V_p I_p$
Now $I_p = V_s I_s / \eta V_p$
$= (440\text{ V})(2\text{A})/(80/100)(220\text{ V})$
$= (440\text{ V})(2\text{A})(100)/(220\text{ V})80 = 5$ A

Ans. 51. Option (B) is correct.

Explanation: Now the current is maximum at resonance, so
$\omega^2 = 1/LC$ or $L = 1/\omega^2 C$
Now, $= 1/(1000)^2(10 \times 10^{-6}) = 0.1$ H or 100 mH

Case Study

Ans. 52. Option (B) is correct.

Explanation: Carbon Composition Resistors are manufactured from a mixture of finely ground carbon dust or graphite and a non-conducting ceramic powder to bind it all together.

Ans. 53. Option (A) is correct.

Explanation: The ratio of carbon dust to ceramic (conductor to insulator) determines the resistive value of the resistor. Higher the ratio of carbon, lower the overall resistance.

Ans. 54. Option (C) is correct.

Explanation: Metal Film Type Resistors are generally made by depositing pure metals, such as nickel on an insulating ceramic rod or substrate.

Ans. 55. Option (B) is correct.

Explanation: Wirewound Resistor, is made by winding a thin metal alloy wire (Nichrome) or similar wire on an insulating ceramic former in the form of a spiral helix.

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Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Self Assessment Paper

Solutions of Question Paper 7

Section-A

Ans. 1. Option (B) is correct.

Explanation: As given charge is + q and lines of forces in positive charge must be outwards from positive charge q. Now, as the positive charge is kept near an isolated conducting sphere, due to induction, left part of sphere gets accumulated negative charge and right part gets positive, and lines of force from right part of sphere must emerge outwards normally.
So, verifies the answer (B)
As lines of forces are not perpendicular to the surface of sphere, so options (iii) and (iv) are not true.

Ans. 2. Option (A) is correct.

Explanation: To shift the balance point of a potentiometer to a higher length, the potential gradient of the wire is to be decreased. This can also be achieved by decreasing the current of the main circuit.

Ans. 3. Option (D) is correct.

Explanation: Impedance of a series LCR circuit is $Z = \sqrt{R^2 + (X_C - X_L)^2}$
At resonance, $X_C = X_L$
So, Z is minimum.

Ans. 4. Option (C) is correct.

Explanation: It is seen that the resonance frequency in radian/second is given as:

$$\omega_o = 1/\sqrt{LC}$$
$$= \frac{1}{\sqrt{8 \times 0.5 \times 10^{-6}}} = 500 \text{ rad/s}$$

Ans. 5. Option (A) is correct.

Explanation: $B_H = B \cos\theta$
$B_V = B \sin\delta$
At equator, $\delta = 0°$.
So, $B_H = B$, $B_V = 90°$
At poles, $\delta = 90°$.
So, $B_H = B$, $B_V = B$
So, the ratio of total intensity of magnetic field at equator to poles is 1 : 1.

Ans. 6. Option (C) is correct.

Explanation: Magnetic field at O due to ABCD straight conductor = $\frac{\mu_0 i}{2\pi r}$

Magnetic field at O due to the BEC circular conductor = $\frac{\mu_0 i}{2r}$

The fields are in opposite direction. Hence the resultant field at O is $\frac{\mu_0 i}{2r} - \frac{\mu_0 i}{2\pi r} = \frac{\mu_0 i}{2\pi r}(\pi - 1)$

Ans. 7. Option (A) is correct.

Explanation: When you place a positive charge near a conducting plane, then electric field lines from positive charges will enter into the conducting plane

(from the side where positive charge is kept) and emerge from opposite side of the plane.
In both cases, the direction of electric field lines will always be perpendicular to the surface of the plane.

Ans. 8. Option (B) is correct.

Explanation: At resonance, LCR circuit behaves as purely resistive circuit. For purely resistive circuit, power factor is 1.

Ans. 9. Option (B) is correct.

Explanation: $B \propto 1/r$

$$B_1/B_2 = r_2/r_1 = \frac{r/2}{r}$$

$$\therefore B_2 = 2B_1 = 2B$$

Ans. 10. Option (A) is correct.

Explanation: As the side or diameter of hemisphere is plane surface, and whole hemisphere is charged with positive charge so, the electric field line of forces emerging outward will be perpendicular to the plane surface or diameter.

Ans. 11. Option (D) is correct.

Explanation: $\tau = nBIA$.

So, torque is directly proportional to the magnetic field strength, area of the coil, number of turns and current flowing.

Ans. 12. Option (D) is correct.

Explanation: Electric flux, through the closed surface (or space) depends only on the charge enclosed inside the surface. Here, charges inside all figures are same. So, electric flux will remain same.

Ans. 13. Option (A) is correct.

Explanation: $B = \mu_0 ni = 4\pi \times 10^{-7} \times 5 \times 10 \times 10^2 = 2\pi \times 10^{-3}$ T

Ans. 14. Option (B) is correct.

Explanation: $C = k\varepsilon_0 A / d$
So, capacitance increase by decreasing the distance between the plates (D) or increasing the area of the plates (A). Thickness of plates has no connection with the capacitance of the capacitor.

Ans. 15. Option (A) is correct.

Explanation: In a moving coil galvanometer, current in the coil is directly proportional to angle of deflection.

Ans. 16. Option (A) is correct.

Explanation: End error of metre bridge is removed when the known and unknown resistances are interchanged.

Ans. 17. Option (C) is correct.

Explanation: From the circuit, if a circuit in broken, the induced e.m.f. is maximum. When contact is broken, current in the circuit decreases. In order to oppose, inductor releases the current as a result, emf is induced which has high value so bulb becomes suddenly bright.

Ans. 18. Option (B) is correct.

Explanation: Current sensitivity of a galvanometer is the deflection produced when unit current passes through it.
Current sensitivity = $\theta/I = nBA/C$

Ans. 19. Option (B) is correct.

Explanation: In a pure inductive circuit containing only inductance L, the current in the circuit lags behind the voltage by angle of 90°.

Ans. 20. Option (A) is correct.

Explanation: Now $q = CV$
So, $U = (1/2)CV^2 = q^2/2C$

Ans. 21. Option (A) is correct.

Explanation: When a capacitor C is charged to a certain potential and connected to an inductor L, energy stored in C oscillates between L and C.

$$X_L = X_C$$

$$\therefore \quad f = \frac{1}{2\pi\sqrt{LC}}$$

Ans. 22. Option (C) is correct.

Explanation: Ratio of acceleration will be qE/m

Ratios of electron and a proton

$$a_e/a_p = m_p/m_e$$

It shows ratio of the masses of proton and electron.

Ans. 23. Option (D) is correct.

Explanation: Now $C_{medium} = KC_{air}$

Also, $K = C_{medium}/C_{air}$

$= 110/50 = 2.20$

Ans. 24. Option (C) is correct.

Explanation: In an a.c. circuit containing only capacitance, the current remains ahead of voltage by a phase difference of 90°.

Ans. 25. Option (A) is correct.

Explanation: Since C_1 and C_2 are in parallel, Voltage across C_1 = Voltage across C_2

Section-B

Ans. 26. Option (C) is correct.

Explanation: If a battery in disconnected, then Q be constant as $C \propto K$.

Also with introduction of dielectric slab, capacitance will increase as $Q = CV$ where V will decrease and using $U = Q^2/2C$, will decrease the energy.

Ans. 27. Option (D) is correct.

Explanation: If maximum reading of voltmeter is 2 V at 2000 Ω, then current running through it is:

$$2V = I \times (2000\ \Omega)$$

$$I = 0.001\ A$$

Now when current stays same, then to increase maximum reading of voltage to 10V by connecting a resistor in series would result as:

$$10\ V = (.001A) \times (2000\ \Omega + R)$$

On solving $R = 8000\ \Omega$

Ans. 28. Option (B) is correct.

Explanation: Magnetic Field $B = \mu_0 Ni/2r$

$= 4\pi \times 10^{-7} \times 50 \times 2/2 \times 0.5$

$= 1.25 \times 10^{-4}$ T

Ans. 29. Option (D) is correct.

Explanation: $T = 2\pi m/qB$ that is independent of both R and v.

Ans. 30. Option (B) is correct.

Explanation: Magnitude of Force per unit length:

$F/l = (\mu_0/4\pi) \times 2 \times i_1 i_2/r$

$= \mu_0/2\pi \times i^2/b = \mu_0 i^2 / 2\pi b$

Ans. 31. Option (B) is correct.

Explanation: For loop of radius r, magnetic field at the center of the loop is given by :

$$B = \mu_0 nI/2r$$

Now magnetic field $B = \mu_0 I/2r$; Here, $n = 1$

When making n number of turns, then radius becomes r'

$$n \times 2\pi r' = 2\pi r$$

or, $$r' = \frac{r}{n}$$

Now $B' = \mu_0 nI/2r'$

$= n^2 \times \mu_0 I/2r = n^2 B$

Ans. 32. Option (B) is correct.

Explanation: In the circuit, current of 2 A equally flows along the paths DAC and DBC where each path carries 1A of current, so the potential difference :

between D and A, $V_D - V_A = 1 \times 2$

$= 2$ volt

between D and *B*, $V_D - V_B = 1 \times 3$
$= 3$ volt
Now on solving, potential difference across $V_A - V_B = +1$ V

Ans. 33. Option (A) is correct.

Explanation: We know that potential gradient

$$= \frac{dV}{dr} = 10 \text{ V/m}$$

$$dr = 0.6 - 0.3 = 0.3 \text{ m}$$

So, $$dV = V_B - V_C = \left(\frac{dV}{dr}\right) \times dr$$

$$= 10 \times 0.3 \text{ V}$$
$$= 3.0 \text{ V}$$

Ans. 34. Option (C) is correct.

Explanation: Effective resistance in series
$= nr$ (maximum resistance)
Effective resistance when connected in parallel
$= r/n$ (minimum resistance)
Ratio = maximum / minimum $= n^2$

Ans. 35. Option (D) is correct.

Explanation: To solve this, use relation

$$\frac{R_1}{R_2} = \left(\frac{r_2}{r_1}\right)^4$$

Now,

$$R_2 = R_1 \left(\frac{r_1}{r_2}\right)^4 = R\left(\frac{r}{r/2}\right)^4 = 16 \text{ R}$$

Hence, $R_2 = 16$ R

Ans. 36. Option (A) is correct.

Explanation: The total number of cells be calculated as

$$mn = 100$$

Here, m is the number of rows and n is the number of cells in each row

Now for maximum current, $R = \frac{nr}{m}$

Putting values :

$$25 = \frac{n \times 1}{m}$$

$$n = 25\, m$$

On solving above equations for m and n, we see that :
$n = 50$ and $m = 2$

Ans. 37. Option (D) is correct.

Explanation: In a meter bridge, if balancing length from left end is 20 cm, then value of unknown resistance X will be $X = R\frac{l}{100 - l} = X/1 = 20/80$

$X = 1/4\Omega = 0.25\ \Omega$

Ans. 38. Option (A) is correct.

Explanation: wire length = 4 m
resistance = 10 Ω
cell e.m.f. = 2 V
It is clear that the potential difference for full wire length is 2 V, so potential difference per unit length of wire = 2/4 = 0.5V/m

Ans. 39. Option (C) is correct.

Explanation: Capacitance in series combination will *b*

$$1/C = 1/2 + 1/2 + 1/2$$

or, $$C = \frac{2}{3} \text{ F}$$

Ans. 40. Option (B) is correct.

Explanation: In a dielectric :

$$C_{medium} = K \times C_{air}$$

Hence when air inside capacitor is replaced by a dielectric constant K, then the capacity will increase K times.

Ans. 41. Option (B) is correct.

Explanation: Volume of big drops = 1000 × Volume of small drop

$$\frac{4}{3}\pi R^3 = 1000 \times \frac{4}{3}\pi r^3$$

or, $$R = 10\, r$$

Let the potential at small drop be V_1

$$V_1 = \frac{Kq}{r}$$

So, the potential at big drop

$$V_2 = \frac{K(1000\ q)}{R}$$

or, $$V_2 = \frac{K \times 1000\ q}{10\ r} = 100\ V_1$$

So, the required factor is 100

Ans. 42. Option (C) is correct.

Explanation: Once the connection of wire among the charged sphere is done, then

$$V_1 = V_2$$

$$Q_1/25 = Q_2/20$$

$$Q_1/Q_2 = 25/20$$

Hence $Q_1 > Q_2$

So charge on 25 cm sphere will be more than that on 20 cm sphere

Ans. 43. Option (A) is correct.

Explanation: In parallel combination, the equivalent capacitance

$$C_{equ} = C_1 + C_2$$

Ans. 44. Option (B) is correct.

Explanation: When two charged spheres are connected by a thin wire, there will be no current when having similar potential.

Ans. 45. Option (A) is correct.

Explanation: The charge enclosed by the Gaussian surface surrounding the cavity is zero. Hence, the electric field is also zero. So, the assertion is true.

Charges in a conductor reside only at its surface. So, in cavity there is no charge. So, the reason is also true and properly explains the assertion.

Ans. 46. Option (D) is correct.

Explanation: According to Gauss's law, electric flux depends on the enclosed charges only. Here the enclosed charges are Q_1 and Q_3 only. Hence the assertion is false and the reason is true.

Ans. 47. Option (C) is correct.

Explanation: Electric field for parallel plate capacitor in vacuum = $E = \sigma/\varepsilon_0$

Electric field in dielectric = $E' = \sigma/K\varepsilon_0$.

Since the value of K for Kerosene oil is greater than 1, then $E' < E$. Hence the assertion is true.

Dielectric constant of Kerosene oil is greater than 1. Hence, the reason is false.

Ans. 48. Option (A) is correct.

Explanation: Potentiometer is used to measure the e.m.f. of a cell. The assertion is true.

Voltmeter draws certain amount of current from the cell. So, $V = E - iR$. The measured value by the voltmeter is less than the actual e.m.f. of the cell. But potentiometer draws no net current at balance point, hence it measures the actual e.m.f. of the cell. So, the reason is also true and explains the assertion properly.

Ans. 49. Option (B) is correct.

Explanation: The torque on the coil in a magnetic field is given by

$$\tau = nIBA \sin\theta$$

For radial field, $\theta = 90°$ and $\sin\theta = 1$

Torque = $nIBA$ and it is maximum.

So assertion is true.

Torque is the rotational equivalence of force. So, torque will tend to rotate a coil.

Reason is also true. But reason cannot explain the assertion that why the torque is maximum in the specified position.

Section-C

Ans. 50. Option (C) is correct.

Explanation: Potential difference (V) = 1V

Kinetic Energy acquired = qV

So, K.E. = $1.6 \times 10^{-19} \times 1$

= 1.6×10^{-19} joules = 1 eV

Ans. 51. Option (B) is correct.

Explanation: Now the Electric field strength will be:

$E = 9 \times 10^9 \times Q/r^2$

$= 9 \times 10^9 \times 5 \times 10^{-6}/(0.8)^2 = 7 \times 10^4$ N/C

CASE STUDY

Ans. 52. Option (A) is correct.

Explanation: On Earth, flowing of liquid metal in the outer core of the planet generates electric currents. The rotation of Earth on its axis causes these electric currents to form a magnetic field which extends around the planet.

Ans. 53. Option (A) is correct.

Explanation: On Earth, flowing of liquid metal in the outer core of the planet generates electric currents.

Ans. 54. Option (C) is correct.

Explanation: As Mars doesn't have flowing liquid metal in its core, it doesn't produce dynamo effect. So, it has very weak or almost no magnetic field.

Ans. 55. Option (B) is correct.

Explanation: The average magnetic field strength in the Earth's outer core was measured to be 25 Gauss.

■■■

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Self Assessment Paper

Solutions of Question Paper 8

Section-A

Ans. 1. Option (A) is correct.

Explanation : $\sigma_1 = Q_1/4\pi R^2$
$\sigma_2 = Q_2/16\pi R_2$
$\sigma_3 = Q_3/36\pi R_2$
$\sigma_1 = \sigma_2 = \sigma_3$
$\Rightarrow Q_1 : Q_2 : Q_3$
$= \sigma_1 \times 4\pi R^2 : \sigma_2 \times 16\,\pi R^2 : \sigma_3 \times 36\pi R^2$
$= 4 : 16 : 36$
$= 1 : 4 : 9$

Ans. 2. Option (A) is correct.

Explanation : $K = /4\pi\varepsilon_0$
So, k depends only on the permittivity of medium.

Ans. 3. Option (D) is correct.

Ans. 4. Option (A) is correct.

Explanation : Work done
$W = QEd\cos\theta$
$2 = 0.2 \times E \times 2 \times \cos 60°$
Or, $2 = 0.2 \times E \times 2 \times 0.5$
$\therefore E = 10N/C$

Ans. 5. Option (B) is correct.

Ans. 6. Option (D) is correct.

Explanation : Our body is a conductor. So the charge in the capacitor discharges through our body and we get an electrical shock.

Ans. 7. Option (A) is correct.

Explanation : Gravitational force acting on the boy is mg.
Electrical field be E.
Electrical force in upward direction is required to counterbalance the gravitational force is eE.
So, $mg = eE$
$\therefore E = mg/e$

Ans. 8. Option (D) is correct.

Explanation : Ammeter should be connected in series. Voltmeter should be connected in parallel.

Ans. 9. Option (A) is correct.

Explanation : $V_C = R_2V/(R_1 + R_2)$
$= 120 \times 100/(120 + 80) = 60V$
$V_D = R_4V/(R_3 + R_4)$
$= 160 \times 100/(480 + 160) = 25V$
Potential difference between C and D is
$60 - 25 = 35V$

Ans. 10. Option (A) is correct.

Explanation : Given,
$R_1 = 5\,\Omega$, $R_2 = 4.5\,\Omega$, $R_3 = 3\,\Omega$
Series combination of these resistor will give the maximum total resistance.
$R_{series} = R_1 + R_2 + R_3$
$R_{series} = 5 + 4.5 + 3 = 12.5\,\Omega$

Ans. 11. Option (B) is correct.

Explanation : Conductivity $= ne^2\tau/m$
Dimension of n (no. of electrons per unit volume) is $[L^{-3}]$
Dimension of e is $[AT]$
Dimension of τ is $[T]$
Dimension of m is $[M]$
So dimension of conductivity is $[M^{-1}L^{-3}T^3A^2]$

Ans. 12. Option (D) is correct.

Explanation : $R_1 = R_0[1+\alpha\Delta t)$

$60 = 20[1+\alpha(500-20)$

Or, $3-1 = 480\alpha$

$\therefore \alpha = 1/240$

Now $R_t = R_0[1+\alpha\Delta t)$

$$25 = 20\left[1+\frac{1}{240}\times(t-20)\right]$$

$$\text{or}\quad \frac{25}{20}-1 = \frac{1}{240}\times(t-20)$$

$\therefore t = 80°C$

Ans. 13. Option (A) is correct.

Explanation : Magnetic Equator is the line where the magnetic field is horizontal or inclination is zero.

Ans. 14. Option (A) is correct.

Explanation : Angle of declination at a point is defined as angle between magnetic meridian and geographical meridian at that point.

Ans. 15. Option (A) is correct.

Ans. 16. Option (B) is correct.

Explanation : As current inside the pipe is zero, the magnetic field associated with the current will be only outside of the pipe.

Ans. 17. Option (A) is correct.

Explanation : A current carrying coil does not necessarily have electric charge, but it always generates magnetic field. Therefore, energy in a current carrying wire in stored in the form of magnetic field.

Ans. 18. Option (D) is correct.

Explanation : Te force acting

$$\vec{F} = q\left(\vec{v}\times\vec{B}\right)$$

So, $\vec{F}$ will be zero when angle between $\vec{v}$ and $\vec{B}$ is 0° or 180°.

Ans. 19. Option (A) is correct.

Explanation : When a proton is accelerated through 1V potential difference, the gain in kinetic energy is

$K = 1e \times 1V$

$K = 1eV$

Ans. 20. Option (C) is correct.

Explanation : $V_{LC} = (\omega L - 1/\omega C)I_{RMS}$

$$= \omega L I_{RMS} - \frac{1}{\omega C} I_{RMS}$$

$= 30 - 30$

$= 0V$

Ans. 21. Option (B) is correct.

Explanation :

$$V = \sqrt{V_R^2 + (V_L - V_C)^2}$$

$$= \sqrt{20^2 + (50-40)^2}$$

$$= \sqrt{500}$$

$$= 10\sqrt{5}\ V$$

Ans. 22. Option (B) is correct.

Explanation :

$X_C = 2\pi f L$

$100 = 2\pi \times 100 \times L$

$\therefore \quad L = 1/2\pi$

Ans. 23. Option (D) is correct.

Explanation : Power Loss $= (V_{RMS})^2/R = 10^2/10 = 10$ W

Ans. 24. Option (D) is correct.

Explanation : Initially, $X_C = 1/2\pi fC$

Finally, $X_C' = 1/8\pi fC = X_C/4$

Ans. 25. Option (D) is correct.

Explanation :

Power $= V_{RMS} \times I_{RMS} \times \cos\phi$

Section-B

Ans. 26. Option (C) is correct.

Explanation : The magnitude of the electric force F is directly proportional to the amount of one electric charge, q_1, multiplied by the other, q_2, and inversely proportional to the square of the distance 'r' between their centres.

Ans. 27. Option (B) is correct.

Explanation : Either positive or negative charges will interact the lines of electric field so makes the electric field discontinuous.

If there is no other charge inside the electric field then the lines will not be affected. So electric field becomes continuous.

Ans. 28. Option (C) is correct.

Explanation : Although net charge in a dipole is zero but its electric field is proportional to $1/r^3$. Work done again electric field is conservative, so net work done in a closed loop is always zero.

Ans. 29. Option (C) is correct.

Explanation : Constant potential means $dV = 0$ So by relation, $E = -dV/dR$,

$E = 0$

As potential may be outside the charge also, so there can be no charge inside the regions of constant potential.

If a charge is placed in outside region, potential difference in region will not be changed or electric field will not be changed.

Ans. 30. Option (A) is correct.

Explanation : As we know that, the excess charge can reside only on the surface of a conductor and inside net positive and negative charge is zero. Any charge can reside only inside the hollow shell or body.

Inside the solid material of conducting body there is no charge, it comes to outer surface.

Ans. 31. Option (D) is correct.

Explanation : $M_{12} = M_{21} = \mu_0 n_1 n_2 \pi r_1^2 I$
Where r_1^2 is the common area of cross section ob of the coils.

Ans. 32. Option (D) is correct.

Explanation : Impedance is given by

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

At resonance frequency, Z is minimum and current is maximum. For any other value of frequency, the value of current will decrease (when compared to current at resonance).

So the circuit must have inductor, resistor and capacitor.

Ans. 33. Option (B) is correct.

Explanation : Amount of charge on an electron, $e = -1.6 \times 10^{-19}$ C.
Let number of electrons transferred from wool to polythene be n.
So, by using the given equation we can calculate the value of n,

$$q = ne$$

$n = q/e = 3 \times 10^{-7} / 1.6 \times 10^{-19} = 1.87 \times 10^{12}$
Therefore, the number of electrons transferred from wool to polythene is 1.87×10^{12} Mass of one electron, $m_e = 9.1 \times 10^{-31}$ kg
Total mass transferred, $m = m_e \times n$
$= 9.1 \times 10^{-31} \times 1.87 \times 10^{12}$
$= 1.706 \times 10^{-18}$ kg

Ans. 34. Option (A) is correct.

Explanation : Both spheres attract each other with the same force. So, the force on the second sphere due to first sphere will be 0.2 N.

Ans. 35. Option (B) is correct.

Explanation : Opposite charges attract each other and same charges repel each other. So, it can be observed that particles 1 and 2 both move towards the positively charged plate and repel away from the negatively charged plate. It means these two particles are negatively charged. Particle 3 moves towards the negatively charged plate and repels away from the positively charged plate. So, particle 3 is positively charged.

Ans. 36. Option (C) is correct.

Explanation: Dielectric constant of medium is defined as the ratio of permittivity of medium to the permittivity of the free space. It is also called the relative permittivity of medium.

$$\varepsilon_r = \varepsilon/\varepsilon_0 = K$$

Since metals does not have free space in them so,

$$\varepsilon_r = \varepsilon/0$$

So, ε_r is equal to infinity

Ans. 37. Option (A) is correct.

Explanation : When positive charge is placed at the centre of the spherical cavity then an equal amount of negative charge (– Q) appears on inner surface of the sphere due to induction. An equal amount of positive charge (+ Q) also appears on outer surface of the sphere.

Now surface charge density on inner surface

= Total charge on inner surface / Area of the inner surface

$= -Q/4\pi R_1^2$

Surface charge density on outer surface

= Total charge on outer surface / Area of the outer surface

$= +Q/4\pi R_2^2$

Ans. 38. Option (D) is correct.

Explanation : The arc is an equipotential surface. Hence work done to move a charge on this surface is zero.

Ans. 39. Option (B) is correct.

Explanation : Charge $-q$ is located at $(0, 0, -a)$ and charge $+q$ is located at $(0, 0, a)$. So, they form a dipole. Point $(0, 0, z)$ is on the axis of this dipole of the dipole.

So, electrostatic potential at point $(0, 0, z)$ is

$$V = \frac{q}{4\pi\varepsilon_0(z-a)} + \frac{-1}{4\pi\varepsilon_0(z+a)}$$

$$\text{Or, } V = \frac{2qa}{4\pi\varepsilon_0(z^2-a^2)}$$

$$\therefore \quad V = \frac{p}{4\pi\varepsilon_0(z^2-a^2)}$$

Ans. 40. Option (B) is correct.

Explanation : Heat generated

$$= H = I^2Rt = I^2 \times \rho \times \frac{l}{A}t$$

So, $H \propto \rho$

As $\rho_{Nichrome} > \rho_{copper}$

So, $H_{Nichrome} > H_{copper}$

Ans. 41. Option (C) is correct.

Explanation : Current in the wire,

$$I = 8 \text{ A}$$

Magnitude of the uniform magnetic field,

$$B = 0.15 \text{ T}$$

Angle between the wire and magnetic field,

$$\theta = 30°$$

Magnetic force per unit length on the wire

$$= F = BI \sin\theta$$
$$= 0.15 \times 8 \times 1 \times \sin 30°$$
$$= 0.6 \text{ N/m}$$

Ans. 42. Option (A) is correct.

Explanation : Induced current can flow when there is change in magnetic flux with respect to time and magnetic flux $\phi = BA\cos\theta$. As there is no any change B, no induced current will flow.

Ans. 43. Option (A) is correct.

Explanation : Emf induced in the wire $= BIv = 0.3 \times 10^{-4} \times 5 \times 10 = 1.5 \times 10^{-3}$ V = 1.5 mV
Using Fleming's right hand rule, it can be inferred that the direction of the induced emf is from West to East end of the falling wire.

Ans. 44. Option (A) is correct.

Explanation : An L-C circuit is considered analogous to a harmonically oscillating spring block system in which Magnetic energy, ½ Li^2, is analogous to kinetic energy and electrical energy due to charging of capacitor , ½ CV^2, is analogous to potential energy.

Ans. 45. Option (B) is correct.

Explanation: Quality factor of a series LCR circuit is $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$. Assertion is true.

Quality factor is also defined as $Q = \frac{\text{Resonant frequency}}{\text{Bandwidth}}$. So, as bandwidth decreases, Q increases. So, reason is also true. But reason does not explain the assertion.

Ans. 46. Option (C) is correct.

Explanation: Step-up transformer means it converts input low AC voltage to output high AC voltage. So, the assertion is true.

For step up transformer, $V_{OUT}/V_{IN} > 1$, but simultaneously $I_{OUT}/I_{IN} < 1$ and $P_{IN} = P_{OUT}$ (ideally). Hence, the law of conservation of energy is not violated.

Ans. 47. Option (A) is correct.

Explanation: The coil of moving coil galvanometer is suspended in a very strong radial magnetic field. Earth's magnetic field is too weak compared to that and hence its effect is negligible. So, assertion and reason both are true and the reason explains the assertion properly.

Ans. 48. Option (A) is correct.

Explanation: Coil of a moving coil galvanometer is wound on a metal frame. So, the assertion is true. It is done to avoid any oscillation and fluctuating reading. The metal frame provides damping to reduce the oscillation so that the reading becomes steady. So the reason is also true and properly explains the assertion.

Ans. 49. Option (A) is correct.

Explanation: Meter bridge wire is generally made of Constantan. The assertion is true.
Temperature coefficient of resistance of Constantan is very low. So, its resistance variation is negligible even after long use. This is the requirement of an ideal meter bridge. So the reason is true and properly explains the assertion.

Section-C

Ans. 50. Option (B) is correct.

Explanation : Inductive reactance $= X_C = 2\pi fL = 2 \times 3.14 \times 50 \times 44 \times 10^{-3} = 13.82\ \Omega$
$I_{rms} = 220/13.82 = 15.92$ A.

Ans. 51. Option (D) is correct.

Explanation : Insulator is a material that does not conduct current due to having high electrical resistivity i.e. in the range of 10^{10} Ωm or more. Therefore, the resistively of a typical insulator is greater than that of a metal by a factor of the order of 10^{22}.

Case Study

Ans. 52. Option (A) is correct.

Ans. 53. Option (B) is correct.

> ***Explanation:*** The value of the capacitor marked as 221 is 220 *p*F. The value of the capacitor marked as 220 is 22 *p*F. When connected in parallel, the total capacitance = 220 *p*F + 22 *p*F = 242 *p*F.

Ans. 54. Option (B) is correct.

> ***Explanation:*** The value of the capacitor = 68 kpF = 1000 × 68 pF = 68 nF

Ans. 55. Option (D) is correct.

> ***Explanation:*** Brown, Green, Brown 15 × 10 = 150 pF

■■■

Time : 90 Minutes
Max. Marks : 35

PHYSICS
CBSE
Self Assessment Paper

Solution of Question Paper 9

Section-A

Ans. 1. Option (D) is correct.

Explanation : Before contact,

Charge on sphere R = $q_1 = \sigma 4\pi R^2$

Charge on sphere 2R = $q_2 = \sigma 4\pi (2R)^2$

$\Rightarrow \quad q_2 = 4q_1$ ...(i)

When these spheres are brought in contact, charges on spheres are shared and new charge will be q_1' and q_2' respectively.

whereas potentials are same

$$V_1 = V_2$$

$$\therefore \quad \frac{q_1'}{4\pi\varepsilon_0 R} = \frac{q_2'}{4\pi\varepsilon_0 (2R)}$$

$$q_2' = 2q_1' \quad \text{...(ii)}$$

now, from the conservation of charge

$$q_1' + q_2' = q_1 + q_2$$
$$= q_1 + 4q_1 \quad \text{[from Eq. (1)]}$$
$$= 5q_1$$
$$= 5(\sigma 4\pi R^2)$$

$$\Rightarrow \quad q_1' + q_2' = 5\sigma 4\pi R^2$$
$$q_1' + 2q_1' = 5\sigma 4\pi R^2$$
$$q_1' = \frac{5}{3}\sigma 4\pi R^2$$

$$\therefore \quad q_2' = 2q_1'$$
$$q_2' = \frac{10}{3}\sigma 4\pi R^2$$

$$\therefore \quad \sigma_1 = \frac{q_1'}{4\pi R^2} = \frac{5}{3}\sigma$$

$$\text{And} \quad \sigma_2 = \frac{q_1'}{4\pi(2R)^2} = \frac{5}{6}\sigma$$

Ans. 2. Option (A) is correct.

Explanation : Kinetic energy = $\frac{1}{2}mv^2 = ev$

$$\therefore \quad v = \sqrt{\frac{2eV}{m}}$$

Radius = $r = mv/eB$

$$= m\,\Re\sqrt{\frac{2i\ddot{u}V}{\ddot{u}}} \quad \frac{1}{B} \quad \frac{\sqrt{2\quad V}}{B}$$

Ans. 3. Option (D) is correct.

Explanation : Self inductance of coil:

$$L = N\phi/I$$
$$= \frac{1000 \times 4 \times 10^{-3}}{4} = 1\ H$$

Ans. 4. Option (B) is correct.

Explanation : Acceleration = qE/m

$\therefore \quad a \propto 1/m$

$\therefore \quad a_P/a_E = m_E/m_P$

Ans. 5. Option (C) is correct.

Explanation : Potentiometer is most preferable and accurate since it draws no current from the source.

Ans. 6. Option (A) is correct.

Explanation : $F \propto \frac{I_1 I_1}{d}$

$$F_1 / F_2 = \frac{I_1 I_1}{d} \times \frac{2d}{2I_1 I_2} = 1$$

So, $F_1 = F_2$

Ans. 7. Option (B) is correct.

Explanation : The capacitance of a parallel plate capacitor is $C = \frac{K\varepsilon_0 A}{d}$

If the space between the plates is filled with a metal, the capacitance becomes ∞ since the dielectric constant of metal is ∞.

C = ∞ means the capacitor of shorted i.e. it is behaving like a conductor i.e. it is no more a capacitor.

Ans. 8. Option (C) is correct.

Explanation : Frequency of oscillation

$$= \frac{1}{2\sqrt{LC}} = \frac{1}{2\pi\sqrt{10^{-6} \times 10^{-6}}} = \frac{10^5}{2\pi} \text{ Hz}$$

Ans. 9. Option (C) is correct.

Explanation : We know that flux of magnetic field through loop is

$$\phi = B\pi r^2 \cos \omega t = B\pi r^2 \cos \theta$$

Here θ is the angle which the normal makes with portion of induced loop generating emf

$$\varepsilon = \omega B\pi r^2 \sin \omega t$$

It is zero when $\omega t = n\pi$, so if $\theta = 0, \pi, 2\pi$, then induced emf changes its direction in every half of rotation, hence frequency of change of direction of the induced e.m.f. is twice per revolution.

Ans. 10. Option (A) is correct.

Explanation : E.M.F. Generated

$$= -n\frac{\Delta B}{T}$$

$$= -n\frac{5B_0}{2t}$$

$$= -2.5\, nB_0/t$$

Ans. 11. Option (C) is correct.

Explanation : When an electric charge is in uniform motion, then its presence produces electric field. Whereas uniformly moving charge generates current and produces magnetic field.

Ans. 12. Option (D) is correct.

Explanation : Lenz's law states that an induced electric current flows in a direction such that the current opposes the change that induced the current.

Ans. 13. Option (A) is correct.

Explanation : Coefficient of self inductance $= L = \frac{\mu_0 N^2 A}{l}$

i.e. $L \propto N^2$

So, if number of turns is doubled, coefficient of self induction will be four times.

Ans. 14. Option (D) is correct.

Ans. 15. Option (A) is correct.

Explanation : All charge reside at the surface of the shell. No charge resides inside. Hence according to Gauss's law, the electric field inside the shell is zero.

Ans. 16. Option (D) is correct.

Explanation : The current produced due to circular motion of charge q is

$$I = qf$$

Now the magnetic field induction at centre of the ring of radius R is

$$B = \mu_0 2\pi I/4\pi R = \mu_0 I/2R = \mu_0 qf/2R$$

Ans. 17. Option (C) is correct.

Explanation : Directions of electric field and current density are in same. Motion of electrons is in opposite direction.

Ans. 18. Option (C) is correct.

Explanation : When resistance is connected to AC source, then current and voltage are in same phase as there is no phase difference between them.

Ans. 19. Option (D) is correct.

Explanation : $R \propto l$

$$R \propto 1/A$$

Resistance of metallic conductor increases with temperature.

Ans. 20. Option (B) is correct.

Explanation : Capacitive reactance
$= 1/2\pi fC$
For D.C., $f = 0$, So, $X_c = \infty$
So, the capacitor functions as a perfect insulator.

Ans. 21. Option (C) is correct.

Explanation :

$$\text{Magnetization} = \frac{\text{Magnetic Moment}}{\text{Volume}}$$

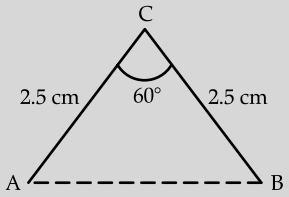
$= nIA/AL$
$= nI/L$
$= 1000 \times 10/(20 \times 10^{-2})$
$= 50000$ A/m

Ans. 22. Option (B) is correct.

Explanation : From Gauss's law,
$\phi = Q/\varepsilon_0$
Given, $\phi = 2 \times 10^3$ Vm
Putting the above equation,
$Q = 2 \times 10^3 \times 8.85 \times 10^{-12}$
$= 17.7 \times 10^{-3}$ μC
$\approx 18 \times 10^{-3}$ μC

Ans. 23. Option (B) is correct.

Explanation : ACB is the original length of the magnet,



C is the mid-point.
So, AC = BC = 2.5 cm
So, Δ ACB is an isosceles triangle.
$\angle ACB = 60°$
$\angle ACB = \angle ABC = 60°$
So, AC = BC = AB = 2.5 cm
Present length of the magnet
= AB = 2.5 cm

Ans. 24. Option (B) is correct.

Explanation : $V = 10x^2$

$$\vec{E} = -\left(\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial Z}\hat{k}\right)$$

$$= \left(20 \times \hat{i} + 0 + 0\right) = -20 \times \hat{i}$$

So at the given point the electric field will be $-20 \times \hat{i}$

Ans. 25. Option (B) is correct.

Explanation : Since P = VI, high voltage corresponds to low current.

Hence if power is transmitted at high voltage, current will be low and subsequently I^2R loss will be low.

So, it is advantageous to transmit power at high voltage.

Section-B

Ans. 26. Option (A) is correct.

Explanation : capacitive reactance = X_C = $1/2\pi fC$

For D.C., $f = 0$, So, $X_C = \infty$.

So, for D.C. capacitor acts as a block.

For A.C., as frequency increases X_C decreases. So, capacitor allows A.C. to pass through.

Ans. 27. Option (A) is correct.

Explanation : Secondary current is low. So, to reduce I^2R loss thick copper wire is used which has lower resistance.

Ans. 28. Option (A) is correct.

Explanation : $X_C = 1/2\pi fC$
So, as capacitor value increases, its reactance decreases.

So, to allow the ripples to ground, it is connected in parallel.

Ans. 29. Option (D) is correct.

Explanation : $X_L = 2\pi f L$
So, as inductance value increases, its reactance increases.
So, to block the ripples at the output, it is connected in series.

Ans. 30. Option (C) is correct.

Explanation : Function of a filter circuit is to remove the ac component present in output and dc component to reach the load.

Ans. 31. Option (A) is correct.

Explanation : Capacitor is connected in parallel with proper polarity.

Ans. 32. Option (C) is correct.

Explanation : Inductor is connected in series.

Ans. 33. Option (B) is correct.

Explanation : Transformer is an electrical device. Since there is no moving parts in it, it is a static device.

Ans. 34. Option (A) is correct.

Explanation : Transformer works on the principle of electromagnetic induction and mutual induction. Therefore, voltage varies and so does the electric current but the frequency remains constant.

Ans. 35. Option (B) is correct.

Explanation : In a step down transformer, output voltage decreases. Since the power remains constant, the current increases.

Ans. 36. Option (C) is correct.

Explanation : The transformer is a step-down transformer. For step-down transformer $N_S < N_P$, so the turns ratio is less than 1.

Ans. 37. Option (A) is correct.

Explanation : $N_P = 5N_S$ $N_S/N_P = E_S/E_P$
Or, $1/5 = E_S/200$
$\therefore$ $E_S = 200/5 = 40V$

Ans. 38. Option (D) is correct.

Explanation : Volt = Change in potential energy / charge
Unit of Potential energy is Joule.
Unit of Charge is coulomb
$\therefore$ Volt = Joule / coulomb

Ans. 39. Option (D) is correct.

Explanation : According to Faraday's Law, emf
$E_m = -d\phi/dt$
Given $\phi = 3t^2 + 4t + 9$
Now differentiating above equation, w.r.t. t, emf
$= d(3t^2 + 4t + 9)/dt = 6t + 4$
Now the induced emf at $t = 2$ s is, emf
$= 6 \times 2 + 4 = 16$ V

Ans. 40. Option (D) is correct.

Explanation : $C_{net} = (6 \times 4)/(6 + 4)$
$= 24/10$ μF
$Q_{net} = C_{net} \times V = (24/20) \times 120$
$= 24 \times 12$ μC
$V_1 = Q_{net}/C_1 = (24 \times 12)/6 = 48$ V

Ans. 41. Option (A) is correcrt

Explanation : Energy is stored in a form of electrostatic field between the capacitor. This energy can be expressed in the form of work done by the battery.

Ans: 42. Option (C) is correct.

Explanation : Energy stored = 1eV $= 1.6 \times 10^{-19}$ C $\times$ 1 V $= 1.6 \times 10^{-19}$ J

Ans. 43. Option (D) is correct.

Explanation : Two 4μF capacitors are joined in parallel. So equivalent capacitance = $C_P = 8$μF
Two 4μF capacitors are joined in series. So equivalent capacitance = $C_S = 2$μF
C_S and C_P are joined in parallel. So $C_{eq} = 10$μF.

Ans. 44. Option (A) is correct.

Ans. 45. Option (B) is correct.

Explanation : Electric lines of force can never form a closed loop since they originate from positive charge and terminate at negative charge. They never start and end on the same charge. So, the assertion is true.

According to Faraday, Number of electric lines of force originating from or terminating at a charge is proportional to the magnitude of the charge. So, the reason is also true but it does not explain the assertion.

Ans. 46. Option (C) is correct.

Explanation : Charging is a process of transfer of charge. A body becomes positively charged losing few electrons and a body becomes negatively charged by gaining electrons. So assertion is true.
A body becomes positively charged by losing few electrons. So, it cannot gain mass. Mass is gained by negatively charged body. So, the reason is false.

Ans. 47. Option (C) is correct.

Explanation : When two capacitors are joined in series, the left plate of C_1 acquires +Q charge and as a consequence its right plate has a charge –Q. This –Q charge comes from the left plate of C_2 and hence left plate of C_2 has +Q charge. The right plate of C_2 has a charge –Q as a consequence.

Thus each capacitor has same amount of charge when connected in series. So, the assertion is true. In Q = CV relation, C is a constant quantity. Charge (Q) on a capacitor is proportional to the potential difference applied (V). So, the reason is false.

Ans. 48. Option (C) is correct.

Explanation : Voltmeter is always connected in parallel to that component whose potential difference is to be measured. So, the assertion is true.
Resistance of voltmeter is very high so that it draws negligible amount of the current passing through the circuit. So reason is also false.

Ans. 49. Option (A) is correct.

Explanation : Ammeter is always connected in series in a circuit. So the assertion is true.
Internal resistance of the ammeter is kept low by connecting a shunt parallel to it so that voltage drop across is negligibly small.

Section-C

Ans. 50. Option (D) is correct.

Explanation : For resistances in series, the current through each resistors remains the same.

Ans. 51. Option (C) is correct.

Explanation :

$$\frac{1}{r_{net}} = \frac{1}{r} + \frac{1}{r} + ...n \text{ times}$$

$$\frac{1}{r_{net}} = \frac{n}{r}$$

$$r_{net} = \frac{r}{n}$$

and emf = E
So, equivalent emf and equivalent internal resistance is $\left(E, \frac{r}{n}\right)$.

Case Study

Ans. 52. Option (D) is correct.

Explanation : Higher the resistance, better is the voltmeter.

Ans. 53. Option (B) is correct.

Explanation : $\phi = R_m/V$
So, the unit is ΩV^{-1}.

Ans. 54. Option (A) is correct.

Explanation : Galvanometer should show full scale deflection. So, the current should be 100μA

Ans. 55. Option (B) is correct.

Explanation : Galvanometer to voltmeter conversion is done by connecting a high value resistance in series.

$$I_g = \frac{V}{R + G}$$

Or, $1.5 \times 10^{-3} = \frac{1.5}{R + 5}$

$\therefore$ $R = 1000 - 5 = 995\Omega$

■■■

Time : 90 minutes
Max. Marks : 35

PHYSICS
CBSE
Self Assessment Paper

Solution of Question Paper 10

Section-A

Ans. 1. Option (A) is correct.

Ans. 2. Option (A) is correct.

Explanation: $C = \frac{K\varepsilon_0 A}{d}$

So, it is independent of the thickness of the plate.

Ans. 3. Option (A) is correct.

Explanation: $Q = CV$

$C = \frac{K\varepsilon_0 A}{d}$

Since $K_1 > K_2$, $C_1 > C_2$

$\therefore \quad Q_1 > Q_2$

Ans. 4. Option (B) is correct.

Explanation: When a charged body is brought near an uncharged body, an opposite charge is developed on the end of the uncharged body nearer to the charged body. This phenomenon is known as induction.

Ans. 5. Option (D) is correct.

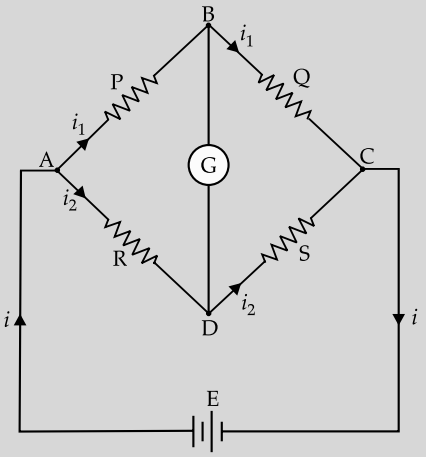
Explanation: Now $P_p = V_p I_p$ or $I_p = P_p / V_p$

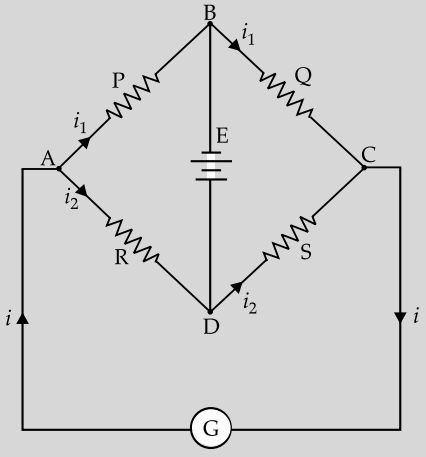
$= 3000/200 = 15$ A

Also, $V_s = P_s / I_s = 2700/6 = 450$ V

Ans. 6. Option (D) is correct.

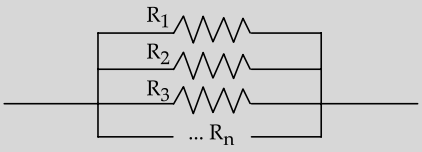
Explanation: The changed configuration also represents a wheat stone bridge hence there will be no changed in the configuration.





Ans. 7. Option (B) is correct.

Explanation: Parallel combination of resistors:



Ans. 8. Option (C) is correct.

Explanation: To shift balance point to higher numbered wire (i.e. greater length) the potential gradient is to be decreased. So, resistance is to be increased in the primary circuit.

Ans. 9. Option (D) is correct.

Explanation: Conventional current is the flow of positive charge from positive terminal of a batter to negative terminal and in reverse of real electron flow. All directions of current shown in electronic/electrical circuits show conventional current.

Ans. 10. Option (B) is correct.

Explanation: $E\sigma = J$

Where E = electric field,

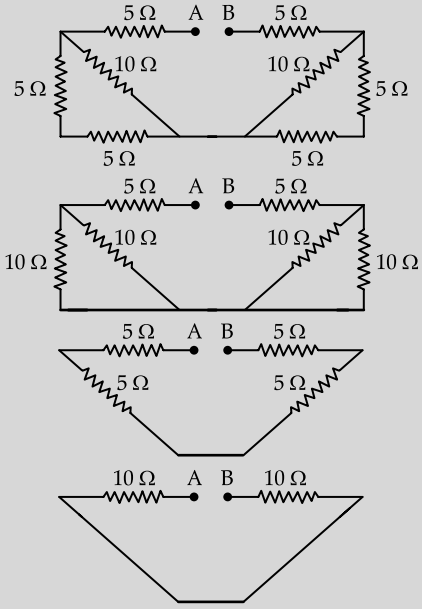
σ = conductivity,

J = current density

Comparing with XY = Z, Y = σ

Ans. 11. Option (C) is correct.

Explanation:



Ans. 12. Option (A) is correct.

Explanation: $B = \frac{\mu_0}{4\pi} \times \frac{2M}{d^3}$

$= 10^{-7} \times \frac{2 \times 0.5}{(0.05)^3}$

$= 8000 \times 10^{-7}$

$= 8 \times 10^{-4}$ T

Ans. 13. Option (D) is correct.

Explanation: τ = NIBA sin θ

So, torque depends on area, magnitude of current and magnetic field.

Ans. 14. Option (B) is correct.

Explanation:

Force acting an electron = $\vec{F} = q\left(\vec{v} \times \vec{B}\right)$

Here electron being stationary,

$\vec{v} = 0$. So, $\vec{F} = 0$ ·

Since no force is acting, the electron will remain stationary.

Ans. 15. Option (B) is correct.

Explanation: For circular motion of a charged particle in a magnetic field

$Bqv = mv^2/r$

$\therefore \quad r = mv/Bq$

When velocity and magnetic field become double, then

$r' = m\,(2v)/(2B)q = mv/Bq = r$

Ans. 16. Option (B) is correct.

Explanation: Both the coils will produce field in the same direction. When they are brought closer, the magnetic fields increase.

According to Lenz's law, induced current will decrease to oppose the increase of magnetic fields. So, in the both the coils current will decrease.

Ans. 17. Option (D) is correct.

Explanation: Metal may be heated by passing direct current, alternating current and induced current. Induced current is generated by placing the plate in a time varying magnetic field.

Ans. 18. Option (B) is correct.

Explanation: In series connection, inductors behave like resistors.
So $L_{eq} = L_1 + L_2$

Ans. 19. Option (C) is correct.

Explanation:

$$[R/L] = [ML^2T^{-3}A^{-2}]/[ML^2T^2A^{-2}]$$
$$= 1/[T]$$
$$[1/RC] = 1/[ML^2T^{-3}A^{-2}]\,[M^{-1}L^{-2}T^4A^2] = 1/[T]$$
$$[1/\sqrt{LC}\,] = 1/[\,M\,L^{2}\,T^{2}\,A^{-2}M^{-1}\,L^{-2}\,T^4A^2]^{1/2}$$
$$= 1/[T]$$
$$[RC] = [ML^2T^{-3}A^{-2}]\,[M^{-1}L^{-2}T^4A^2]$$
$$= [T]$$

Ans. 20. Option (A) is correct.

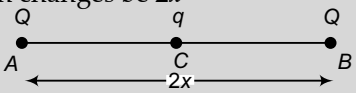
Explanation: Dimension of impedance is same to the dimension of resistance.
So $[Z] = [ML^2T^{-3}A^{-2}]$

Ans. 21. Option (C) is correct.

Explanation: Total flux = Net Charge enclosed/ε_0
It depends only on net charge enclosed by the surface.

Ans. 22. Option (B) is correct.

Explanation: Let the distance between given changes be $2x$



In equilibrium, $|\vec{F}_{AB}| + |\vec{F}_{AC}| = 0$

So, $|F_{AB}| = -|F_{AC}|$

$$\frac{1}{4\pi\varepsilon_0}\frac{Q^2}{4x^2} = -\frac{1}{4\pi\varepsilon_0}\frac{Qq}{x^2}$$

or, $q = -Q/4$

Ans. 23. Option (A) is correct.

Explanation: In a potentiometer, similar amount of current is passing in the entire wire length so, $V \alpha R \alpha l$
Now, $V_1/V_2 = l_1/l_2$
$6/V_2 = 300/50$
Solving for potential difference V_2 we get 1 V

Ans. 24. Option (A) is correct.

Explanation: Here $F \perp v \Rightarrow v$ = constant
Hence, the speed of the particle remains unchanged.

Ans. 25. Option (C) is correct.

Explanation: Magnetic Field $B = \mu_0 Ni/2r$
$= 4\pi \times 10^{-7} \times 1000 \times 0.1/(2 \times 0.1)$
$= 6.28 \times 10^{-4}$ T

Section-B

Ans. 26. Option (B) is correct.

Explanation: Total voltage drop across the wire :

$$V = 150 \times 8 = 1200 \text{ volt}$$

Total resistance of wire, (R)

$$= 150 \times 0.5 = 75\ \Omega$$

Hence, current through wire

$$I = V/R$$

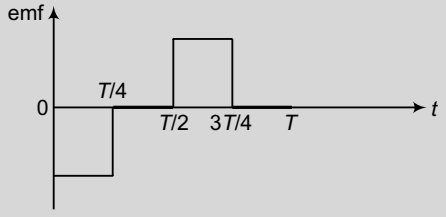
or $I = 1200/75 = 16$ A

Finally the power loss will be,

$$P = I^2R = (16)^2 \times 75$$
$$= 19200 \text{ W or } 19.2 \text{ kW}$$

Ans. 27. Option (B) is correct.

Explanation: By analysing the figures, $\varepsilon = -\phi L\,(di/dt)$
or $\varepsilon \propto -di/dt$
It is observed that during 0 to T/4, di/dt is constant, so induced emf is negative.
During phase from T/4 to T/2, (di/dt) is 0, so induced emf is 0.
In phase, T/2 to 3T/4, (di/dt) is constant, so induced emf is positive.



Ans. 28. Option (B) is correct.

Explanation: In case when a magnet is allowed to fall vertically along axis of loop with its north pole towards the ring, then upper face of ring becomes north pole so as to oppose approaching north pole of magnet. In such case, acceleration in magnet will be less than g.

Ans. 29. Option (B) is correct.

Explanation:

Since, $E = -L \times (di/dt)$

$8 = -L(-2/0.05)$

or, $L = 0.2\ H$

Ans. 30. Option (D) is correct.

Explanation: Magnetic flux is defined as the total number of magnetic field lines through a coil or given area. Magnetic flux has the dimension: length^2 × mass × time^{-2} × electric-current^{-1} which is $[ML^2T^{-2}A^{-1}]$.

Ans. 31. Option (D) is correct.

Explanation: Efficiency of transformer,

$$\eta = [(V_s \times I_s)/(V_p \times I_p)] \times 100$$

$$= \frac{V_S}{V_P} \times \frac{I_S}{I_P} \times 100$$

$$= \frac{110}{220} \times \frac{100/110}{0.5} \times 100$$

$$= 90.9\% \approx 90\%$$

Ans. 32. Option (A) is correct.

Explanation: Self inductance of a solenoid, $\mu A n^2/l$

If self induction is proportional to n^2, inductance becomes 4 times when n is doubled.

Ans. 33. Option (A) is correct.

Explanation: In transformer, eddy currents results due to changing magnetic field which induces currents in the secondary coil. Such current flows in little circles in iron core that cause heat loss. The heat losses in the transformer can be lowered by having its core laminated.

Ans. 34. Option (C) is correct.

Explanation:

$P = V_{rms}\, I_{rms} \cos\phi$

$= (1/2)(1/2)\cos\pi/3 = 1/8$

Ans. 35. Option (D) is correct.

Explanation: In an AC generator, the emf generated is maximum when flux is maximum. It is possible if angle between area vector of the coil and magnetic field is 0°. In such case the emf generated is $e = NBA\omega \cos\omega t$. On neglecting cosωt, maximum value of emf generated in the coil is $e = NBA\omega$

Ans. 36. Option (D) is correct.

Explanation: In an ac circuit, when voltage across two terminals of resistance changes, current changes immediately. If voltage rises, current also rises and when voltage falls, current also falls, hence current and voltage are in phase. Further, as voltage rises and falls, current rises and falls, after a fraction of a second; so current flowing through inductor is always lagging behind voltage and current and voltage are out of phase.

Ans. 37. Option (B) is correct.

Explanation: Torque is given by

$\tau = pE\sin\theta = qlE\sin\theta$

or, $q = \tau/lE\sin\theta$

$= 4/(2 \times 10^{-2} \times 0.5 \times 2 \times 10^5) = 2\ mC$

Ans. 38. Option (A) is correct.

Explanation: An electric dipole if kept in non-uniform electric field will experiences two forces that are opposite and not equal.

In this, a net force will exists and the forces will act at different points of a body along with a torque.

Ans. 39. Option (D) is correct.

Explanation: It is observed that on equipotential surfaces, electric field results as normal to the charged surface not allowing the work done.

Ans. 40. Option (B) is correct.

Explanation: As seen, system potential energy will be:

$$(-e) \times (-e)/4\pi\varepsilon_0 r = e^2/4\pi\varepsilon_0 r$$

When radius r decreases, then potential energy of system increases.

Ans. 41. Option (B) is correct.

Explanation: Energy stored

$U = Q^2/2C$

$= (40 \times 10^{-6})^2/(2 \times 10^{-6} \times 10)$

$= 16 \times 10^{-10}/(2 \times 10^{-5}) = 8 \times 10^{-5}$ J

Now converting to erg,

$= 8 \times 10^{-5} \times 10^7 = 800$ erg

Ans. 42. Option (C) is correct.

Explanation: The relation of capacitance with dielectric constants is given as:

$$C_{medium} \propto \frac{K}{d}$$

So, if the distance between parallel plates of a capacitor is halved and dielectric constant is doubled then the capacitance will be four times more.

Ans. 43. Option (C) is correct.

Explanation: Here, $l = 4\text{m} = 400$ cm

potential gradient $\frac{dV}{dr} = \frac{1\text{ mV}}{\text{cm}}$

So, potential drop

$$\Delta V = l \times \frac{dV}{dr} = 0.4 \text{ V}$$

Since, in series current in same so,

$$\frac{\Delta V}{R} = \frac{E}{R + R_s}$$

or, $$\frac{0.4}{8} = \frac{2}{R_s + 8}$$

or, $R_s = 32\ \Omega$ must be connected in series.

Ans. 44. Option (B) is correct.

Explanation: From the circuit,

$$\varepsilon_1 = (i_1 + i_2)R + i_1 r_1$$

Hence $\varepsilon_1 - (i_1 + i_2)R - i_1 r_1 = 0$

Ans 45. Option (B) is correct.

Explanation: In induction furnace high frequency alternating current is passed through a coil which surrounds the metals to be melted. The eddy currents generated in the metals produce high temperatures sufficient to melt it. Thus metals are melt to prepare alloy.

So, the assertion is true.

In transformers, electric motors and other such devices in which a coil is to be wound over metallic core eddy currents are produced which are undesirable since they heat up the core and dissipate electrical energy in the form of heat. In such cases Eddy currents are minimised by using laminations of metal to make a metal core. The laminations are separated by an insulating material like lacquer. The plane of the laminations must be arranged parallel to the magnetic field, so that they cut across the eddy current paths. This arrangement reduces the strength of the eddy currents. Since the dissipation of electrical energy into heat depends on the square of the strength of electric current, heat loss is substantially reduced.

So, the reason is also true. But it does not explain the assertion.

Ans. 46. Option (C) is correct.

Explanation: Whenever there is change in magnetic flux, e.m.f. is induced in a loop. So, the assertion is true.

For generation of induced current along with change in magnetic flux, the loop should be closed. So, the reason is false.

Ans. 47. Option (A) is correct.

Explanation: As the magnet travels, non-uniform magnetic field is produced. So eddy current will be generated and will provide electromagnetic damping which will reduce the acceleration.

So, the assertion is true.

According to Lenz's law, the induced current produced in a circuit always flow in such direction that it opposes the change or the cause the produced it. So the reason is also true and explains the assertion.

Ans. 48. Option (B) is correct.

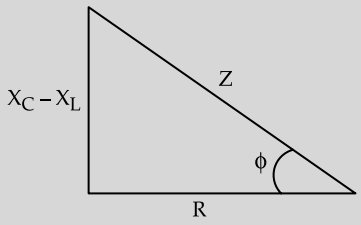
Explanation: By moving a conductor in a magnetic field the conductor cuts the magnetic field in different ways. Thus it senses a change in magnetic field and as per Faraday's laws of electromagnetic induction , an e.m.f. is induced. So, the assertion is true.

When a conductor is placed in a changing magnetic field then according to Faraday's laws of electromagnetic induction, an e.m.f. is induced.

Ans. 49. Option (A) is correct.

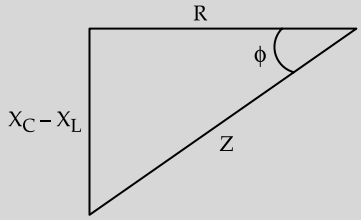
Explanation: The impedance diagram of a LCR circuit is a right angled triangle with as hypotenuse, R is along X-axis and $X_C - X_L$ is along Y axis.

$X_C - X_L$ is positive when $X_C > X_L$. So, the diagram looks like as below:



ϕ is positive.

$X_C - X_L$ is negative when $X_C < X_L$. So, the diagram looks like as below



ϕ is negative.

Section-C

Ans. 50. Option (B) is correct.

Explanation: The value of domestic supply a.c. voltage is 240 V. The corresponding amplitude is obtained by multiplying r.m.s. value by $\sqrt{2}$ i.e. $\sqrt{2} \times 240 = 340$ V.

Ans. 51. Option (C) is correct.

Explanation: Average power loss over a complete cycle is given by $P = VI \cos \phi$
In pure capacitive and inductive circuit $\cos \phi = 0$ (since $\phi = 90°$)
So, power loss = 0

Case Study

Ans. 52. Option (B) is correct.

Explanation: $\sigma = 0.5\ C/m^2$

$r = 100\ cm = 1m$

$Q = \sigma A$

$= 0.5 \times 4\pi \times 1^2$

$= 6.25\ C$

Ans. 53. Option (C) is correct.

Explanation: $\sigma = Q/4\pi r^2$

Since the radius of sphere = radius of shell and Charge on sphere = charge on shell, So, surface charge densities will be same for both.

Ans. 54. Option (A) is correct.

Explanation: Greater the curvature means lower the radius. So, Surface charge density is greater for greater curvature.

Ans. 55. Option (B) is correct.

Explanation: The dimension of electric charge is [TA] and the dimension of surface area is $[L^2]$. So, the dimension of surface charge density of a conductor is $[L^{-2}TA]$.

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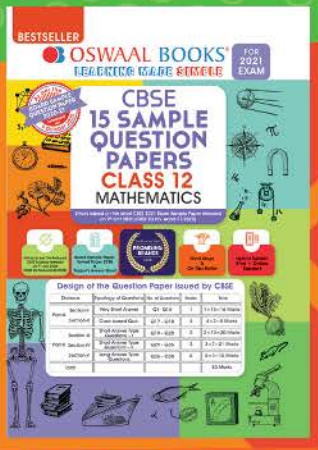
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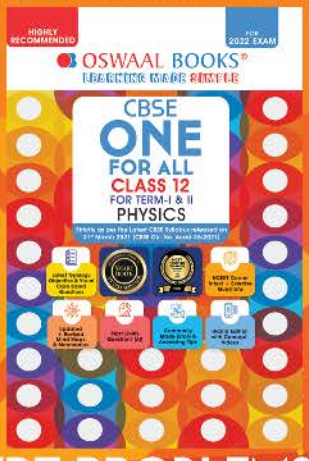
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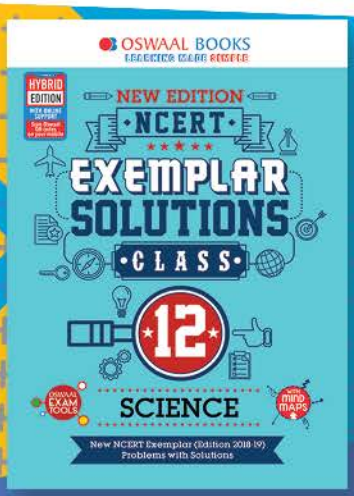
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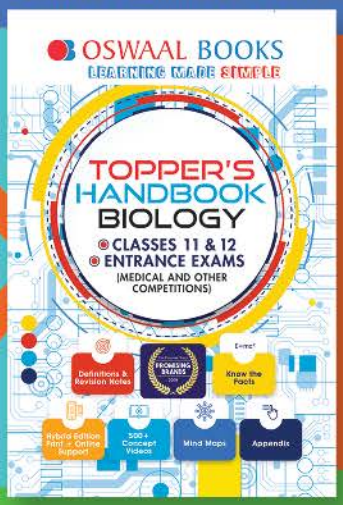
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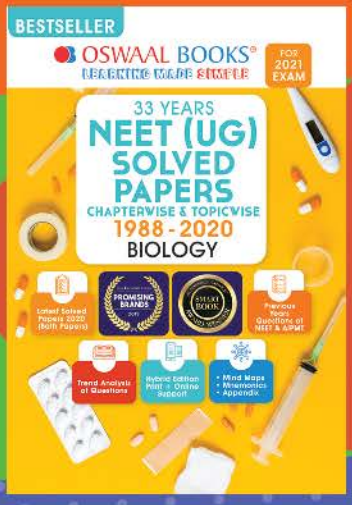
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