Test Code: MTP 2202324

ROOTS ACADEMY

Dedicated to Excellence

JEE|NEET|NTSE|OLYMPIAD|BOARD EXAM

Class: XII

SESSION : 2023-2024

SUBJECT: PHYSICS

Maximum Marks: 50 Marks. **Time Allowed: 1 hours 45 min.**

General Instructions:

(1) There are 26 questions in all. All questions are compulsory

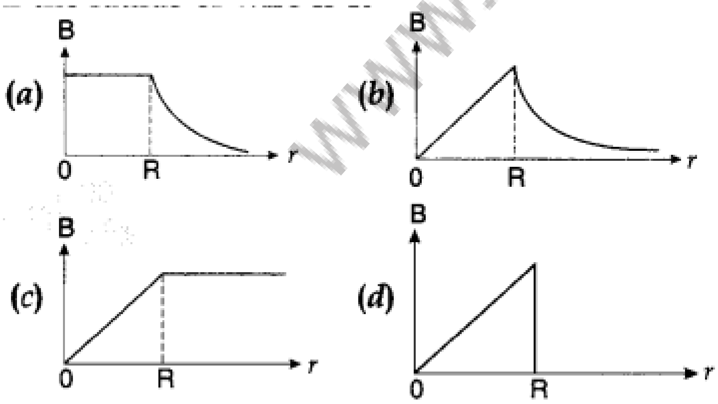
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.

(3) Section A contains fifteen MCQ of 1 mark each, Section B contains five questions of two marks each, Section C contains two questions of three marks each, section D contains three long questions of five marks each and Section E contains one case study based questions of 4 marks each.

(5) Use of any electronic gadgets are strictly prohibited

Section-A

Q1) The correct plot of the magnitude of magnetic field $\vec{B}$ vs distance r from centre of the wire is, if the radius of wire is R



Q2) A current carrying loop is placed in a uniform magnetic field. The torqe acting on it does not depend upon
(a) area of loop
(b) value of current
(c) magnetic field
(d) None of these

Q3) In a moving coil galvanometer the deflection (Φ) on the scale by a pointer attached to the spring is

(a) $\left(\frac{NA}{kB}\right)I$ **(b)** $\left(\frac{N}{kAB}\right)I$

(c) $\left(\frac{NAB}{k}\right)I$ **(d)** $\left(\frac{NAB}{kI}\right)$.

Q4) A moving coil galvanometer can be converted into an ammeter by
(a) introducing a shunt resistance of large value in series.
(b) introducing a shunt resistance of small value in parallel.
(c) introducing a resistance of small value in series.
(d) introducing a resistance of large value in parallel

Q5) A charged particle is moving on circular path with velocity v in a uniform magnetic field B, if the velocity of the charged particle is doubled and strength of magnetic field is halved, then radius becomes
(a) 8 times
(b) 4 times
(c) 2 times
(d) 16 times

Q6) Two a-particles have the ratio of their velocities as 3 : 2 on entering the field. If they move in different circular paths, then the ratio of the radii of their paths is
(a) 2 : 3
(b) 3 : 2
(c) 9 : 4
(d) 4 : 9

Q7) The dimensional representation of magnetic flux density is :
(a) $[MLT^{-2}]$
(b) $[MLT^{-2}A^{-1}]$
(c) $[MLT^{-2}A^{-2}]$
(d) $[MT^{-2}A^{-1}]$

Q8) In a moving coil galvanometer, we use a radial magnetic field so that the galvanometer scale is :
(a) exponential
(b) linear
(c) algebraic
(d) logarithmic

Q9) A wire of length l has a magnetic moment M. It is then bent into a semi-circular arc. The net magnetic moment is :
(a) M
(b) M.l.
(c) $2M/\pi$
(d) M/π

Q10) The polarity of induced emf is given by
(a) Ampere’s circuital law
(b) Biot-Savart law
(c) Lenz’s law
(d) Fleming’s right hand rule

Q11) The self inductance of a coil is a measure of
(a) electrical inertia
(b) electrical friction
(c) induced e.m.f.
(d) induced current

Q12)The laws of electromagnetic induction have been used in the construction of a

(a) galvanometer

(b) voltmeter

(c) electric motor

(d) generator

Q13)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) it is more economical due to less power loss
(c) power cannot be transmitted at low voltages
(d) a precaution against theft of transmission lines

Assertion Reason type

Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

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

b) Both A and R are true and 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

Q14) **Assertion :** In series LCR resonance circuit, the impedance is equal to the ohmic resistance.
Reason: At resonance, the inductive reactance exceeds the capacitive reactance.

Q15) **Assertion :** The alternating current lags behind the emf by a phase angle of, $\pi/2$ when AC flows through an inductor.
Reason : The inductive reactance increases as the frequency of AC source increases.

Section-B

Q16) When an ac source is connected across an ideal inductor, show on a graph the nature of variation of the voltage and the current over one complete cycle

Q17) Plot a graph showing variation of capacitive reactance with the change in the frequency of the AC source

Q18) Derive an expression for the impedance of an a.c. circuit consisting of an inductor and a resistor.

Q19) An ammeter of resistance 0.6 Ω can measure current upto 1.0 A. Calculate the shunt resistance required to enable the ammeter to measure current upto 5.0 A

Q20) State Biot-Savart law.

Section-C

Q21) A steady current (I_1) flows through a long straight wire. Another wire carrying steady current (I_2) in the same direction is kept close and parallel to the first wire. Show with the help of a diagram how the magnetic field due to the current I_1 exerts a magnetic force on the second wire. Write the expression for this force.

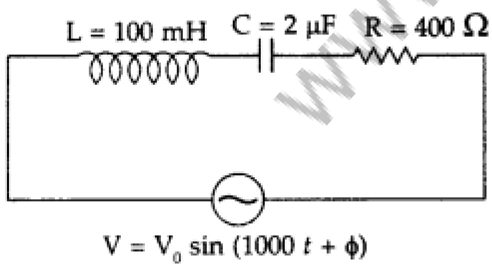
Q22) Using Ampere's circuital law, obtain the expression for the magnetic field due to a long solenoid at a point inside the solenoid on its axis.

Section-D

Q23) (a) Using Biot-Savart's law, derive an expression for the magnetic field at the centre of a circular coil of radius R, number of turns N, carrying current i.
(b) Two small identical circular coils marked 1, 2 carry equal currents and are placed with their geometric axes perpendicular to each other as shown in the figure. Derive an expression for the resultant magnetic field at O.

Q24) Define mutual inductance between two long coaxial solenoids. Find out the expression for the mutual inductance of inner solenoid of length l having the radius r_1 and the number of turns n_1 per unit length due to the second outer solenoid of same length and n_2 number of turns per unit length.

Q25) (i) Find the value of the phase difference between the current and the voltage in the series LCR circuit shown here. Which one leads in phase: current or voltage?



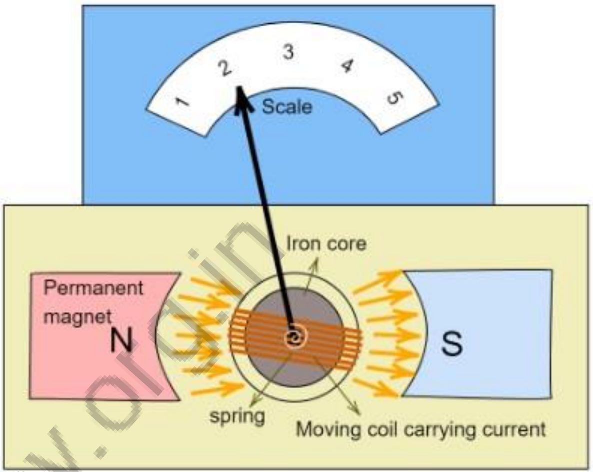
(ii) Without making any other change, find the value of the additional capacitor Cv to be connected in parallel with the capacitor C, in order to make the power factor of the circuit unity

Section-E

Q26) **Case study-** Moving coil galvanometer operates on Permanent Magnet Moving Coll (PMMC) mechanism and was designed by the scientist Darsonval.

Moving coil galvanometers are of two types
(i) Suspended coll
(ii) Pivoted coil type or tangent galvanometer

Its working is based on the fact that when a current carrying coil is placed in a magnetic field, it experiences a torque. This torque tends to rotate the coil about its axis of suspension in such a way that the magnetic flux passing through the coil is maximum.



Front view of a Moving Coil Galvanometer

(i) A moving coil galvanometer is an instrument which

(a) is used to measure emf

(b) is used to measure potential difference

(C)is used to measure resistance

(d) is a deflection instrument which gives a deflection when a current flows through its coil

(ii) To make the field radial in a moving coil galvanometer.

(a) number of turns of coil is kept small

(b) magnet is taken in the form of horse-shoe

(c) poles are of very strong magnets

(d) poles are cylindrically cut

(iii) The deflection in a moving coil galvanometer is
(a) directly proportional to torsional constant of spring

(b) directly proportional to the number of turns in the coil
(c) inversely proportional to the area of the coil
(d) inversely proportional to the current in the coil

(iv) In a moving coil galvanometer, having a coil of N-turns of area A and carrying current I is placed in a radial field of strength B.
The torque acting on the coil is
(a) NA^2B^2I
(b) $NABI^2$
(c) N^2ABI
(d) NABI