Academic Resource Centre

1/3, Near SAP Theatre, Tirupur - 641603

PHYSICS BOARD PREP 1

Class 12 - Physics

Time Allowed: 3 hours **Maximum Marks: 70**

General Instructions:

1. There are 33 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.
3. All the sections are compulsory.
4. **Section A** contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, **Section B** contains five questions of two marks each, **Section C** contains seven questions of three marks each, **Section D** contains two case study based questions of four marks each and **Section E** contains three long answer questions of five marks each.
5. There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
6. Use of calculators is not allowed.

Section A

1. In a semiconductor crystal, if current flows due to breakage of crystal bonds, then the semiconductor is called **[1]**

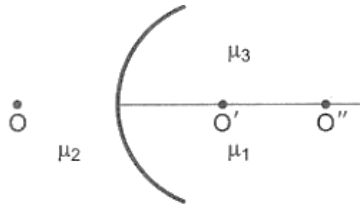
   a) Intrinsic semiconductor
   b) donor
   c) Extrinsic semiconductor
   d) acceptor

2. 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 **[1]**

   a) the electric field produced by charges accumulated on the surface of the wire.
   b) the charges just behind a given segment of wire which push them just the right way by repulsion.
   c) source of emf.
   d) the charges ahead.

3. Figure shows three transparent media of refractive indices μ_1, μ_2 and μ_3. A point object O is placed in the medium μ_2. If the entire medium on the right of the spherical surface has refractive index μ_1, the image forms at O'. If this entire medium has refractive index μ_3, the image forms at O''. In the situation shown in the figure **[1]**

given ahead:



a) the image forms to the right of O''

b) the image forms to the left of O'

c) the image forms between O' and O''

d) two images form, one at O' and the other at O''

4. The major contribution of magnetism in substances is due to **[1]**

a) equally due to orbital and spin motions of electrons

b) orbital motion of electrons

c) spin motion of electrons

d) hidden magnets.

5. For making a parallel-plate capacitor you have two plates of copper, a sheet of mica (thickness $= 0.10\,mm,\ K = 5.4$), a sheet of glass (thickness $= 0.20\,mm, K = 7$) and a slab of paraffin (thickness = $1.0\,cm,\ K = 2$). To obtain the largest capacitance, which sheet should you place between the copper plates? **[1]**

a) Glass

b) Information is insufficient

c) Mica

d) Copper

6. Two thin long parallel wires A and B are separated by a distance r and carry current I each in the same direction. The force per unit length exerted by A on wire B is: **[1]**

a) $\frac{\mu_0 \mathrm{I}^2}{2\pi \mathrm{r}}$, attractive

b) $\frac{\mu_0 \mathrm{I}}{2\mathrm{r}}$, attractive

c) $\frac{\mu_0 \mathrm{I}}{2\pi \mathrm{r}}$, repulsive

d) $\frac{\mu_0 I^2}{2\pi r}$, repulsive

7. A dynamo works on the principle of: **[1]**

a) Induced magnetism

b) Induced current

c) Electromagnetic induction

d) Faraday's effect

8. Which one of the following has relative magnetic permeability between 0 and 1? **[1]**

a) Alnico

b) Water

c) Sodium

d) Aluminium

9. Electromagnetic radiation of frequency n, wavelength λ, travelling with velocity v in air enters a glass slab of refractive index μ. The frequency, wavelength and velocity of light in the glass slab will be respectively, **[1]**

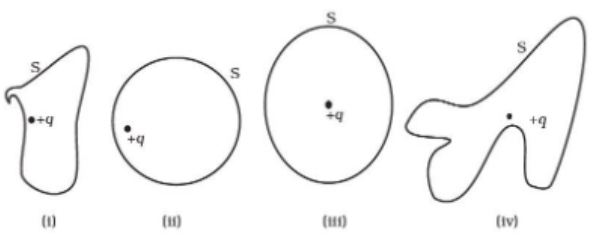
a) n, 2λ and $\frac{v}{\mu}$

b) $\frac{2n}{\mu}$, $\frac{\lambda}{\mu}$ and v

c) $\frac{n}{\mu}, \frac{\lambda}{\mu}$ and $\frac{v}{\mu}$

d) n, $\frac{\lambda}{\mu}$ and $\frac{v}{\mu}$

10. The Electric flux through the surface **[1]**



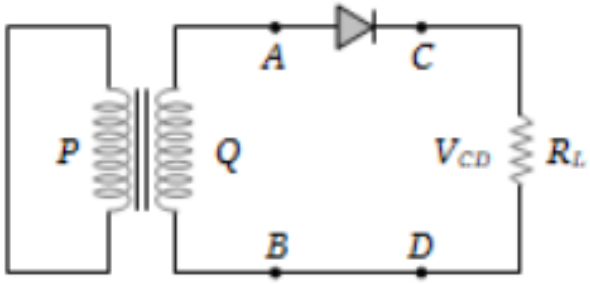
a) in Fig. (ii) is same as Fig. (iii) but is smaller than Fig. (iv)

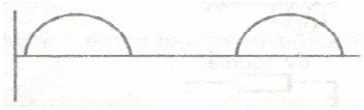
b) in Fig (iv) is the largest.

c) is the same for all the figures

d) in Fig. (iii) is the least

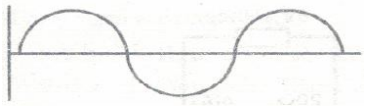
11. In the half wave rectifier circuit shown which one of the following wave forms is true for V_{CD}, the output across C and D? **[1]**



a) 

b) 

c) 

d) 

12. The relationship between angle of incidence i, prism of angle A and angle of minimum deviation for a triangular prism is **[1]**

a) $2A + \delta_m = i$

b) $A + \delta_m = 2i$

c) $A + \frac{\delta_m}{2} = i$

d) $A + \delta_m = i$

13. **Assertion (A):** Photoelectric process is instantaneous process. **[1]**

Reason (R): When photons of energy (hv) greater than work function of metal (ϕ_0) are incident on a metal, the electrons from metal are emitted with no time lag.

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 but R is true.

14. **Assertion (A):** When a charged capacitor is filled completely with a metallic slab, its capacitance is increased by a large amount. **[1]**

Reason (R): The dielectric constant for metal is infinite.

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 but R is true.

15. **Assertion (A):** Thin films such as soap bubble or a thin layer of oil on water show beautiful colours when illuminated by monochromatic light. **[1]**

Reason (R): The colours are obtained by dispersion of light.

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 but R is true.

16. A resistor, a capacitor and an inductor are connected in series. The combination is connected across an ac source **[1]**

of frequency 50 Hz.

Assertion: Peak current through each remains same.

Reason: Average power delivered by source is equal to average power developed across resistance.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

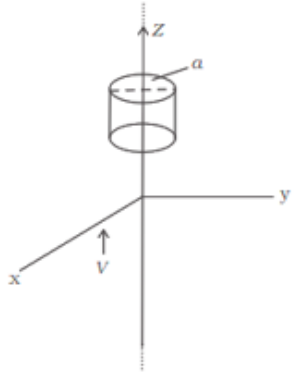
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

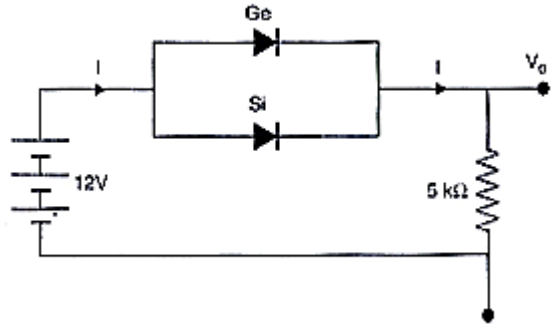
d) Assertion is wrong statement but reason is correct statement.

Section B

17. An infinitely long thin wire carrying a uniform linear static charge density λ is placed along the z-axis (Fig). The wire is set into motion along its length with a uniform velocity $\vec{v} = v\vec{k}_z$. Calculate the Poynting vector $\vec{S} = \frac{1}{\mu_0}(\vec{E} \times \vec{B})$. **[2]**



18. Calculate the value of V_o and I, if the Si diode and the Ge diode conduct at 0.7 V and 0.3 V respectively, in the circuit given in figure. If now Ge diode connections are reversed, what will be the new values of V_o and I. **[2]**



19. Use de-Broglie's hypothesis to write the relation for the radius of nth Bohr orbit in terms of Bohr's quantization condition of orbital angular momentum. **[2]**

20. A bar magnet with poles 25 cm apart and of pole strength 14.4 Am rests with its centre on a frictionless pivot. It is held in equilibrium at 60° to a uniform magnetic field of induction 0.25 T by applying a force F, at right angles to its axis, 12 cm from its pivot. Calculate F. What will happen if the force F is removed? **[2]**

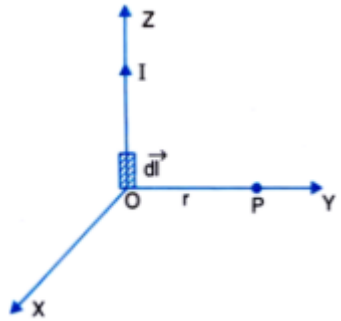
OR

A magnetising field of 1500 A/m produces a magnetic flux of 2.4×10^{-5} weber in a bar of iron of crosssection 0.5 cm^2. Calculate permeability and susceptibility of the iron-bar used.

21. A charged particle of mass'm', charge 'q' moving at uniform velocity 'v', enters a uniform magnetic field 'B' acting normal to the plane of the paper. Deduce expression for the (t) radius of the circular path in which it travels, (ii) kinetic energy of the particle (assuming v << c). **[2]**

OR

State Biot Savart law. A current I flows in a conductor placed perpendicular to the plane of the paper. Indicate the direction of the magnetic field due to a small element $\vec{dl}$ at point P situated at a distance $\vec{r}$ from the element as shown in the figure.

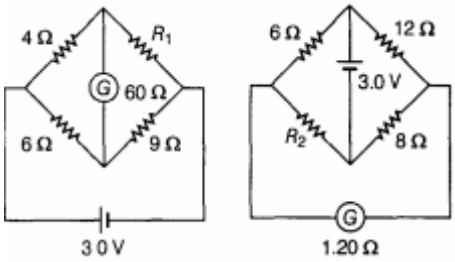


Section C

22. Define the current sensitivity of a galvanometer. Write its SI unit. **[3]**

Figure shows two circuits each having a galvanometer and a battery of 3 V.

When the galvanometer in each arrangement do not show any deflection, obtain the ratio R_1/R_2.

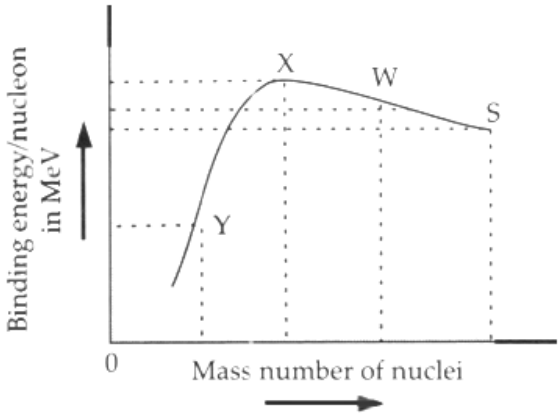


23. a. State briefly, with what purpose was Davisson and Germer experiment performed and what inference was drawn from this. **[3]**

b. Obtain an expression for the ratio of the accelerating potentials required to accelerate a proton and an α-particle to have the same de-Broglie wavelength associated with them.

24. What is a Zener diode? Draw its V-I characteristic. Explain with the help of a circuit diagram how a Zener diode can be used as a voltage regulator. **[3]**

25. Binding energy per nucleon versus mass number curve is as shown. ${}^{A}_{Z}S$, ${}^{A1}_{Z1}W$, ${}^{A2}_{Z2}X$, and ${}^{A3}_{Z3}Y$ are four nuclei indicated on the curve. **[3]**



Based on the graph:

i. Arrange X, W, and S in the increasing order of stability.

ii. Write the relation between the relevant A and Z values for the following nuclear reaction. $S \rightarrow X + W$

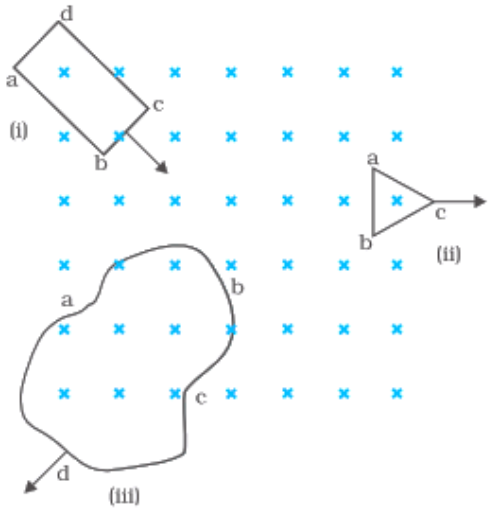
iii. Explain why binding energy for heavy nuclei is low.

26. Calculate the de-Broglie wavelength associated with the electron in the 2^{nd} excited state of hydrogen atom. The ground state energy of the hydrogen atom is 13.6 eV. **[3]**

27. Deduce an expression for the mutual inductance of two long coaxial solenoids but having different radii and different number of turns. **[3]**

OR

In Figure, shows planar loops of different shapes moving out of or into a region of a magnetic field which is directed normal to the plane of the loop away from the reader. Determine the direction of induced current in each loop using Lenz's law.



28. For sound waves, the Doppler formula for frequency shift differs slightly between the two situations: **[3]**

a. source at rest; observer moving, and

b. source moving; observer at rest.

The exact Doppler formulas for the case of light waves in vacuum are, however, strictly identical for these situations. Explain why this should be so. Would you expect the formulas to be strictly identical for the two situations in case of light travelling in a medium?

Section D

29. **Read the text carefully and answer the questions:** **[4]**

All the known radiations from a big family of electromagnetic waves which stretch over a large range of wavelengths. Electromagnetic wave include radio waves, microwaves, visible light waves, infrared rays, UV rays, X-rays and gamma rays. The orderly distribution of the electromagnetic waves in accordance with their wavelength or frequency into distinct groups having widely differing properties is electromagnetic spectrum.

(a) Which wavelength of the Sun is used finally as electric energy?
radio waves, infrared waves, visible light, microwaves

a) infrared waves b) radio waves

c) microwaves d) visible light

(b) Which of the following electromagnetic radiations have the longest wavelength?
X-rays, γ-rays, microwaves, radiowaves

a) γ-rays b) X-rays

c) microwaves d) radiowaves

(c) Which one of the following is not electromagnetic in nature?
X-rays, gamma rays, cathode rays, infrared rays

a) infrared rays b) gamma rays

c) cathode rays d) X-rays

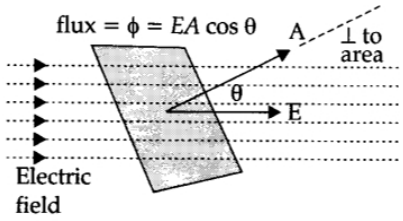
(d) Which of the following has minimum wavelength?

X-rays, ultraviolet rays, γ-rays, cosmic rays

a) ultraviolet rays b) X-rays

c) cosmic rays d) γ-rays

30. The total number of electric field lines passing a given area in a unit time is defined as the electric flux. **[4]**



If the plane is normal to the flow of the electric field, the total flux is given as:

ϕ = EA

When the same plane is tilted at an angle θ, the projected area is given as A cos θ and the total flux through this surface is given as:

ϕ = EA cos θ

where, E is the magnitude of the electric field. A is the area of the surface through which the electric flux is to be calculated.

i. If a unit positive charge is kept in the air, then what is the total flux coming out of unit charge? (1)

ii. What is the value of electric flux (φ) on a plane of area 1 m^2 on which an electric field of 2 V/m crosses with an angle of 30^o. (2)

iii. When is the flux through a surface taken as positive? (1)

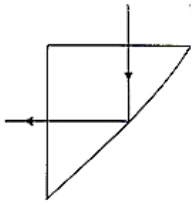
Section E

31. a. Draw a ray diagram for formation of a real and diminished image of an object kept in front of a concave mirror. Hence derive the mirror equation. **[5]**

b. A concave mirror of focal length 10 cm produces a real image which is 3 times the size of the object. Find the distance of the object from the mirror.

OR

A ray of light incident normally on one of the faces of a right angled isosceles prism is found to be totally reflected as shown.



i. What is the minimum value of the refractive index of the material of the prism?

ii. When the prism is immersed in water, trace the path of the emergent ray for the same incident ray indicating the values of all the angles. (μ of water = $\frac{4}{3}$).

32. i. Derive an expression for potential energy of an electric dipole $\vec{p}$ in an external uniform electric field $\vec{E}$. When is the potential energy of the dipole (1) maximum, and (2) minimum? **[5]**

ii. An electric dipole consists of point charges -1.0 pC and +1.0 pC located at $(0, 0)$ and (3 mm, 4 mm) respectively in x - y plane. An electric field $\vec{E} = \left(\frac{1000V}{m}\right)\hat{i}$ is switched on in the region. Find the torque $\vec{\tau}$

acting on the dipole.

OR

i. Obtain an expression for the potential energy of an electric dipole placed in a uniform electric field.

ii. Three capacitors of capacitance C_1, C_2 and C_3 are connected in series to a source of V volt. Show that the total energy stored in the combination of capacitors is equal to sum of the energy stored in individual capacitors.

iii. A capacitor of capacitance C is connected across a battery. After charging, the battery is disconnected and the separation between the plates is doubled. How will (i) the capacitance of the capacitor, and (ii) the electric field between the plates be affected? Justify your answer.

33. A small town with a demand of 800 kW of electric power at 220 V is situated 15 km away from an electric plant generating power at 440 V. The resistance of the two wirelines carrying power is 0.5 Ω per km. The town gets power from the line through a 4000 - 220 V step-down transformer at a sub-station in the town. **[5]**

a. Estimate the line power loss in the form of heat.

b. How much power must the plant supply, assuming there is negligible power loss due to leakage?

c. Characterize the step-up transformer at the plant.

OR

A series L-C-R circuit is connected to an AC source. Using the phasor diagram, derive the expression for the impedance of the circuit. Plot a graph to show the variation of current with frequency of the source, explaining the nature of its variation.