SAMPLE PAPER SET - 3 (2024-25)

Time : 03 : 00 Hours   **CLASS :– XII-PHYSICS (042)**   **M.M. : 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. Carbon, silicon and germanium have four valence electron each. These are characterized by valence and conduction bands separated by an energy band gap, respectively, each to $(E_g)_C ; (E_g)_{Si} ; (E_g)_{Ge}$. Which of the following statement is true ?

   (a) $(E_g)_{Si} < (E_g)_{Ge} < (E_g)_C$ (b) $(E_g)_C > (E_g)_{Si} > (E_g)_{Ge}$

   (c) $(E_g)_C < (E_g)_{Ge} < (E_g)_{Si}$ (d) $(E_g)_{Ge} < (E_g)_{Si} < (E_g)_C$

2. For a cell, the terminal potential difference is 3.6 V, when the circuit is open. If the potential difference reduces to 3 V, when cell is connected to a resistance of 5Ω, the internal resistance of cell is

   (a) 1Ω (b) 2Ω (c) 4Ω (d) 8Ω

3. A diver at a depth 12 m inside water $(\mu = 4/3)$ sees the sky in a cone of semi-vertical angle of

   (a) $\sin^{-1}\dfrac{4}{3}$ (b) $\tan^{-1}\dfrac{4}{3}$ (c) $\sin^{-1}\dfrac{3}{4}$ (d) 90°

4. In an alternating current circuit consisting of element in series, the current increases on increasing the frequency of supply. Which of the following elements are likely to constitute the circuit ?

   (a) Only capacitor   (b) Inductor and capacitor

   (c) Resistor and capacitor   (d) Only resistor

5. 64 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 charge on the big drop will be

   (a) 2q (b) 4q (c) 16q (d) 64q

6. The length of a solenoid is 0.2 m and it has 120 turns. If a current of 2.5 A is flowing through it, then the magnitic field in its interior be

   (a) $3.75 \times 10^{-2} T$ (b) $5.97 \times 10^{-4} T$ (c) $4.76 \times 10^{-3} T$ (d) $1.85 \times 10^{-3} T$

7. The current i in an induction coil varies with time according to the graph shown in figure. Which of the following graphs shows induced emf in the coil with time.

(a)

(b)

(c)

(d)
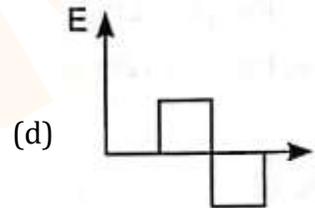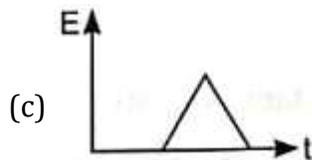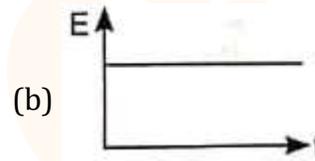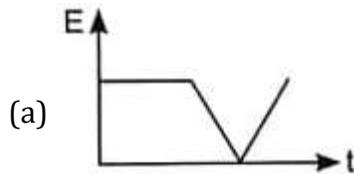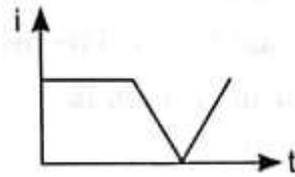
8. When a proton has a velocity,

   $\vec{v} = (2\hat{i} + 3\hat{j}) \times 10^6 m/s$, it experiences a force $\vec{F} = -(1.28 \times 10^{-3}\hat{k})N$. When its velocity is along z-axis it experiences a force along x-axis. The magnetic field in the region is (in tesla).

   (a) $0.4\hat{j}$ (b) $0.4\hat{i}$ (c) $-0.4\hat{j}$ (d) $0.6\hat{i}$

9. In Young's double-slit experiment, the intensity at the central maximum is I_0 if one of the slit is covered, then the intensity at the central maximum becomes

   (a) $\dfrac{I_0}{2}$ (b) $\dfrac{I_0}{\sqrt{2}}$ (c) $\dfrac{I_0}{4}$ (d) I_0

10. The magnitude of electric field intensity E is such that, an electron placed in it would experience an electrical force equal to its weight is given by

    (a) mge (b) mg/e (c) e/mg (d) e^2g/m^2

11. In half wave rectification, the input frequency is 50 Hz. What is the output frequency of a full wave rectifier for the same input frequency ?

    (a) 60 Hz (b) 100 Hz (c) 50 Hz (d) 70 Hz

12. A microscope is focussed on a mark on a piece of paper and then a slab of glass of thickness 3 cm and refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again ?

    (a) 2 cm upward (b) 1 cm upward (c) 4.5 cm downward (d) 1 cm downward

Direction :(Q.13-16) 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 false

13. Assertion (A) : Forces acting between proton-proton (f_{pp}), proton-neutron (f_{pn}) and neutron-neutron (f_{nn}) are such that $f_{pp} < f_{pn} = f_{nn}$.

    Reason (R) : Electrostatic force of repulsion between two protons reduces net nuclear forces between them.

14. Assertion (A) :Capacitor serves as a block for DC and offer an easy path to AC.

    Reason (R) : Capacitive reactance is inversely proportional of frequency.

15. Assertion (A) : Photoelectric effect demontrates the wave nature of light.

    Reason (R) : The number of photoelectrons is proportional to the velocity of incident light.

16. Assertion (A) : If a proton and an electron are placed in the same uniform electric field, they experience different acceleration.

SECTION - B

17. The threshold frequency for a certain metal is 3.3×10^{14} Hz. If light of frequency 8.2×10^{14} Hz is incident on the metal, predict the cut-off voltage for the photelectric emission.

18. A beam of light consisting of two wavelength, 650 nm and 520 nm, is used to obtain interference fringes in Young's double-slit experiment.

    (a) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm.

    (b) What is the least distance from the central maximum where the bright fringes due to both the wavelength coincide ?

19. In a chamber, a uniform magnetic field of 6.5 G (1 G = 10^{-4} T) is maintained. An electron is shot into the field with a speed of $4.8 \times 10^6 \, \text{ms}^{-1}$ normal to the field. Explain why the path of the electron is a circle. Determine the radius of the circular orbit. $\left(e = 1.5 \times 10^{-19} \text{C}. \, m_e = 9.1 \times 10^{-31} \text{kg}\right)$

20. Suppose, we think of fission of a $_{26}^{56}\text{Fe}$ nucleus into two equal fragments, $_{13}^{28}\text{Al}$. Is the fission energetically possible ? Argue by working out Q of the process. Given $m\left(_{26}^{56}\text{Fe}\right) = 55.93494$ u and $m\left(_{13}^{28}\text{Al}\right) = 27.98191$ u.

OR

Write any two limitations of Bohr's atomic model.

21. A cylindrical conductor of length 1 and cross-section area A is connected to a DC source. Under the influence of electric field set up due to source, the free electron begin to drift in the opposite direction of the electric field.

(I) Draw the curve showing the dependency of drift velocity on relaxation time.

(II) If the DC source is replaced by a source whose current change its magnitude with time such that $I = I_0 \sin 2\pi vt$, where v is the frequency of variation of current, then determine the average drift velocity of the free elecrtrons over one complete cycle.

OR

Plot a curve to show relation between number of scattered α–particle and defelection angle.

SECTION - C

22. Draw V-I characteritics of a p-n junction diode. Answer the following questions, giving reasons:

    (i) Why is the current under reverse bias almost independent of the applied potential upto a critical voltage ?

    (ii) Why does the reverse current show a sudden increase at the critical voltage ?

23. Find the expression for the capacitance of a parallel plate capacitor of plate area A and plate eparation d when (a) a dielectric slab of thickness t and (b) a matallic slab of thickness t, where (t<d) are introduced one by one between the plates of the capacitor. In which case would the capacitance be more and why ?

24. (i) Name the phenomenon on which the working of an optical fibre is based.

    (ii) What are the necessary conditions for this phenomenon to occur ?

    (iii) Draw a labelled diagram of an optical fibre and show how light propagates through the optical fibre using this phenomenon.

OR

You are given three lenses L_1, L_2 and L_3 each of focal length 20 cm. An object is kept at 40 cm in front of L_1, as shown. The final real image is formed at the focus 'I' of L_3. Find the separation between L_1, L_2 and L_2.
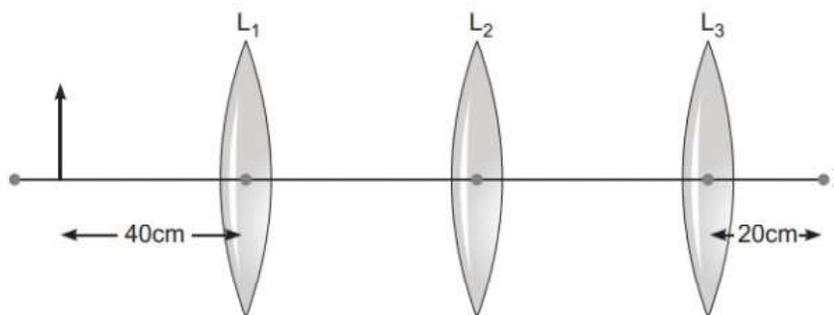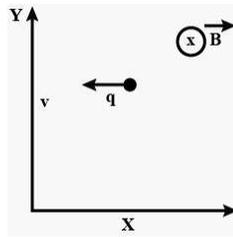

25. The reading of the ammeter for a silicon diode in the given circuit is
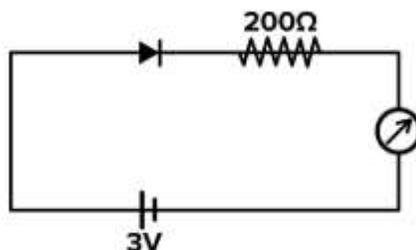

OR

Suppose a pure Si crystal has 5×10^{28} atom m^{-3}. It is doped by 1 ppm concentration of pentavalent As. Calculate the number of electrons and holes. Given that $n_i = 1.5 \times 10^{16} \, \text{m}^{-3}$.

26.

(i) A point charge q moving with speed v enter a uniform magnetic field B that is acting into the plane of the paper a shown. What is the path followed by the charge q and in which plane does it move ?

(ii) How does the path followed by the charge get affected if its velocity has a component parallel to $\vec{B}$?

(iii) If a electric field $\vec{E}$ is also applied such that the particle continues moving along the original straight line path, what should be the magnitude and direction of the electric field $\vec{E}$?

27. A light ray entering a right-angled prism undergoes refraction at the face AC as shown in fig.

Fig. 1
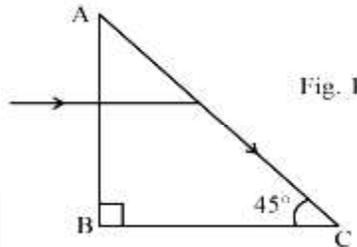
(i) What is the refractive index of the material of the prism in fig.

(ii) (a) If the side AC of the above prism is now surrounded by a liquid of refractive index $\dfrac{2}{\sqrt{3}}$, as shown in fig. Determine if the light ray continues to graze along the interface AC or undergoes total internal reflection or undergoes refraction into the liquid.

Fig. 2
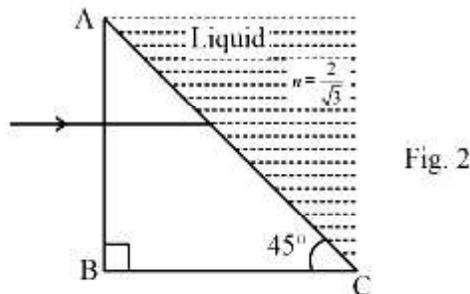
28. (a) Define electric flux and write it SI unit.

(b) Use Gauss law to obtain the expression for the electric field due to a uniformly charged infinite plane sheet of charge.
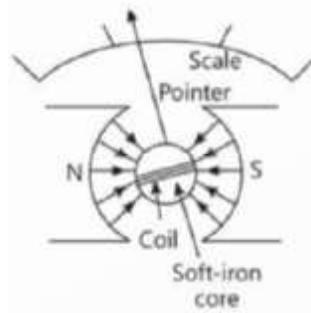
SECTION - D

29. **Read the following paragraph and answer the questions that follow.**

Moving coil galvanometer operates on Permanent Magnet Moving Coil (PMMC) mechanism and was designed by the scientist d'Arsonval. Moving coil galvanometers are of two types:

(I) Suspended coil

(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.

(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, a coil of N-turns of area A and carrying current I is placed in a radial field of strength B, experienced torque is:

(a) NA^2B^21 (b) $NABI^2$ C. N^2ABI (d) $NABI$

OR

To increase the current sensitivity of a moving coil galvanometer, we should decrease:

(a) strength of magnet   (b) torsional constant of spring

(c) number of turns in coil   (d) area of coll

30. **Read the following paragraph and answer the questions that follow.**

Types of Lenses and their combination

A convex or converging lens is thicker at the centre than at the edges. It converges a beam of light on refraction through it. It has a real focus. Convex lens is of three types: Double convex lens, Plano convex lens and Concavo-convex lens.

Concave lens is thinner at the centre than at the edges. It diverges a beam of light on refraction through it. It has a virtual focus. Concave lenses are of three types: Double concave lens, Plano-concave lens and Convexo-concave lens.

When two thin lenses of focal lengths f_1 and f_2 are placed in contact with each other along their common principal axis, then the two lens system is regarded as a single lens of focal length f and

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$$

If several thin lenses of f_1, f_2, ...,f_n are placed in contact, then the effective focal length of the combination is given by

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + ... + \frac{1}{f_n}$$

and in terms of power, we can write $P = P_1 + P_2 + ... + P_n$

The value of focal length and power of a lens must be used with proper sign consideration.

(i) Two thin lenses are kept coaxially in contact with each other and the focal length of the combination is 80 cm. If the focal length of one lens is 20 cm, the focal length of the other would be

(a)-26.7 cm   (b) 60 cm   (c) 80 cm   (d) 30 cm

(ii) A spherical air bubble is embedded in a piece of glass. For a ray of light passing through the bubble, it behaves like a

(a) converging lens (b) diverging lens   (c) mirror   (d) thin plane sheet of glass

(iii) Lens generally used in magnifying glass is

(a) single concave lens

(b) single convex lens

(c) combination of convex lens of lower power and concave lens of lower focal length

(d) planoconcave lens

(iv) The magnification of an image by a convex lens is positive only when the object is placed

(a) at its focus F.   (b) between F and 2F.

(c) at 2F.   (d) between F and optical centre.

OR

(iv) A convex lens of 20 cm focal length forms a real image which is three times magnified. The distance of the object from the lens is

(a) 13.33 cm   (b) 14 cm   (c) 26.66 cm   (d) 25 cm

SECTION - E

31. (I) (a) Write two limitations of ohm's law. Plot their I-V characteristics.

(b) A heating element connected across a battery of 100 V having an internal resistance of 1Ω draws an initial current of 10 A at room temperature 20.0 °C which settles after a few seconds to a steady value. What is the power consumed by battery itself after the steady temperature of 320.0 °C is attained? Temperature coefficient of resistance averaged over the temperature range involved is 3.70×10^{-4} °C^{-1}.

OR

(II) (a) Using Kirchhoff'?s laws obtain the equation of the balanced state in Wheatstone bridge.

(b) A wire of uniform cross-section and resistance of 12 ohm is bent in the shape of circle as shown in the figure. A resistance of 10 ohms is connected to diametrically opposite ends C and D. A battery of emf 8V is connected between A and B. Determine the current flowing through arm AD.
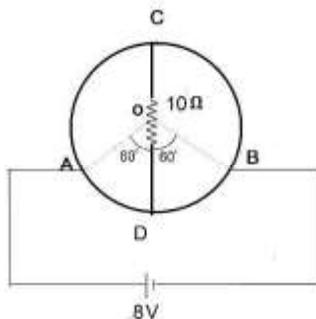
32. (I) Explain briefly, with the help of a labelled diagram, the basic principle of the working of an a.c. generator. In an a.c. generator, coil of N turns and area A is rotated at an angular velocity ? in a uniform magnetic field B. Derive an expression for the instantaneous value of the emf induced in coil. What is the source of energy generation in this device?

OR

(II) (a) With the help of a diagram, explain the principle of a device which changes a low ac voltage into a high voltage . Deduce the expression for the ratio of secondary voltage to the primary voltage in terms of the ratio of the number of turns of primary and secondary winding. For an ideal transformer, obtain the ratio of primary and secondary currents in terms of the ratio of the voltages in the secondary and primary coils.

(b) Write any two sources of the energy losses which occur in actual transformers.

(c) A step-up transformer converts a low input voltage into a high output voltage. Does it violate law of conservation of energy? Explain.

33. (a) Two convex lenses P and Q of an astronomical telescope having focal lengths 4 cm and 16 cm respectively are arranged as shown in the figure.

(i) Which one of the two lenses will you select to use as the objective lens and why ?

(ii) What should be the changes in the distance between the lenses to have the telescope in its normal adjustment position ?

(iii) Calculate the magnifiying power of the telescope in the normal adjustment position.

(b) Explain the basi differences between the contruction and working of a telescope and a microscope.

OR

(a) In Young's double slit experiment, deduce the conditions for obtaining contructive and destructive interference fringes. Hence, deduce the expression for the fringe width.

(b) Show that the fringe pattern on the screen i actually a superposition of single slit diffraction from each slit.

(c) What should be the width of each slit to obtain 10 maxima of the double slit pattern within the central maximum of the single slit pattern, for green light of wavelength 500 nm, if the separation between two slits is 1mm ?

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