SAMPLE PAPER TEST 02 FOR BOARD EXAM 2025

SUBJECT: PHYSICS **MAX. MARKS : 70**

CLASS : XII **DURATION: 3 HRS**

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. All the sections are compulsory.

3. Section A contains sixteen questions, twelve MCQ and four Assertion-Reasoning based questions 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 three long questions of five marks each and Section E contains two case study based questions of 4 marks each.

4. There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.

5. Use of calculators is not allowed.

SECTION – A

Questions 1 to 16 carry 1 mark each.

1. In the process of charging of a capacitor, the current produced between the plates of the capacitor is:

(a) $\mu_0 \frac{d\phi_E}{dt}$ (b) $\frac{1}{\mu_0}\frac{d\phi_E}{dt}$ (c) $\varepsilon_0 \frac{d\phi_E}{dt}$ (d) $\frac{1}{\varepsilon_0}\frac{d\phi_E}{dt}$

where symbols have their usual meanings.

2. The area of a square shaped coil is 10^{-2} m^2. Its plane is perpendicular to a magnetic field of strength 10^{-3} T. The magnetic flux linked with the coil is

(a) 10 Wb (b) 10^{-5} Wb (c) 10^5 Wb (d) 100 Wb

3. A particle of mass m and charge q moving with a uniform velocity $\vec{v} = v_{0x}\hat{i} + v_{0y}\hat{j}$ enters a region with a magnetic field $\vec{B} = B_0\hat{j}$. After some time, an electric field $\vec{E} = E_0\hat{j}$ is also switched on in the region. The resulting path described by the particle will be:

(a) a circle in x-z plane (b) a parabola in x-y plane

(c) a helix with constant pitch (d) a helix with increasing pitch

4. An electron experiences a force $(1.6\times10^{-16}N)\hat{i}$ in an electric field $\vec{E}$. The electric field $\vec{E}$ is :

(a) $(1.0\times10^3 \frac{N}{C})\hat{i}$ (b) $-(1.0\times10^3 \frac{N}{C})\hat{i}$ (c) $(1.0\times10^{-3} \frac{N}{C})\hat{i}$ (d) $-(1.0\times10^{-3} \frac{N}{C})\hat{i}$

5. At a certain temperature in an intrinsic semiconductor, the electrons and holes concentration is 1·5 x 10^{16} m^{-3}. When it is doped with a trivalent dopant, hole concentration increases to 4·5 x 10^{22} m^{-3}. In the doped semiconductor, the concentration of electrons (n_e) will be :

(a) 3 x 10^6 m^{-3} (b) 5 x 10^7 m^{-3} (c) 5 x 10^9 m^{-3} (d) 6·75 x 10^{38} m^{-3}

6. A voltage signal is described by:

$v = V_0$ *for* $0 \le t \le \frac{T}{2}$

$= 0$ *for* $\frac{T}{2} \le t \le T$

for a cycle. Its rms value is :

(a) $V_0/\sqrt{2}$ (b) V_0 (c) $V_0/2$ (d) $\sqrt{2}\,V_0$

7. In the wave picture of light, the intensity I of light is related to the amplitude A of the wave as:
(a) $I \propto \sqrt{A}$ (b) $I \propto A$ (c) $I \propto A^2$ (d) $I \propto 1/A^2$

8. An inductor, a capacitor and a resistor are connected in series across an ac source of voltage. If the frequency of the source is decreased gradually, the reactance of :
(a) both the inductor and the capacitor decreases.
(b) inductor decreases and the capacitor increases.
(c) both the inductor and the capacitor increases.
(d) inductor increases and the capacitor decreases.

9. A graph is plotted between the stopping potential (on y-axis) and the frequency of incident radiation (on x-axis) for a metal. The product of the slope of the straight line obtained and the magnitude of charge on an electron is equal to :
(a) h (b) h/c (c) 2h/c (d) h/2c

10. Light of frequency $6{\cdot}4 \times 10^{14}$ Hz is incident on a metal of work function 2·14 eV. The maximum kinetic energy of the emitted electrons is about :
(a) 0·25 eV (b) 0·51 eV (c) 1·02 eV (d) 0·10 eV

11. Which one of the following is not a scalar quantity?
(a) Electric field (b) Voltage (c) Resistivity (d) Power

12. The electromagnetic radiations used to kill germs in water purifiers are called :
(a) Infrared waves (b) X-rays (c) Gamma rays (d) Ultraviolet rays

ASSERTION-REASON BASED QUESTIONS

In the following questions, a statement of assertion (A) is followed by a statement of Reason (R). Choose the correct answer out of the following choices.
(a) Both Assertion (A) and Reason (R) are true and (R) is the correct explanation of (A).
(b) Both Assertion (A) and Reason (R) are true and (R) is NOT the correct explanation of (A).
(c) Assertion (A) is true and Reason (R) is false.
(d) Assertion (A) is false and Reason (R) is also false.

13. Assertion (A): The nucleus ${}^{7}_{3}X$ is more stable than the nucleus ${}^{4}_{3}Y$.
Reason (R): ${}^{7}_{3}X$ contains more number of protons.

14. Assertion (A): The internal resistance of a cell is constant.
Reason (R): Ionic concentration of the electrolyte remains same during use of a cell.

15. Assertion (A): When radius of a circular loop carrying a steady current is doubled, its magnetic moment becomes four times.
Reason (R): The magnetic moment of a circular loop carrying a steady current is proportional to the area of the loop.

16. Assertion (A): Thin films such as soap bubble or a thin layer of oil on water show beautiful colours when illuminated by white light.
Reason (R): It is due to interference of sun's light reflected from upper and lower surfaces of the film.

SECTION – B

Questions 17 to 21 carry 2 marks each.

17. The refractive indices of two media A and B are 2 and $\sqrt{2}$ respectively. What is the critical angle for their interface?

18. Explain the property of a p-n junction which makes it suitable for rectifying alternating voltages. Differentiate between a half-wave and a full-wave rectifier.

19. What is meant by the term 'displacement current' ? Briefly explain how this current is different from a conduction current.

20. A wire of length *l* is in the form of a circular loop A of one turn. This loop is reshaped into loop B of three turns. Find the ratio of the magnetic fields at the centres of loop A and loop B for the same current through them.

21. (a) State Huygens' principle. How did Huygens explain the absence of the backwave?

OR

(b) Use Huygens' principle to show reflection/refraction of a plane wave by (i) concave mirror, and (ii) a convex lens.

SECTION – C

Questions 22 to 28 carry 3 marks each.

22. Draw a diagram to show the variation of binding energy per nucleon with mass number for different nuclei and mention its two features. Why do lighter nuclei usually undergo nuclear fusion ?

23. (a) An ac source $v = v_m \sin\omega t$ is connected across an ideal capacitor. Derive the expression for the (i) current flowing in the circuit, and (ii) reactance of the capacitor. Plot a graph of current i versus ωt.

OR

(b) A series combination of an inductor L, a capacitor C and a resistor R is connected across an ac source of voltage in a circuit. Obtain an expression for the average power consumed by the circuit. Find power factor for (i) purely inductive circuit, and (ii) purely resistive circuit.

24. Explain the roles of diffusion current and drift current in the formation of the depletion layer in a p-n junction diode.

25. Calculate the wavelength of de Broglie waves associated with a proton having (500/1·673) eV energy. How will the wavelength be affected for an alpha particle having the same energy ?

26. What is meant by the term 'mutual inductance' of a pair of coils ? Obtain an expression for the mutual inductance of two long coaxial solenoids, each of length *l* but having different number of turns N_1 and N_2 and radii r_1 and r_2 ($r_2 > r_1$).

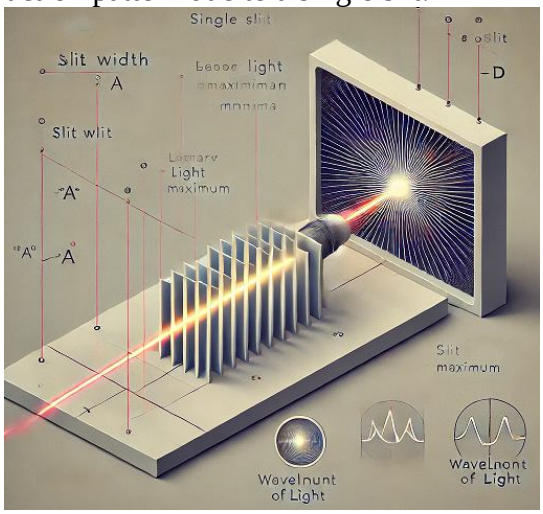
27. (i) Draw a graph to show the variation of the number of scattered particles detected (N) in Geiger-Marsden experiment as a function of scattering angle (θ).
(ii) Discuss briefly two conclusions that can be drawn from this graph and how they lead to the discovery of nucleus in an atom.

28. A potential difference V is applied across a conductor of length l and uniform cross-section area A. How will the (i) electric field E, (ii) drift velocity v_d, and (iii) current density j be affected when (a) V is doubled and (b) *l* is halved (keeping other factors constant) ?

SECTION – D (Case Study Based Questions)

Questions 29 to 30 carry 4 marks each.

29. Diffraction: Diffraction of light is bending of light around the corners of an object whose size is comparable with the wavelength of light. Diffraction actually defines the limits of ray optics. This limit for optical instruments is set by the wavelength of light. An experimental arrangement is set up to observe the diffraction pattern due to a single slit.



(i) The penetration of light into the region of geometrical shadow is called

(a) polarisation (b) interference (c) diffraction (d) refraction

(ii) To observe diffraction, the size of an obstacle

(a) should be of the same order as wavelength

(b) should be much larger than the wavelength

(c) have no relation to wavelength

(d) should be exactly $l/2$

(iii) Both, light and sound waves produce diffraction. It is more difficult to observe diffraction with light waves because

(a) light waves do not require medium (b) wavelength of light waves is too small

(c) light waves are transverse in nature (d) speed of light is far greater

(iv) Angular width of central maximum of a diffraction pattern of a single slit does not depend upon

(a) distance between slit and source (b) wavelength of light used

(c) width of the slit (d) frequency of light used

OR

The diffraction effect can be observed in

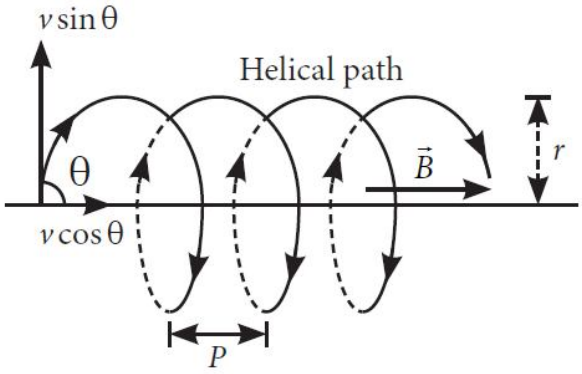
(a) only sound waves (b) only light waves

(c) only ultrasonic waves (d) sound as well as light waves

30. Helical Motion

The path of a charged particle in magnetic field depends upon angle between velocity and magnetic field.

If velocity v is at angle q to $\vec{B}$, component of velocity parallel to magnetic field (v cosθ) remains constant and component of velocity perpendicular to magnetic field (v sinθ) is responsible for circular motion, thus the charge particle moves in a helical path.



The plane of the circle is perpendicular to the magnetic field and the axis of the helix is parallel to the magnetic field. The charged particle moves along helical path touching the line parallel to the magnetic field passing through the starting point after each rotation.
Radius of circular path is r = mvsin-θ/qB
Hence the resultant path of the charged particle will be a helix, with its axis along the direction of $\vec{B}$ as shown in figure.
(i) When a positively charged particle enters into a uniform magnetic field with uniform velocity, its trajectory can be
(i) a straight line (ii) a circle (iii) a helix.
(a) (i) only (b) (i) or (ii) (c) (i) or (iii) (d) any one of (i), (ii) and (iii)

(ii) Two charged particles A and B having the same charge, mass and speed enter into a magnetic field in such a way that the initial path of A makes an angle of 30° and that of B makes an angle of 90° with the field. Then the trajectory of
(a) B will have smaller radius of curvature than that of A
(b) both will have the same curvature
(c) A will have smaller radius of curvature than that of B
(d) both will move along the direction of their original velocities.

(iii) An electron having momentum 2.4×10^{-23} kg m/s enters a region of uniform magnetic field of 0.15 T. The field vector makes an angle of 30° with the initial velocity vector of the electron. The radius of the helical path of the electron in the field shall be
(a) 2 mm (b) 1 mm (c) $\sqrt{3}/2$ mm (d) 0.5 mm

(iv) The magnetic field in a certain region of space is given by $\vec{B} = 8.35\times10^{-2}\hat{i}$ T. A proton is shot into the field with velocity $\vec{v} = (2\times10^{5}\hat{i} + 4\times10^{5}\hat{j})$ m/s. The proton follows a helical path in the field. The distance moved by proton in the x-direction during the period of one revolution in the yz-plane will be
(Mass of proton = 1.67×10^{-27} kg)
(a) 0.053 m (b) 0.136 m (c) 0.157 m (d) 0.236 m

SECTION – E

Questions 31 to 33 carry 5 marks each.

31. (a) (i) Draw a ray diagram showing the formation of a real image of an object placed at a distance 'v' in front of a concave mirror of radius of curvature 'R'. Hence, obtain the relation for the image distance 'v' in terms of u and R.
(ii) A 1·8 m tall person stands in front of a convex lens of focal length 1 m, at a distance of 5 m. Find the position and height of the image formed.

OR

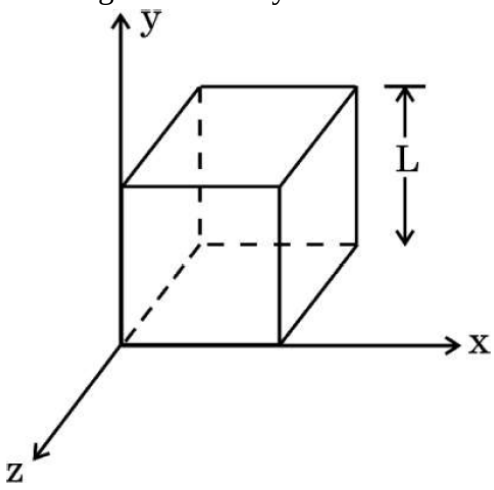
(b) (i) Draw a ray diagram showing refraction of a ray of light through a triangular glass prism. Hence, obtain the relation for the refractive index (μ) in terms of angle of prism (A) and angle of minimum deviation (δ_m).

(ii) The radii of curvature of the two surfaces of a concave lens are 20 cm each. Find the refractive index of the material of the lens if its power is –5·0 D.

32. (a) (i) Define electric flux and write its SI unit.

(ii) Use Gauss' law to obtain the expression for the electric field due to a uniformly charged infinite plane sheet.

(iii) A cube of side L is kept in space, as shown in the figure. An electric field $\vec{E} = (Ax + B)\hat{i}\frac{N}{C}$ exists in the region. Find the net charge enclosed by the cube.



OR

(b) (i) Define electric potential at a point and write its SI unit.

(ii) Two capacitors are connected in series. Derive an expression of the equivalent capacitance of the combination.

(iii) Two point charges + q and –q are located at points (3a, 0) and (0, 4a) respectively in x-y plane. A third charge Q is kept at the origin. Find the value of Q, in terms of q and a, so that the electrostatic potential energy of the system is zero.

33. (a) (i) Write the principle and explain the working of a moving coil galvanometer. A galvanometer as such cannot be used to measure the current in a circuit. Why ?

(ii) Why is the magnetic field made radial in a moving coil galvanometer ? How is it achieved ?

OR

(b) (i) Derive an expression for magnetic field on the axis of a current carrying circular loop.

(ii) Write any two points of difference between a diamagnetic and a paramagnetic substance.