SAMPLE PAPER TEST 01 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

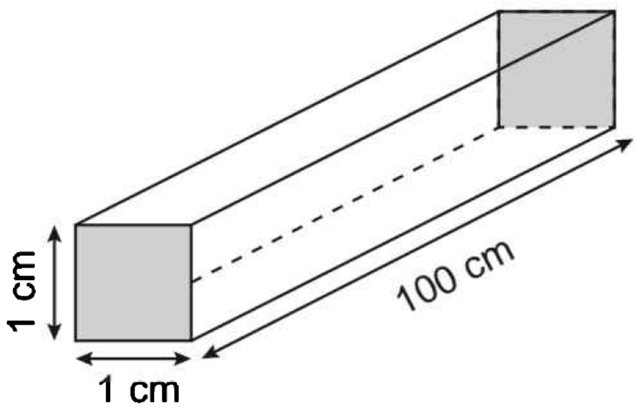
Questions 1 to 16 carry 1 mark each.

1. The current density due to drift of electrons in a conductor is given by: (symbols have their usual meanings)

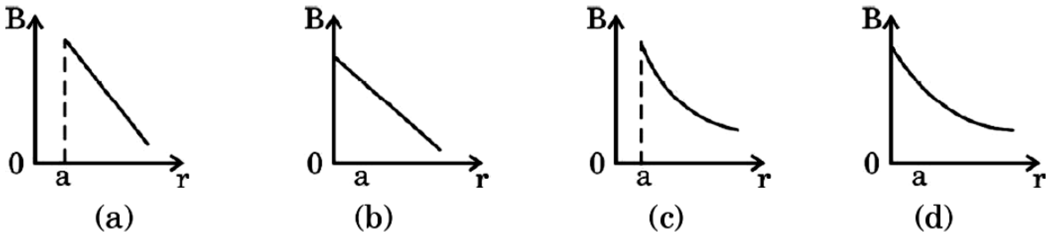
(a) $neAv_d$ (b) $\frac{nAv_d}{e}$ (c) $\frac{nv_d}{eA}$ (d) nev_d

2. Dimensions of a block are l cm x l cm x 100 cm. If specific resistance of its material is 3×10^{-7} Ω m, then the resistance between the opposite rectangular faces is

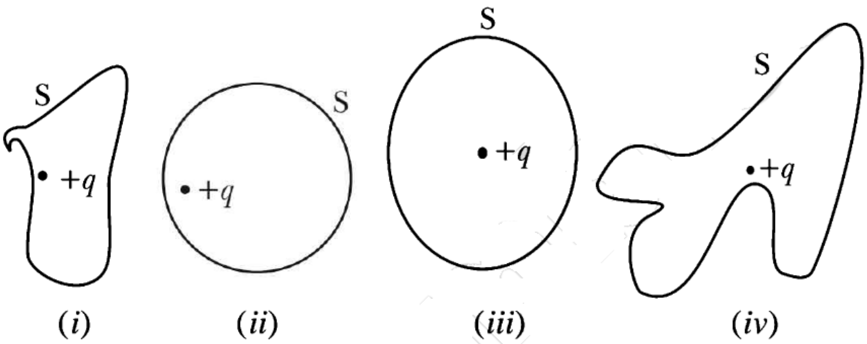
(a) 3×10^{-9} Ω (b) 3×10^{-7} Ω (c) 3×10^{-5} Ω (d) 3×10^{-3} Ω



3. Which of the following graphs correctly represents the variation of the magnitude of the magnetic field outside a straight infinite current carrying wire of radius 'a', as a function of distance 'r' from the centre of the wire ?

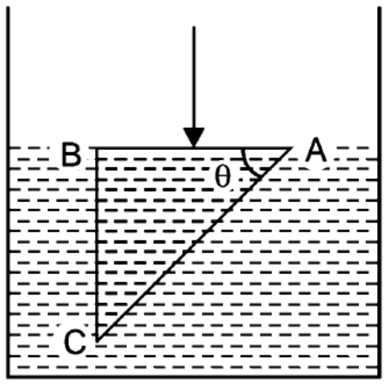


4. The Electric flux through the surface



(a) in Fig.(iv) is the largest.
(b) in Fig.(iii) is the least.
(c) in Fig.(ii) is same as Fig.(iii) but is smaller than Fig. (iv)
(d) is the same for all the figures.

5. A glass prism of refractive index 1-5 is immersed in water (refractive index 4/3), A light beam incident normally on the face AB (fig. shown) is totally reflected to reach the face BC if

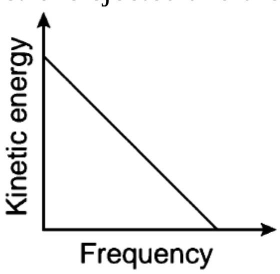


(a) sinθ > 8/9 (b) 2/3 < sinθ < 8/9 (c) sinθ ≤ 2/3 (d) none of the above

6. A point charge situated at a distance 'r' from a short electric dipole on its axis, experiences a force $\vec{F}$. If the distance of the charge is '2r', the force on the charge will be:

(a) $\frac{\vec{F}}{16}$ (b) $\frac{\vec{F}}{8}$ (c) $\frac{\vec{F}}{4}$ (d) $\frac{\vec{F}}{2}$

7. According to Einstein's photoelectric equation, the graph between the kinetic energy of photoelectrons ejected and the frequency of incident radiation is

(a)


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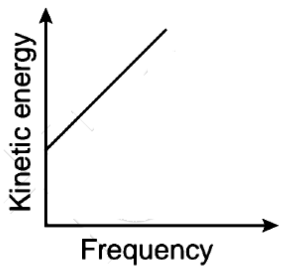
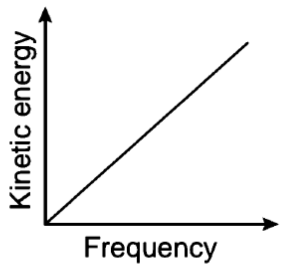
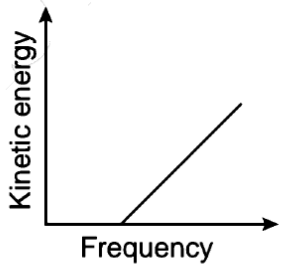


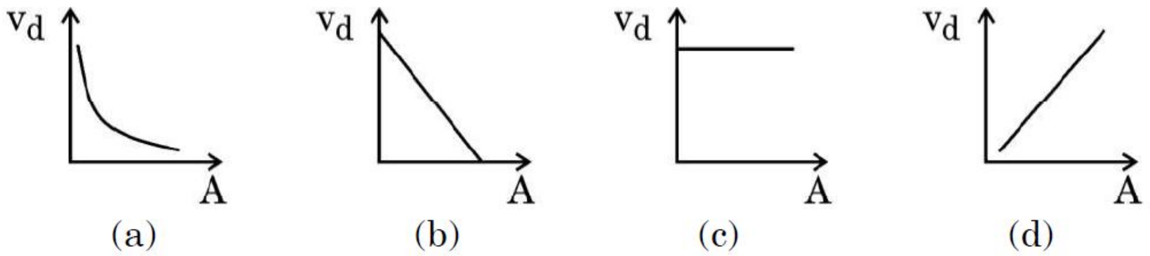
(c)


(d)


8. Consider sunlight incident on a slit of width 10^4 Å. The image seen through the slit shall
(a) be a fine sharp slit white in colour at the center.

(b) a bright slit white at the center diffusing to zero intensities at the edges.
(c) a bright slit white at the center diffusing to regions of different colours.
(d) only be a diffused slit white in colour.

9. A steady current flows through a metallic wire whose area of cross-section (A) increases continuously from one end of the wire to the other. The magnitude of drift velocity (v_d) of the free electrons as a function of 'A' can be shown by:



10. In Bohr's model of hydrogen atom, the total energy of the electron in nth discrete orbit is proportional to
(a) n (b) 1/n (c) n^2 (d) $1/n^2$

11. An electron is released from rest in a region of uniform electric and magnetic fields acting parallel to each other. The electron will
(a) move in a straight line. (b) move in a circle.
(c) remain stationary. (d) move 1n a helical path.

12. The current in the primary coil of a pair of coils changes from 7A to 3A in 0.04 s. The mutual inductance between the two coils is 0.5 H. The induced emf in the secondary coil is
(a) 50 V (b) 75V (c) 100 V (d) 220 V

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 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.

13. Assertion (A): If a proton and an electron a replaced in the same uniform electric field, they experience different acceleration.
Reason (R): Electric force on a test charge is independent of its mass.

14. Assertion (A) : Thermonuclear fusion reactions may become the source of unlimited power for the mankind.
Reason (R): A single fusion event involving isotopes of hydrogen produces more energy than energy from nuclear fission of $^{235}_{93}U$

15. Assertion (A): Thin film such as soap bubble or a thin layer of oil on water shows beautiful colors when illuminated by white light.
Reason (R): It happens due to the interference of light reflected from the upper surface of the thin film.

16. Assertion (A): When a charged particle moves in a circular path, it produces electromagnetic wave.
Reason (R) : Charged particle has acceleration.

SECTION – B

Questions 17 to 21 carry 2 marks each.

17. Briefly explain how the diffusion and drift currents contribute to the formation of potential barrier in a p-n junction diode.

18. A 100 W sodium lamp radiates energy uniformly in all directions. The lamp is located at the centre of a large sphere that absorbs all the sodium light which is incident on it. The wavelength of the sodium light is 589 nm.
(i) What is the energy associated per photon with sodium light?
(ii) At what rate are the photons delivered to the sphere?

OR

If light of wavelength 412.5 nm is incident on each of the metals given below, which ones will show photoelectric emission and why?

Metal	Work Function (eV)
Na	1.92
K	2.15
Ca	3.20
Mo	4.17

19. What are optical fibres? Mention their one practical application.

20. An alpha particle is projected with velocity $\vec{v}$ = $(3{\cdot}0 \times 10^5$ m/s) $\hat{i}$ into a region in which magnetic field $\vec{B}$ = $[(0.4T)\hat{i} + (0.3T)\hat{j}]$ exists. Calculate the acceleration of the particle in the region. $\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors along x, y and z axis respectively and charge to mass ratio for alpha particle is $4{\cdot}8 \times 10^7$ C/kg.

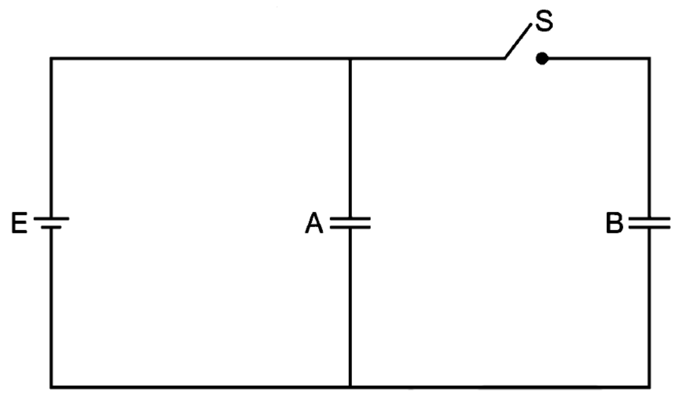
21. A slab of material of dielectric constant K has the same area as that of the plate of a parallel plate capacitor but has the thickness d/2, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor.

SECTION – C

Questions 22 to 28 carry 3 marks each.

22. (i) An infinitely long positively charged straight wire has a linear charge density λ cm^{-1}. An electron is revolving around the wire as its centre with a constant velocity in a circular plane perpendicular to the wire. Deduce the expression for its kinetic energy.
(ii) Plot a graph of the kinetic energy as a function of charge density A.

23. Two identical parallel plate capacitors A and B are connected to a battery of V volts with the switch S closed. The switch is now opened and the free space between the plates of the capacitors is filled with a dielectric of dielectric constant K. Find the ratio of the total electrostatic energy stored in both capacitors before and after the introduction of the dielectric.



24. (a) How does the resistance differ from impedance? With the help of a suitable phasor diagram, obtain an expression for impedance of a series LCR circuit, connected to a source $v = v_m \sin \omega t$.

OR

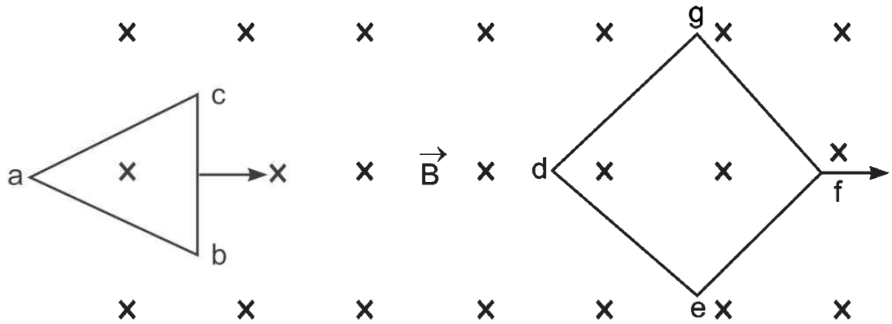
(b) Find the condition for resonance in a series LCR circuit connected to a source $v_m \sin \omega t$., where can be varied. Give the factors on which the resonant frequency of a series LCR circuit depends. Plot a graph showing the variation of electric current with frequency in a series LCR circuit.

25. A capacitor of unknown capacitance, a resistor of 100 Q and an inductor of self inductance $L\left(=\frac{4}{\pi^2}\right)$ henry are connected in series to an ac source of 200 V and 50 Hz. Calculate the value of the capacitance and impedance of the circuit when the current is in phase with the voltage. Calculate the power dissipated in the circuit.

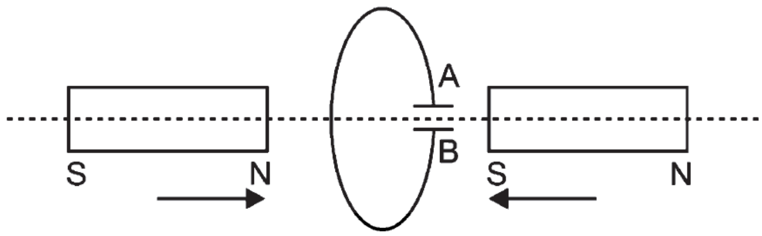
26. Draw a graph showing the variation of binding energy per nucleon as a function of mass number A. The binding energy per nucleon for heavy nuclei (A > 170) decreases with the increase in mass number. Explain.

27. The focal length of a convex lens made of glass of refractive index (1.5) is 20 cm. What will be its new focal length when placed in a medium of refractive index 1.25? Is focal length positive or negative? What does it signify?

28. (i) Two loops of different shapes are moved in the region of a uniform magnetic field pointing downward. The loops are moved in the directions shown by arrows. What is the direction of induced current in each loop?



(ii) Predict the polarity of the capacitor C connected to coil, which is situated between two bar magnets moving as shown in figure.

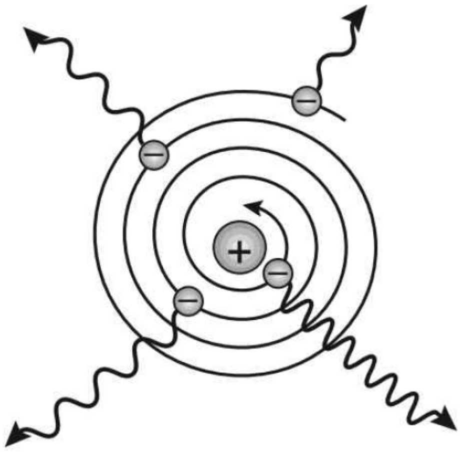


SECTION – D (Case Study Based Questions)

Questions 29 to 30 carry 4 marks each.

29. Case-Study 1: Read the following paragraph and answer the questions.

The Bohr Atom: Rutherford's model of the atom, although strongly supported by evidence for the nucleus, is inconsistent with classical physics. An electron moving ina circular orbit round a nucleus is accelerating and according to electromagnetic theory it should emit radiation continuously and so lose energy. If this happened the radius of the orbit would decrease and the electron would spiral into the nucleus. Evidently either this model of the atom or the classical theory of radiation requires modification.



In 1913, in an effort to overcome this paradox, Bohr, drawing inspiration from the success of the quantum theory in solving other problems involving radiation and atoms, made two revolutionary suggestions.

Electrons can revolve round the nucleus only in certain ‘allowed orbits’ and while they are in these orbits they do not emit radiation. An electron in an orbit has a definite amount of energy. It possesses kinetic energy because of its motion and potential energy on account of the attraction of the nucleus. Each allowed orbit is therefore associated with a certain quantity of energy, called the ‘energy of the orbit’, which equals the total energy of an electron in it.

An electron can ‘jump’ from one orbit of energy E_2 to another of lower energy E_1 and the energy difference is emitted as one quantum of radiation of frequency f given by Planck's equation

$E_2 – E_1 = hf$.

(*i*) According to Bohr’s model of hydrogen atom, an electron can revolve round a proton indefinitely, if its path is

(*a*) a perfect circle of any radius (*b*) a circle of constantly decreasing radius

(*c*) a circle of an allowed radius (*d*) an ellipse

(*ii*) In Bohr model of hydrogen atom, which of the following is quantised?

(*a*) Linear velocity of electron (*b*) Angular velocity of electron

(*c*) Linear momentum of electron (*d*) Angular momentum of electron

(*iii*) For an electron in the second orbit of hydrogen, what is the moment of momentum as per the Bohr’s model?

(*a*) $2ph$ (*b*) ph (*c*) h/p (*d*) $2h/p$

OR

An electron orbiting in H atom has energy level –3.4 eV. Its angular momentum will be

(*a*) 2.1×10^{-34} Js (*b*) 2.1×10^{-20} Js (*c*) 4×10^{-20} Js (*d*) 4×10^{-34} Js

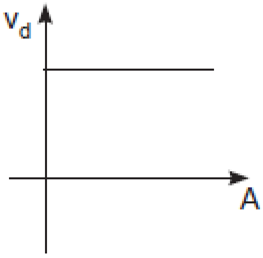
(*iv*) The Bohr’s model is applicable to which kind of atoms?

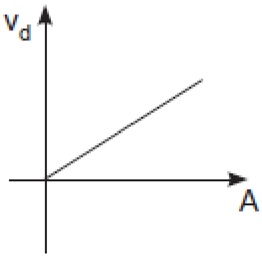
(*a*) Having one electron only (*b*) Having two electrons

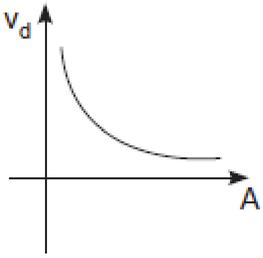
(*c*) Having eight electrons (*d*) Having more than eight electrons

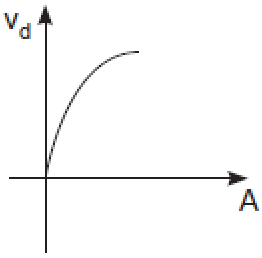
30. When a conductor does not have a current through it, its conduction electrons move randomly, with no net motion in any direction. When the current flows through the conductor, these electrons actually still move randomly, but now they tend to drift with the drift speed v_d. The drift speed is very less as compared to speeds in random thermal motion.

(i) A steady current I flows through a metallic conductor whose area of cross-section (A) increases continuously from one end to the other. The drift velocity of free electron (v_d) as a function of A will be:

(a) 

(b) 

(c) 

(d) 

(ii) For Ohm's law is obeyed, then what is the relation between electric field(E) and drift velocity (vd)?

(a) $v_d \propto E^2$
(b) $v_d \propto E$
(c) $v_d \propto \frac{E}{2}$
(d) $v_d \propto \sqrt{E}$

(iii) When a current flows in a conductor, the order of magnitude of drift velocity of electrons through it is

(a) 10^{-7} cm/s
(b) 10^{-2} cm/s
(c) 10^{4} mm/s
(d) 0.5 mm/s

(iv) Two nichrome wires of equal lengths but having radii in the ratio 1 : 3 are connected in series across an electric cell. The drift velocities of free electrons through them will be in the ratio of

(a) 3 : 1
(b) 1 : 3
(c) 4 : 9
(d) 9 : 1

SECTION – E

Questions 31 to 33 carry 5 marks each.

31. State the working of ac generator with the help of a labelled diagram. The coil of an ac generator having N turns, each of area A, is rotated with a constant angular velocity ω. Deduce the expression for the alternating emf generated in the coil. What is the source of energy generation in this device?

OR

(i) Draw a labelled diagram of a step-up transformer. Obtain the ratio of secondary to primary voltage in terms of number of turns and currents in the two coils.
(ii) A power transmission line feeds input power at 2200 V to a step-down transformer with its primary windings having 3000 turns. Find the number of turns in the secondary to get the power output at 220 V.

32. Draw a circuit diagram of a full wave rectifier. Explain the working principle. Draw the input/output waveforms indicating clearly the functions of the two diodes used.

OR

(i) Distinguish between an intrinsic semiconductor and a p-type semiconductor. Give reason why a p-type semiconductor is electrically neutral, although $n_h >> n_e$.
(ii) A semiconductor has equal electron and hole concentration of 2×10^8 m^{-3}. On doping with a certain impurity, the hole concentration increases to 4×10^{10} m^{-3},
(a) What type of semiconductor is obtained on doping?

(b) Calculate the new electron and hole concentration of the semiconductor.
(c) How does the energy gap vary with doping?

33. (a) (i) State Coulomb's law in electrostatics and write it in vector form, for two charges.
(ii) Gauss's law is based on the inverse-square dependence on distance contained in the Coulomb's law. Explain
(iii) Two charges A (charge q) and B (charge 2q) are located at points (0, 0) and (a, a) respectively. Let $\hat{i}$ and $\hat{j}$ be the unit vectors along x-axis and y-axis respectively. Find the force exerted by A on B, in terms of $\hat{i}$ and $\hat{j}$.

OR

(b) (i) Derive an expression for the electric field at a point on the equatorial plane of an electric dipole consisting of charges q and -q separated by a distance $2l$.
(ii) The distance of a far off point on the equatorial plane of an electric dipole is halved. How will the electric field be affected for the dipole ?
(iii) Two identical electric dipoles are placed along the diagonals of a square ABCD of side √2 m as shown in the figure. Obtain the magnitude and direction of the net electric field at the centre (O) of the square.