SAMPLE PAPER TEST 03 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.

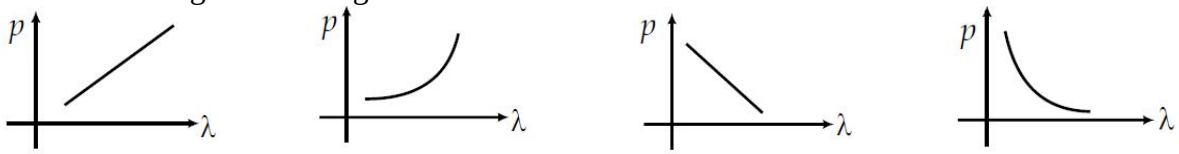
4. There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.

5. Use of calculators is not allowed.

SECTION – A

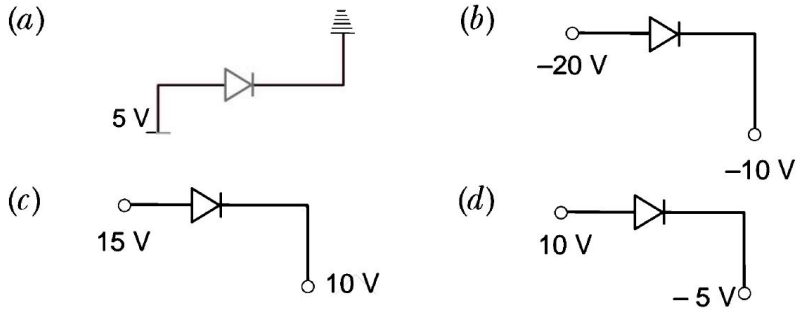
Questions 1 to 16 carry 1 mark each.

1. Which of the following graphs correctly represents the variation of a particle momentum with its associated de-Broglie wavelength?



(a) (b) (c) (d)

2. Which is reverse biased diode?



3. The capacitors, each of 4 μF are to be connected in such a way that the effective capacitance of the combination is 6 μF. This can be achieved by connecting

(a) All three in parallel

(b) All three in series

(c) Two of them connected in series and the combination in parallel to the third.

(d) Two of them connected in parallel and the combination in series to the third.

4. The radius of the nth orbit in Bohr model of hydrogen atom is proportional

(a) n^2 (b) $1/n^2$ (c) n (d) 1/n

5. A point charge is situated at an axial point of a small electric dipole at a large distance from it. The charge experiences a force F. If the distance of the charge is doubled, the force acting on the charge will become

(a) 2F (b) F/2 (c) F/4 (d) F/8.

6. In a dc circuit the direction of current inside the battery and outside the battery respectively are
(a) positive to negative terminal and negative to positive terminal
(b) positive to negative terminal and positive to negative terminal
(c) negative to positive terminal and positive to negative terminal
(d) negative to positive terminal and negative to positive terminal

7. The Young's double-slit experiment is performed with blue and green lights of wavelengths 4360 Å and 5460 Å respectively. If x is the distance of 4th maxima from the central one, then
(a) $(x)_{blue} = (x)_{green}$ (b) $(x)_{blue} > (x)_{green}$ (c) $(x)_{blue} < (x)_{green}$ (d) $\frac{(x)_{blue}}{(x)_{green}} = \frac{5460}{4360}$

8. In a Young's double-slit experiment, the screen is moved away from the plane of the slits. What will be its effect on the following?
(i) Angular separation of the fringes.
(ii) Fringe-width.
(a) Both (i) and (ii) remain constant. (b) (i) remains constant, but (ii) decreases.
(c) (i) remains constant, but (ii) increases. (d) Both (i) and (ii) increase.

9. A rectangular coil of length 0.12 m and width 0.1 m having 50 turns of wire is suspended vertically in a uniform magnetic field of strength 0.2 Weber/m?. The coil carries a current of 2 A. If the plane of the coil is inclined at an angle of 30^0 with the direction of the field, the torque required to keep the coil in stable equilibrium will be
(a) 0.24 Nm (b) 0.12 Nm (c) 0.15 Nm (d) 0.20 Nm

10. The ratio of the nuclear densities of two nuclei having mass numbers 64 and 125 is
(a) 64/125 (b) 4/5 (c) 5/4 (d) 1

11. A hydrogen atom makes a transition from n = 5 to n = 1 orbit. The wavelength of photon emitted is λ. The wavelength of photon emitted when it makes a transition from n = 5 to n = 2 orbit is
(a) 8λ/7 (b) 16λ/7 (c) 24λ/7 (d) 32λ/7

12. Which of the following has its permeability less than that of free space?
(a) Copper (b) Aluminium (c) Copper chloride (d) Nickel

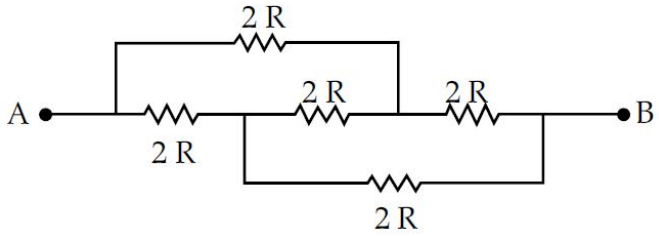
ASSERTION-REASON BASED QUESTIONS

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 resistance of an intrinsic semiconductor decreases with increase in its temperature.
Reason (R): The number of conduction electrons as well as hole increase in an intrinsic semiconductor with rise in its temperature.

14. Assertion (A) : Susceptibility is defined as the ratio of intensity of magnetisation *I* to magnetic intensity H.
Reason (R) : Greater the value of susceptibility, smaller the value of intensity of magnetisation *I*.

15. Assertion (A): The equivalent resistance between points A and B in the given network is 2R.
Reason (R): All the resistors are connected in parallel



16. Assertion (A): An electron and a photon possessing same wavelength, will have the same momentum.
Reason (R): Momentum of both particle is same by de Broglie hypothesis.

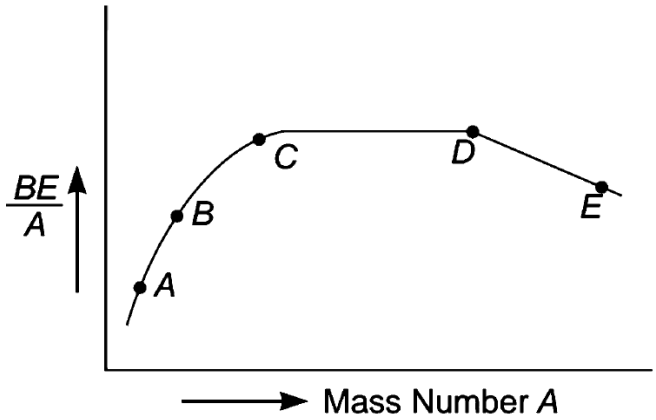
SECTION – B

Questions 17 to 21 carry 2 marks each.

17. (i) How are infrared waves produced? Write their one important use.
(ii) The thin ozone layer on top of the stratosphere is crucial for human survival. Why?

18. The potential difference applied across a given conductor is doubled. How will this affect (i) the mobility of electrons and (ii) the current density in the conductor? Justify your answers. 2

19. The figure shows the plot of binding energy (BE) per nucleon as a function of mass number A. The letters A, B, C, D and E represent the positions of typical nuclei on the curve. Point out, giving reasons, the two processes (in terms of A, B, C, D and E), one of which can occur due to nuclear fission and the other due to nuclear fusion.

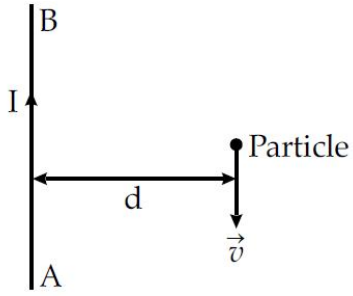


20. How would the stopping potential for a given photosensitive surface change if (i) the frequency of the incident radiation were increased? and (ii) the intensity of incident radiation were decreased? Justify your answer.

21. Write the expression for the Lorentz force on a particle of charge q moving with a velocity $\vec{v}$ in a magnetic field $\vec{B}$. When is the magnitude of this force maximum? Show that no work is done by this force on the particle during its motion from a point $\vec{r_1}$ to point $\vec{r_2}$.

OR

A long straight wire AB carries a current I. A particle (mass m and charge q) moves with a velocity $\vec{v}$, parallel to the wire, at a distance d from it as shown in the figure. Obtain the expression for the force experienced by the particle and mention its directions.



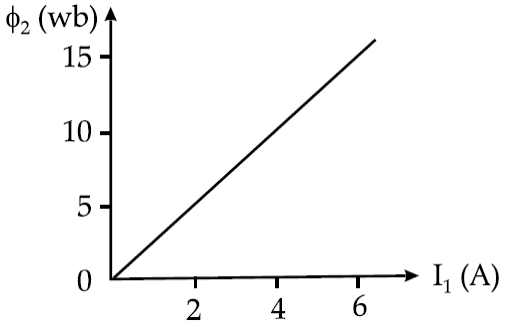
SECTION – C

Questions 22 to 28 carry 3 marks each.

22. Two coils C_1 and C_2 are placed close to each other. The magnetic flux ϕ_2 linked with the coil C_2 varies with the current I_1 flowing in coil C_1, as shown in the figure. Find

(i) the mutual inductance of the arrangement, and

(ii) the rate of change of current $\left(\frac{dI_1}{dt}\right)$ that will induce an emf of 100 V in coil C_2.



23. A plane wave-front propagating in a medium of refractive index 'μ_1' is incident on a plane surface making an angle of incidence (i). It enters into a medium of refractive index μ_2 ($\mu_2 > \mu_1$). Use Huygen's construction of secondary wavelets to trace the retracted wave-front. Hence, verify Snell's law of refraction.

24. (i) Differentiate between 'distance of closest approach' and 'impact parameter'.

(ii) Determine the distance of closest approach when an alpha particle of kinetic energy 3.95 MeV approaches a nucleus of Z = 79, stops and reverses its directions.

OR

(i) How is the size of a nucleus found experimentally? Write the relation between the radius and mass number of a nucleus.

(ii) Prove that the density of a nucleus is independent of its mass number.

25. A series CR circuit with R = 200 W and C = (50/π) μF is connected across an ac source of peak voltage ε_0, = 100 V and frequency n = 50 Hz. Calculate (a) impedance of the circuit (Z), (b) phase angle (ϕ), and (c) voltage across the resistor.

26. Define current density and relaxation time. Derive an expression for resistivity of a conductor in terms of number density of charge carriers in the conductor and relaxation time.

27. Depict the orientation of an electric dipole in (a) stable and (b) unstable equilibrium in an external uniform electric field. Write the potential energy of the dipole in each case.

28. State the basic principle behind the working of an ac generator. Briefly describe its working and obtain the expression for the instantaneous value of emf induced.

SECTION – D (Case Study Based Questions)

Questions 29 to 30 carry 4 marks each.

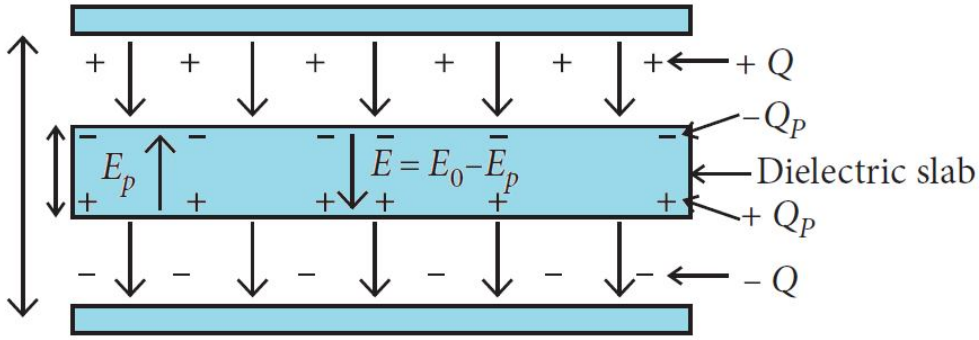
29. Case-Study 1:

Read the following paragraph and answer the questions

Dielectric Slab

A dielectric slab is a substance which does not allow the flow of charges through it but permits them to exert electrostatic forces on one another.

When a dielectric slab is placed between the plates, the field E_0 polarises the dielectric. This induces charge $-Q_p$ on the upper surface and $+Q_p$ on the lower surface of the dielectric. These induced charges set up a field E_p inside the dielectric in the opposite direction of $\overrightarrow{E_0}$ as shown.



(i) In a parallel plate capacitor, the capacitance increases from 4μF to 80μF, on introducing a dielectric medium between the plates. What is the dielectric constant of the medium?

(a) 10 (b) 20 (c) 50 (d) 100

(ii) A parallel plate capacitor with air between the plates has a capacitance of 8 pF. The separation between the plates is now reduced half and the space between them is filled with a medium of dielectric constant 5. Calculate the value of capacitance of the capacitor in second case.

(a) 8 pF (b) 10 pF (c) 80 pF (d) 100 pF

(iii) A dielectric introduced between the plates of a parallel plate condenser

(a) decreases the electric field between the plates (b) increases the capacity of the condenser

(c) increases the charge stored in the condenser (d) increases the capacity of the condenser

(iv) A parallel plate capacitor of capacitance 1 pF has separation between the plates is *d*. When the distance of separation becomes 2*d* and wax of dielectric constant *x* is inserted in it the capacitance becomes 2 pF. What is the value of *x*?

(a) 2 (b) 4 (c) 6 (d) 8

OR

(v) A parallel plate capacitor having area A and separated by distance d is filled by copper plate of thickness b. The new capacity is

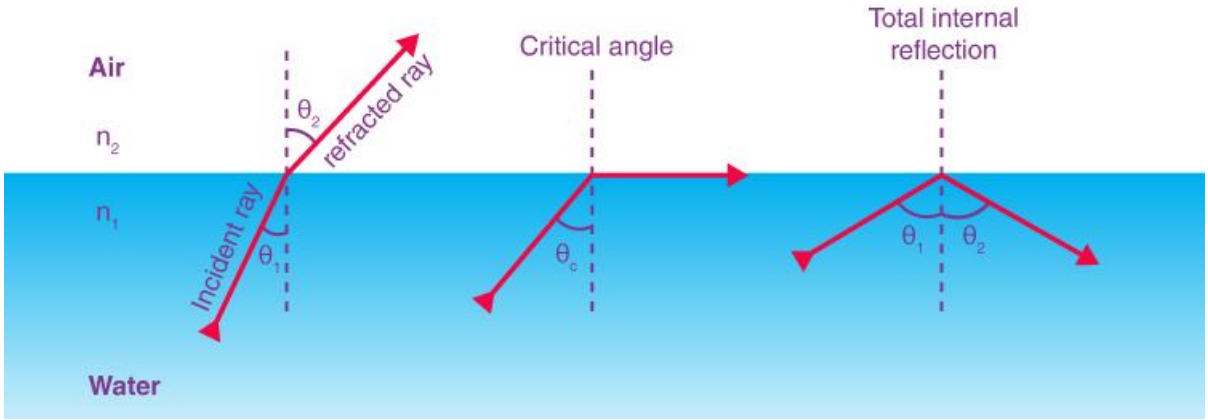
(a) $\frac{\varepsilon_0 A}{d+\frac{b}{2}}$ (b) $\frac{\varepsilon_0 A}{2d}$ (c) $\frac{\varepsilon_0 A}{d-b}$ (d) $\frac{2\varepsilon_0 A}{d+\frac{b}{2}}$

30. Case-Study 2:

Read the following paragraph and answer the questions.

Total Internal Refraction

Total internal reflection is the phenomenon of reflection of light into denser medium at the interface of denser medium with a rarer medium. For this phenomenon to occur necessary condition is that light must travel from denser to rarer and angle of incidence in denser medium must be greater than critical angle (C) for the pair of media in contact. Critical angle depends on nature of medium and wavelength of light. We can show that $\mu = \frac{1}{\sin C}$.



(i) Critical angle for glass air interface, where m of glass is 3/2, is
(a) 41.8° (b) 60° (c) 30° (d) 15°

(ii) Critical angle for water air interface is 48.6°. What is the refractive index of water?
(a) 1 (b) 3/2 (c) 4/3 (d) 3/4

(iii) Critical angle for air water interface for violet colour is 49°. Its value for red colour would be
(a) 49° (b) 50° (c) 48° (d) cannot say

(iv) Which of the following is not due to total internal reflection?
(a) Working of optical fibre. (b) Difference between apparent and real depth of a pond.
(c) Mirage on hot summer days. (d) Brilliance of diamond.

OR

(v) Critical angle of glass is θ_1 and that of water is θ_2. The critical angle for water and glass surface would be ($\mu_g = 3/2$, $\mu_w = 4/3$).
(a) less than θ_2 (b) between θ_1 and θ_2 (c) greater than θ_2 (d) less than θ_1

SECTION – E

Questions 31 to 33 carry 5 marks each.

31. (i) State Huygen's principle. With the help of a diagram, show how a plane wave is reflected from a surface. Hence, verify the law of reflection.
(ii) A concave mirror of focal length 12 cm forms a three times magnified virtual image of an object. Find the distance of the object from the mirror.

OR

(i) Draw a labelled ray diagram showing the image formation by a refracting telescope. Define its magnifying power. Write two limitations of a refracting telescope over a reflecting telescope.
(ii) The focal lengths of the objective and the eye-piece of a compound microscope are 1.0 cm and 2.5 cm respectively. Find the tube length of the microscope for obtaining a magnification of 300.

32. (i) Explain how free electrons in a metal at constant temperature attain an average velocity under the action of an electric field. Hence obtain an expression for it.
(ii) Consider two conducting wires A and B of the same diameter but made of different materials joined in series across a battery. The number density of electrons in A is 1.5 times that in B. Find the ratio of drift velocity of electrons in wire A to that in wire B.

OR

(i) A cell emf of (E) and internal resistance (r) is connected across a variable load resistance (R). Draw plots showing the variation of terminal voltage V with (i) R and (ii) the current (I) in the load.
(ii) Three cells, each of emf E but internal resistances 2r, 3r and 6r are connected in parallel across a resistor R.
Obtain expressions for (i) current flowing in the circuit, and (ii) the terminal potential difference across the equivalent cell.

33. Draw the circuit arrangement for studying V-I characteristics of a p-n junction diode in (i) forward biasing and (ii) reverse biasing. Draw the typical V-I characteristics of a silicon diode. Describe briefly the following terms: (i) minority carrier injection in forward biasing and (ii) breakdown voltage in reverse biasing.

OR

Name two important processes involved in the formation of a p-n junction diode. With the help of a circuit diagram, explain the working of junction diode as a full wave rectifier. Draw its input and output waveforms. State the characteristic property of a junction diode that makes it suitable for rectification.