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CLASS – XII
SUB – PHYSICS

PRE-BOARD 2025 – 26

FM – 70
TIME – 3 HR

SECTION A (MCQ)

General Instructions:

Read the following instructions carefully and follow them:

- There are 33 questions in all. All questions are compulsory.
- This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
- All the sections are compulsory.
- Section A contains sixteen questions, twelve MCQs 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 two case-study-based questions of four marks each and Section E contains three long-answer questions of five marks each.
- There is no overall choice. However, an internal choice has been provided in two questions in Section B, one question in Section C and all three questions in Section E. You have to attempt only one of the choices in such questions.
- Use of calculators is not allowed.
- You may use the following values of physical constants wherever necessary:

$$c = 3 \times 10^8 \text{ ms}^{-1}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

$$m_p = 1.7 \times 10^{-27} \text{ kg}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T mA}^{-1}$$

$$h = 6.63 \times 10^{-34} \text{ J s}$$

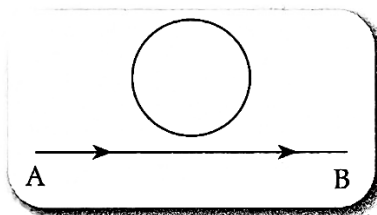
$$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$$

$$\text{Avogadro's number} = 6.023 \times 10^{23} \text{ mol}^{-1}$$

SECTION A

- If an electric dipole of moment \vec{p} is placed in an electric field of strength \vec{E} , then which of the following gives the potential energy of the dipole?
(a) $\vec{p} \cdot \vec{E}$ (b) $-\vec{p} \cdot \vec{E}$ (c) $|\vec{p} \times \vec{E}|$ (d) $-\vec{p} \times \vec{E}$ 1 Min R [E] [1]
- The time taken by AC of 50 Hz to reach from zero to the maximum value is:
(a) $50 \times 10^{-3} \text{ s}$ (b) $5 \times 10^{-3} \text{ s}$ (c) $1 \times 10^{-3} \text{ s}$ (d) $2 \times 10^{-3} \text{ s}$ 1 Min A [E] [1]
- In an AC circuit, the instantaneous values of e.m.f. and current are $E = 400 \sin 314t \text{ V}$ and $I = \sin\left(314t + \frac{\pi}{3}\right) \text{ A}$. The average power consumed in watts is?
(a) 200 (b) 25 (c) 100 (d) 300 2 Min A [E] [1]
- In the middle of the depletion layer of reversed-biased p - n junction, the
(a) electric field is zero. (b) potential is zero.
(c) potential is maximum. (d) electric field is maximum. 1 Min U [E] [1]
- A parallel beam is incident on a convex lens of focal length f . It is then put in contact with a concave lens of focal length $f/2$. What will happen to the image?
(a) Real, at $v = f/2$ (b) Real, at $v = f$ (c) Virtual, at $v = f/2$ (d) Virtual, at $v = f$ 2 Min A [E] [1]

6. Which of the following statements is true about the width of the central diffraction maximum in a single-slit diffraction pattern? 1 Min. U [E] [1]
- It increases when the width of the aperture increases.
 - It decreases when the width of the aperture increases.
 - It remains unchanged regardless of the aperture width.
 - It cannot be predicted from the aperture width.
7. Which of the following statements is true regarding the stability of a nucleus? 1 Min. R [E] [1]
- Binding energy alone determines the nuclear stability.
 - Binding energy per nucleon is a better indicator of nuclear stability than total binding energy.
 - Neither binding energy nor binding energy per nucleon is related to nuclear stability.
 - Only the number of protons and neutrons determines the nuclear stability.
8. The electron in a hydrogen atom makes a transition from an excited state to the ground state. Which of the following statements is true? 2 Min. A [M] [1]
- Its kinetic energy increases and its potential and total energies decrease.
 - Its kinetic energy decreases, potential energy increases and its total energy remains the same.
 - Its kinetic and total energies decrease and its potential energy increases.
 - Its kinetic, potential and total energies decrease.
9. If a charged particle enters perpendicularly into a uniform magnetic field, then which of the following statements is true? 2 Min. U [H] [1]
- Energy and momentum both remain constant.
 - Energy remains constant but momentum changes.
 - Both energy and momentum change.
 - Energy changes but momentum remains constant.
10. A positively charged particle moves along the line AB, which lies in the same plane of a circular loop of conducting wire, as shown in the figure below. Which of the following statements is true? 2 Min. A [M] [1]



- The current induced will be anticlockwise.
 - The current induced will be clockwise.
 - No current will be induced in the loop.
 - The current induced in the loop will change its direction as the charged particle passes by.
11. Given a current carrying wire of non-uniform cross-section. Which of the following is constant throughout the length of the wire? 2 Min. A [M] [1]
- Current, electric field and drift speed
 - Drift speed only
 - Current and drift speed
 - Current only
12. A long wire carries a steady current. It is bent into a circle of one turn and the magnetic field at the centre of the coil is B . It is then bent into a circular loop of n turns. The magnetic field at the centre of the coil will be 5 Min. Ap [D] [1]
- nB
 - n^2B
 - $2nB$
 - $2n^2B$

For Questions 13 to 16, two statements are given: one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options given below.

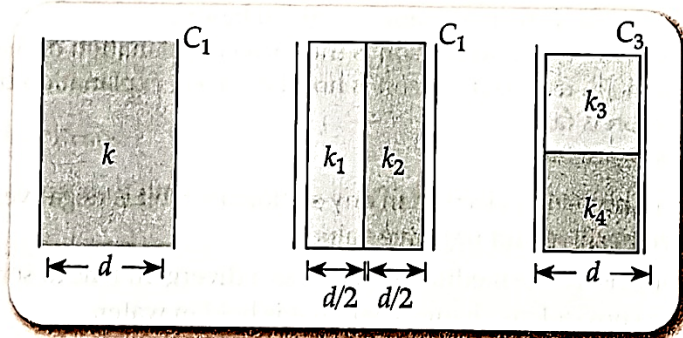
- Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
 - Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion.
 - Assertion is true, but Reason is false.
 - Both Assertion and Reason are false.
13. Assertion (A): Total energy of revolving electron in any stationary orbit is negative.
Reason (R): Energy can have positive and negative values. 1 Min. U [E] [1]
14. Assertion (A): A convergent lens in one medium behaves as a divergent lens in some other medium.
Reason (R): Focal length of a convex lens changes, when it is held in water. 2 Min. U [E] [1]
15. Assertion (A): The diffraction of light at a slit is more clearly visible when the slit width is increased.
Reason (R): On increasing slit width, the width of central maximum increases. 2 Min. A [E] [1]
16. Assertion (A): No work is done in moving a test charge inside a charged conductor.
Reason (R): Electric potential at any point inside the charged conductor is the same as that on the surface. 2 Min. U [M] [1]

SECTION B

17. Draw the energy band diagrams of (a) n -type and (b) p -type semiconductors at temperature, $T > 0$ K. 5 Min. R [E] [2]
18. A 9 V battery is connected in series with a resistor. The terminal voltage is found to be 8 V. The current through the circuit is measured as 10 A. What is the internal resistance of the battery? 3 Min. Ap [E] [2]
19. Calculate the mutual inductance between two coils when a current of 8 A changes to 4 A in 2 s and induces an emf of 20 mV in the secondary coil. 4 Min. Ap [E] [2]
20. (I) A circular coil of 20 turns and radius 10 cm is placed in uniform magnetic field of 0.10 T normal to the plane of the coil. If the current in the coil is 5 A, then calculate the torque acting on the coil. 4 Min. Ap [E] [2]
OR
(II) Write any four important properties of the magnetic field lines due to a bar magnet. 5 Min. R [E] [2]
21. (I) Draw a graph showing the variation of binding energy per nucleon versus the mass number A . 4 Min. R [E] [2]
OR
(II) An α -particle and a proton are accelerated through the same potential difference. Calculate the ratio of linear momenta acquired by the two. 4 Min. Ap [M] [2]

SECTION C

22. Which of the following, if any, can act as a source of electromagnetic waves? Explain with reason. 5 Min. U & R [E] [3]
- (i) A charge moving with a constant velocity.
(ii) A charge moving in a circular orbit.
(iii) A charge at rest.
23. Two cells of different emfs and internal resistances are connected in series. Find expressions for the equivalent emf and equivalent internal resistance of the combination. 7 Min. C [E] [3]
24. State Bohr's postulate to define stable orbits in a hydrogen atom. How does de Broglie's hypothesis explain the stability of these orbits? 5 Min. R & A [M] [3]
25. Draw a diagram of an astronomical telescope in its normal adjustment. Given the focal length of the objective lens is 15 m and that of the eyepiece is 10 cm. Calculate:
(i) The length of the telescope.
(ii) Magnification. 8 Min. R & A [E] [3]
26. A plane wavefront propagating from a denser to a rarer medium is incident at an angle of incidence i on a refracting surface. Draw a diagram showing the incident wavefront and the refracted wavefront. Hence verify Snell's law of refraction. 6 Min. Ap [M] [3]
27. Three identical parallel plate (air) capacitors C_1, C_2, C_3 have capacitances C each. The space between their plates is now filled with dielectrics as shown. If all three capacitors still have equal capacitances, obtain the relation between the dielectric constants k_1, k_2, k_3 and k_4 . 6 Min. Ap [M] [3]



28. (I) (a) Write the expression for the magnetic force \vec{F} acting on a charged particle q moving with velocity \vec{v} in the presence of the magnetic field \vec{B} in a vector form.
(b) Show that no work is done and no change in the magnitude of the velocity of the particle is produced by this force.
(c) Define the unit of magnetic field. 5 Min. Ap [M] [3]

OR

(II) Show that a current loop behaves like a magnetic dipole and calculate its magnetic dipole moment.

5 Min. Ap [D] [3]

SECTION D

29. (i) A semiconductor diode consists of a p - n junction with metallic contacts at both ends to allow the application of an external voltage. It is a two-terminal electronic device. When the positive terminal of a battery is connected to the p -side and the negative terminal to the n -side, the diode is said to be forward biased. Conversely, when the n -side is connected to the positive terminal and the p -side to the negative terminal, the diode is reverse biased. An ideal diode exhibits zero resistance under forward bias and infinite resistance under reverse bias. In forward bias, the diode remains non-conductive up to a certain voltage, known as the knee voltage. Once this voltage is exceeded, the potential barrier is reduced significantly, allowing charge carriers to flow freely, resulting in a rapid increase in current with further increases in voltage.

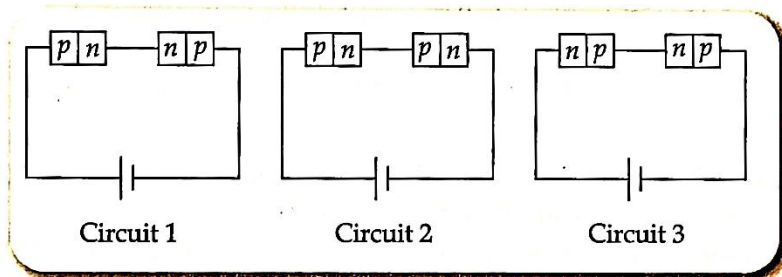
Under reverse bias, the diode blocks the flow of current, allowing only a very small leakage current known as the reverse saturation current, typically in the range of microamperes. This current remains nearly constant regardless of the reverse bias voltage applied.

15 Min. Ap [M] [4]

(I) A silicon diode is connected in series with a resistor of $200\ \Omega$ and a DC source of 6.7 V . The forward voltage drop across the diode is 0.7 V . Calculate the power dissipated in the resistor.

- (a) 0.18 W (b) 0.20 W (c) 0.25 W (d) 0.28 W [1]

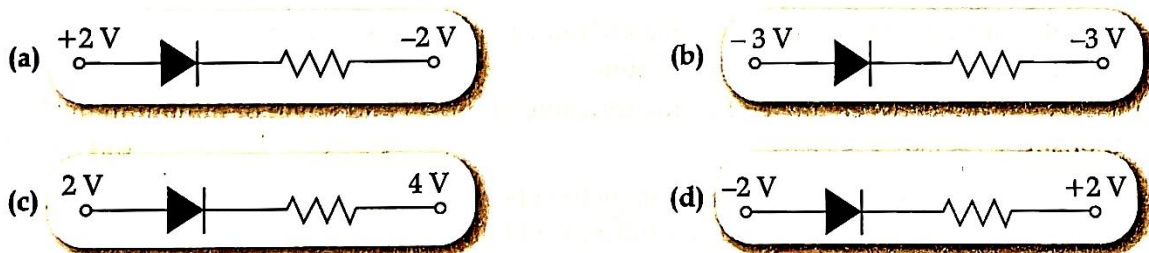
(II) Two identical p - n junctions may be connected in series with a battery in three ways, as shown in figure.



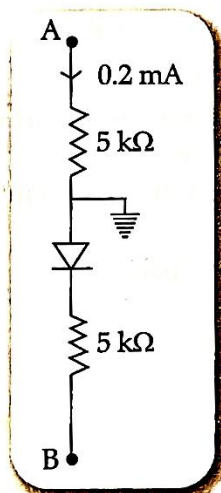
The potential drops across the two p - n junctions are equal in:

- (a) Circuit 1 and Circuit 2 (b) Circuit 2 and Circuit 3 (c) Circuit 3 and Circuit 1 (d) Circuit 1 only [1]

(III) The forward-biased diode connection is:



(IV) In the circuit shown in figure, if the diode forward voltage is 0.5 V , the voltage difference between A and B is:



- (a) 1.5 V (b) 2.5 V (c) 0 V (d) 0.5 V [1]

30. A student is analysing the results of a photoelectric experiment conducted on two different photosensitive metals, Metal P and Metal Q. They plot a graph of the stopping potential (V_0) versus the frequency (f) of the incident radiation for both metals. The graphs are straight lines, parallel to each other, but with different intercepts on the y-axis. The intercept for Metal P is less negative than that for Metal Q. The experiment is performed under ideal conditions. 15 Min. A & Ap [M] [4]

- (i) Based on the graph, what can be inferred about the work functions of Metal P and Metal Q? Explain your reasoning. [2]
- (ii) If the intensity of the incident radiation is doubled for Metal P, how would it affect the threshold frequency? [1]
- (iii) If the accelerating potential for a free electron is increased from V to $4V$, how does its de Broglie wavelength change? [1]

SECTION E

31. (I) (a) State Gauss's theorem in electrostatics.

- (b) Using Gauss's theorem, find an expression for the electric field intensity due to uniformly charged infinite plane sheet.
- (c) Two charges of magnitudes $-2Q$ and $+Q$ are located at points $(a, 0)$ and $(4a, 0)$ respectively. What is the electric flux due to these charges through a sphere of radius $3a$ with its centre at the origin? 10 Min. R & U [E] [5]

OR

(II) A parallel-plate capacitor is charged by a battery which is then disconnected. A dielectric slab is then inserted to fill the space between the plates. Explain the changes, if any, that occur in the values of (a) charge on the plates, (b) electric field between the plates, (c) potential difference between the plates, (d) capacitance and (e) energy stored in the capacitor. 10 Min. A [M] [5]

32. (I) A slit of width 0.6 mm is illuminated by a beam of light consisting of two wavelengths, 720 nm and 480 nm . The diffraction pattern is observed on a screen 1.0 m from the slit. Find:

- (a) The distance of the second bright fringe from the central maximum pertaining to light of 720 nm .
- (b) The least distance from the central maximum at which bright fringes due to both the wavelengths coincide.
- (c) Draw the graph showing intensity distribution of fringes with phase angle due to diffraction through a single slit. 12 Min. U & Ap [M] [5]

OR

(II) (a) For same value of angle of incidence, the angles of refraction in three media are 15° , 30° and 45° respectively. In which medium, the velocity of light will be minimum?

(b) Derive the relationship between angle of incidence, angle of prism and angle of minimum deviation for an equilateral prism. 12 Min. U & R [E] [5]

33. (I) (a) Distinguish between diamagnetic and ferromagnetic substances in respect of (i) intensity of magnetisation, (ii) behaviour in a non-uniform magnetic field and (iii) susceptibility.

(b) A magnet of magnetic moment 2.5 Am^2 weighs 62.5 g . If the density of the material of the magnet is 7500 kg m^{-3} , find the intensity of magnetisation. 10 Min. R & Ap [E] [5]

OR

(i) (a) Derive the lens maker's formula.

(b) Equi-convex lenses are to be manufactured from a glass of refractive index 1.55 , with both faces of the same radius of curvature. What is the radius of curvature required if the focal length is to be 10 cm ? [5]