Roll No. ☐☐☐☐☐☐☐☐

Q.P. Code 55/2/1

PHYSICS (THEORY)

CBSE Class XII Board Examination 2022 (Term 2)

Time allowed: 2 hours **Maximum Marks: 35**

General Instructions:

1. This Term-2 paper has 12 questions in three sections (A, B and C); all of them must be answered.
2. Section A: Q1–3, 2 marks each.
3. Section B: Q4–11, 3 marks each.
4. Section C: Q12 is a case-study based question of 5 marks.
5. There is no overall choice, but some questions offer an internal choice (OR); answer only one alternative. Log tables may be used; calculators are not allowed.
6. Constants you may use: $c = 3 \times 10^8$ m/s, $h = 6.63 \times 10^{-34}$ J s, $e = 1.6 \times 10^{-19}$ C, $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}, $\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2}, $1/(4\pi\varepsilon_0) = 9 \times 10^9$ N m^2 C^{-2}, $m_e = 9.1 \times 10^{-31}$ kg, $m_n = 1.675 \times 10^{-27}$ kg, $m_p = 1.673 \times 10^{-27}$ kg, Avogadro number = 6.023×10^{23} per gram mole, Boltzmann constant = 1.38×10^{-23} J K^{-1}.

SECTION A

Q1–3 carry 2 marks each.

1. How is the depletion region formed at a p-n junction? Explain. **2**

2. (i) In the Geiger–Marsden α-particle scattering experiment, what is meant by (a) impact parameter and (b) distance of closest approach? **2**
(ii) What is the impact parameter when the scattering angle is (I) $\theta = 0^\circ$ and (II) $\theta = 180^\circ$?

OR

A metal surface is irradiated with radiation of frequency ν_1 and then with radiation of frequency ν_2. The maximum kinetic energies of the photoelectrons are K and 2K respectively. Find an expression for the threshold frequency of the surface.

3. Explain how a solar cell produces an emf through its three basic processes. **2**

SECTION B

Q4–11 carry 3 marks each.

4. (i) Draw a sketch of a plane electromagnetic wave travelling along the x-axis and write expressions for its oscillating electric and magnetic fields. **3**

(ii) State three characteristics of electromagnetic waves.

OR

Identify the electromagnetic waves produced by each source below and give one use of each:

(i) radioactive decay of nuclei

(ii) welding arcs

(iii) hot bodies

---

5. (a) State the conditions needed for total internal reflection. **3**

(b) A tank holds a transparent liquid up to height H. A coin hanging from a thread is lowered slowly through the liquid until it reaches the bottom, and its apparent depth is measured for different real depths.

(i) Sketch the graph of apparent depth against real depth.

(ii) What does the slope of this graph physically represent?

---

6. Draw a labelled ray diagram for image formation by an astronomical (refracting) telescope in normal adjustment, and use it to derive its magnifying power. **3**

OR

Light of wavelength λ, as a plane wavefront, falls normally on a narrow single slit of width a, and the diffraction pattern is seen on a screen at distance D.

(i) Sketch the intensity distribution of the pattern.

(ii) Derive the position of the first secondary maximum measured from the central maximum.

---

7. A converging glass lens ($\mu = 1.5$) has spherical surfaces with radii of curvature 10 cm and 20 cm. Find its focal length (a) in air, and (b) when it is immersed in a liquid of refractive index 1.25. **3**

---

8. In the first excited state, a hydrogen atom has energy -3.4 eV. Find, for the electron in this orbit: **3**

(a) the orbit radius (Bohr radius = 0.53 Å)

(b) its angular momentum

(c) its kinetic energy and potential energy.

---

9. (a) Sketch how the potential energy of a pair of nucleons changes with the distance between them. **3**

(b) Suppose a $^{56}_{26}\mathrm{Fe}$ nucleus splits into two equal $^{28}_{13}\mathrm{Al}$ nuclei. Work out the Q value and decide whether this fission is energetically possible.

Given: m($^{56}_{26}\mathrm{Fe}$) = 55.93494 u, m($^{28}_{13}\mathrm{Al}$) = 27.98191 u.

10. Find the ratio of the de Broglie wavelength of an α-particle to that of a proton when both **3**

(a) move with the same speed,

(b) have the same kinetic energy,

(c) are accelerated through the same potential difference.

11. Using a circuit diagram, explain how p-n junction diodes work as a full-wave rectifier. Also sketch the input and output waveforms. **3**

SECTION C

Q12 is a case-study based question of 5 marks (five 1-mark MCQs).

12. *Thomas Young explained interference of light with the superposition principle. In his double-slit experiment, light from a single slit S illuminates two slits S_1 and S_2, and a pattern of bright and dark bands (fringes) appears on a screen; the spacing between consecutive bright (or dark) fringes is the fringe width.* **5**

(a) (a) If the screen is moved closer to the plane of the slits S_1 and S_2, the fringe width:

(A) decreases, but the intensity of the bright fringes stays the same

(B) increases, but the intensity of the bright fringes decreases

(C) decreases, but the intensity of the bright fringes increases

(D) and the intensity of the bright fringes both stay the same

(b) (b) What happens to the pattern on the screen if S_1 and S_2 are replaced by two independent but identical light sources?

(A) The intensity of the pattern increases **(B)** The intensity of the pattern decreases

(C) The number of fringes doubles **(D)** No pattern is seen on the screen

(c) (c) Two light sources are called coherent when the waves they emit have:

(A) the same amplitude and a varying phase difference

(B) the same wavelength and a constant phase difference

(C) different wavelengths and the same intensity

(D) different wavelengths and a constant phase difference

(d) (d) The fringe width is β in air. If the whole apparatus is immersed in a liquid of refractive index μ, the new fringe width is:

(A) β **(B)** $\beta\mu$

(C) $\frac{\beta}{\mu}$ **(D)** $\frac{\beta}{\mu^2}$

(e) (e) At points P_1 and P_2 on the screen, the path differences between the two interfering waves are $\frac{3\lambda}{2}$ and 2λ respectively. Then:

(A) bright fringes form at both points

(B) dark fringes form at both points

(C) a bright fringe forms at P_1 and a dark fringe at P_2

(D) a bright fringe forms at P_2 and a dark fringe at P_1

— END —

Questions restated from the CBSE Class XII Board Examination 2022 (set 55/2/1) for practice. Reading passages and map items are described, not reproduced.