

CBSE Class 12 Physics 2022 - 55/6/2 - Compartment



Question Paper

Conducted by the Central Board of Secondary Education (CBSE)

Time Allowed: 2 Hours

Maximum Marks: 35

General Instructions

- (i) This question paper contains **12 questions**. All questions are **compulsory**.
- (ii) The question paper is divided into Sections A, B, C.
- (iii) Section A - Questions 1 to 3 carry 2 marks each.
- (iv) Section B - Questions 4 to 11 carry 3 marks each.
- (v) Section C - Question 12 carries 5 marks.
- (vi) There is no overall choice. Where an internal choice is provided, attempt only one of the alternatives.
- (vii) Use of calculators is not permitted.

You may use the following values of physical constants wherever necessary:

$$\begin{aligned}c &= 3 \times 10^8 \text{ m/s} \\h &= 6.63 \times 10^{-34} \text{ Js} \\e &= 1.6 \times 10^{-19} \text{ C} \\\mu_0 &= 4\pi \times 10^{-7} \text{ T m A}^{-1} \\\epsilon_0 &= 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2} \\\frac{1}{4\pi\epsilon_0} &= 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}\end{aligned}$$

$$\begin{aligned}\text{Mass of electron } (m_e) &= 9.1 \times 10^{-31} \text{ kg} \\\text{Mass of neutron} &= 1.675 \times 10^{-27} \text{ kg} \\\text{Mass of proton} &= 1.673 \times 10^{-27} \text{ kg} \\\text{Avogadro's number} &= 6.023 \times 10^{23} \text{ per gm mole} \\\text{Boltzmann constant} &= 1.38 \times 10^{-23} \text{ JK}^{-1}\end{aligned}$$

Section A

1(a). In n-type semiconductors, explain how the crystal is electrically neutral although electrons are the majority carriers in it.

1(b). Write the conditions under which two light sources are said to be coherent.

2(a). (i) Long distance radio broadcasts use short-wave bands. Why?

(ii) The experimental demonstration of electromagnetic waves is possible only in the low frequency region (the radio wave region). Explain.

OR

2(b). (i) Draw a diagram showing a linearly polarized electromagnetic wave, propagating in the z -direction, depicting $\vec{E}$ and $\vec{B}$.

(ii) The wavelength of an electromagnetic wave is 10^{-10} m. Identify the wave and mention its one use.

3(a). In Geiger-Marsden experiment, the distance of closest approach is considerably larger than the sum of the radii of the gold nucleus and the α -particle. Explain.

3(b). The total energy of hydrogen atom in a state is -3.4 eV. What are the kinetic and potential energies of the electron in this state?

Section B

4(a). Explain why, in a single slit diffraction, at $\theta = \left(n + \frac{1}{2}\right) \frac{\lambda}{a}$, the secondary maxima becomes weaker and weaker as n increases. State two important differences between interference and diffraction patterns.

OR

4(b). A plane wavefront is incident on a surface separating two media of refractive indices n_1 and $n_2 (> n_1)$. With the help of a suitable diagram, explain its propagation from the rarer to denser medium. Hence, verify Snell's law.

5. In Young's double slit experiment, the slit separation is 1 mm and the screen is 1 m away from the slits. For a monochromatic light of wavelength 500 nm, find:

- (a) the distance of third minima, and
- (b) the distance of second maxima, from the central maxima.

6(a). Draw a ray diagram to show the formation of an image at the least distance of distinct vision, by a compound microscope. Hence, obtain an expression for its angular magnification.

OR

6(b). Consider a convex spherical surface of radius of curvature R , separating two media of refractive indices n_1 and $n_2 (> n_1)$. A point object is placed at a distance u in front of the surface in medium of refractive index n_1 . Its real image is formed at a distance v . Obtain a relation between u , v , n_1 , n_2 and R .

7(a). How did de Broglie hypothesis explain the quantisation of orbital angular momentum of the orbiting electron in a hydrogen atom, as postulated in the Bohr's second postulate? Discuss.

7(b). Identify the transition of electron in Bohr model which gives rise to (i) the maximum, and (ii) the minimum wavelength in Balmer series of hydrogen spectrum.

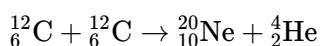
8(a). A proton and an α -particle are moving with the same speed. Which one of them has greater value of de Broglie wavelength associated with it? Justify your answer.

8(b). Lights of wavelengths 430 nm, 450 nm and 660 nm are incident on a metal surface whose threshold wavelength is 600 nm. In which case/cases will photoelectron emission take place and why? Calculate the threshold frequency of the metal surface.

9. Draw V-I characteristics of a p-n junction diode. Answer the following, giving reasons:

- (a) Why is the reverse bias current almost independent of applied voltage up to breakdown voltage?
- (b) Why does the reverse current show a sudden increase at breakdown voltage?

10(a). Determine from the given data, whether the following reaction is exothermic or endothermic:



Atomic masses: $m({}^4_2\text{He}) = 4.002603 \text{ u}$, $m({}^{12}_6\text{C}) = 12.000000 \text{ u}$, $m({}^{20}_{10}\text{Ne}) = 19.992439 \text{ u}$

10(b). What is the ratio of the nuclear densities of the phosphorus ${}^{30}_{15}\text{P}$ and nitrogen ${}^{14}_7\text{N}$?

11. Explain how the barrier potential is formed in a p-n junction. How is it affected in:

- (a) forward bias, and
- (b) reverse bias?

Section C

12. A lens is a portion of a transparent medium bounded by two surfaces, one of which is essentially spherical. It is used to converge or diverge the light incident on it. Power of a lens is the measure of its ability to converge or diverge the light incident on it. Power of a lens depends on the refractive index of the material of the lens with respect to the surrounding medium and the radii of curvature of its two surfaces.

12(a). The power of a convex lens:

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| (A) increases when the lens is dipped in water. | (B) increases when the wavelength of incident light decreases. |
| (C) decreases when another convex lens is placed in contact with it. | (D) increases when the lens is cut into two identical plano-convex lenses. |

12(b). The focal length of a concave lens is 40 cm. The power of the lens is:

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|--------------|------------|
| (A) 0.025 D | (B) 2.5 D |
| (C) -0.025 D | (D) -2.5 D |

12(c). The focal length of a concave lens ($\mu_g = 1.5$) in air is 20 cm. What should be the refractive index of the surrounding medium so that this lens behaves as a converging lens of focal length 60 cm?

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|---------|---------|
| (A) 1.4 | (B) 1.8 |
| (C) 1.7 | (D) 1.2 |

12(d). Beams of red light, blue light, yellow light and violet light are incident on a convex lens, one by one. Which one of these converges nearest to the lens?

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|----------------|------------------|
| (A) Blue light | (B) Violet light |
| (C) Red light | (D) Yellow light |

12(e). A beam of light coming parallel to the principal axis of a convex lens L_1 of focal length 15 cm is incident on it. Another convex lens L_2 of focal length 25 cm is placed coaxially at a distance d from L_1 . For the final image to be formed at infinity, the value of d should be:

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|-----------|-----------|
| (A) 10 cm | (B) 15 cm |
| (C) 25 cm | (D) 40 cm |

- End of Question Paper -