Objective Questions

(For Complete Chapter)

Multiple Choice Questions (MCQs)

1. A photocell connected in an electrical circuit is placed at a distance d from a source of light. As a result, current I flows in the circuit. What will be the current in the circuit when the distance is reduced to $d/2$? **All India 2020**

(a) I (b) $2I$

(c) $4I$ (d) $I / 2$

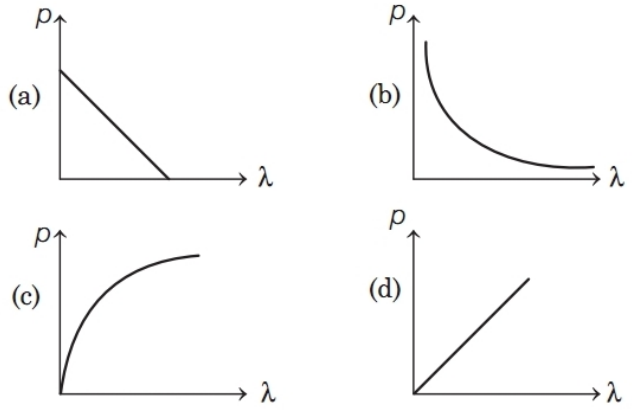
2. If photons of frequency ν are incident on the surfaces of metals A and B of threshold frequencies $\frac{\nu}{2}$ and $\frac{\nu}{3}$ respectively, the ratio of the maximum kinetic energy of electrons emitted from A to that from B is **Delhi 2020**

(a) 2 : 3 (b) 3 : 4
(c) 1 : 3 (d) $\sqrt{3}:\sqrt{2}$

3. The kinetic energy of a proton and that of an α-particle are 4 eV and 1 eV, respectively. The ratio of the de-Broglie wavelengths associated with them, will be **All India 2020**

(a) 2 : 1 (b) 1 : 1
(c) 1 : 2 (d) 4 : 1

4. The graph showing the correct variation of linear momentum (p) of a charge particle with its de-Broglie wavelength (λ) is **Delhi 2020**



5. The work function of a substance is 4 eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately

(a) 540 nm (b) 400 nm
(c) 310 nm (d) 220 nm

6. Sodium and copper have work functions 2.3 eV and 4.5 eV, respectively. Then, the ratio of their threshold wavelengths is nearest to

(a) 1 : 2 (b) 2 : 1 (c) 1 : 4 (d) 4 : 1

7. The energy of photon of light is 3 eV. Then, the wavelength of photon must be

(a) 4125 nm (b) 412.5 nm
(c) 41.250 nm (d) 4 nm

8. What is the de-Broglie wavelength of the electron accelerated through a potential difference of 10000 V?

(a) 12.27 Å (b) 1.227 Å
(c) 0.1227 Å (d) 0.001227 Å

9. If the momentum of an electron is changed by p, then the de-Broglie wavelength associated with it changes by 0.5%. The initial momentum of electron will be

(a) $200p$ (b) $400p$
(c) $\frac{p}{200}$ (d) $100p$

10. If the particles listed below all have the same kinetic energy, which one would possess the shortest de-Broglie wavelength?

(a) Deuteron (b) α-particle
(c) Proton (d) Electron

11. An electron and a proton are moving in the same direction with same kinetic energy. The ratio of the de-Broglie wavelength associated with these particles is

(a) $\frac{m_e}{m_p}$ (b) $\frac{m_p}{m_e}$ (c) $\sqrt{\frac{m_p}{m_e}}$ (d) $m_p m_e$

Assertion-Reason Questions

Directions (Q. Nos. 12-19) *In the following questions, two statements are given- one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below*

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both Assertion and Reason are incorrect.

12. **Assertion** Electromagnetic theory of light failed to explain photoelectric effect.

Reason Photoelectric effect can only be explained by assuming particle nature of light.

13. **Assertion** Photoelectric emission is an instantaneous process.

Reason There is very small time lag ($\sim 10^{-9}$s) between incidence of light and emission of photoelectron.

14. **Assertion** If distance of the point source is increased from the photoelectric plate, then stopping potential will remain unchanged.

Reason Saturation current will decrease.

15. **Assertion** For $\nu > \nu_0$ (threshold frequency), photoelectric current is proportional to intensity.

Reason Greater the number of energy quanta available, greater is the number of electrons absorbing the energy quanta and greater is the number of electrons coming out of the metal.

16. **Assertion** Photosensitivity of a metal is high, if its work-function is small.

Reason Work-function = $h\nu_0$, where ν_0 is the threshold frequency.

17. **Assertion** Light quantum of energy is associated with a photon.

Reason Light quantum of energy is also associated with momentum.

18. **Assertion** The photocells, which inserted in the door light electric circuit are used as automatic door opener.

Reason Abrupt change in photocurrent, helps to open the door.

19. **Assertion** Electron has the smallest wavelength as compare to proton and α-particle (if they have same kinetic energy).

Reason de-Broglie wavelength is inversely proportional to $(\text{mass})^{\frac{1}{2}}$.

Case Based Questions

Directions (Q.No. 20) *This question is case study based question. Attempt any 4 sub-parts from this question. Each question carries 1 mark.*

20. **Dual Nature of Matter**

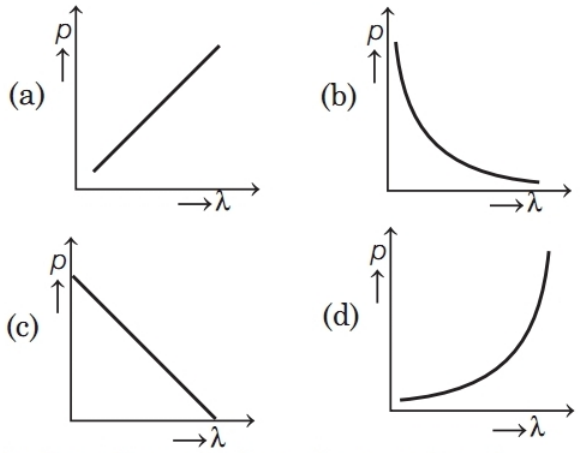
Matter cannot exist both as a particle and as a wave simultaneously. At a particular instant of time, it is either the one or the other aspect, i.e. the two aspects are complementary to each other.

According to de-Broglie, a wave is associated with moving material particle which controls the particle in every respect. The wave associated with moving material particle is called matter wave or de-Broglie wave whose wavelength is called de-Broglie wavelength.

(i) The de-Broglie wave of a moving particle does not depend on
(a) mass (b) charge
(c) velocity (d) momentum

(ii) The de-Broglie wavelength of a particle of KE, K is λ. What will be the wavelength of the particle, if it's kinetic energy is $\frac{K}{9}$?
(a) λ (b) 2λ
(c) 3λ (d) 4λ

(iii) Which of the following figures represent the variation of particle momentum and the associated de-Broglie wavelength?



(iv) de-Broglie wavelength associated with an electron, accelerating through a potential difference of 100 V lies in the region of
(a) Gamma rays
(b) X-rays
(c) Ultraviolet rays
(d) Visible region

(v) A proton and an α-particle are accelerated through the same potential difference. The ratio of de-Broglie wavelength λ_p to that of λ_α is

(a) $\sqrt{2}:1$ (b) $\sqrt{4}:1$

(c) $\sqrt{6}:1$ (d) $\sqrt{8}:1$