

Photoelectric Effect (Questions 14, 16, 17, 20, 24)

The **photoelectric effect** describes how electrons are ejected from a metal surface when it is illuminated by light of sufficient frequency.

- **Question 14:**

- The kinetic energy of the emitted electrons follows Einstein's equation:

$$E_k = h\nu - W$$

- A graph of E_k versus ν should be a straight line with a threshold frequency ν_0 below which no electrons are emitted.

- **Question 16:**

- The stopping potential V_s is given by:

$$eV_s = h(\nu - \nu_0)$$

- Changing the frequency of incident light affects V_s proportionally.

- **Question 17:**

- The work function W determines the threshold frequency ν_0 , and the stopping potential varies based on the incident wavelength.
- If light of wavelength λ gives stopping potential $3V_0$ and wavelength 2λ gives V_0 , we can calculate λ_0 , the threshold wavelength.

- **Question 20:**

- The kinetic energy of photoelectrons follows:

$$KE_{\max} = h\nu - W$$

- The threshold frequency can be determined based on the kinetic energy ratio.

- **Question 24:**

- Electrons are emitted only if the incident light's frequency is above a threshold, confirming that the correct answer relates to threshold frequency.

de Broglie Wavelength and Particle Motion (Questions 15, 18, 21)

- **Question 15:**

- Particles with the same de Broglie wavelength have different kinetic energies depending on mass:

$$\lambda = \frac{h}{\sqrt{2mE}}$$

- Since $m_\alpha > m_p > m_e$, the kinetic energy order is determined accordingly.

- **Question 18:**

- de Broglie wavelength is given by:

$$\lambda = \frac{h}{\sqrt{2mV}}$$

- The voltage ratio affects the wavelength inversely as the square root of the accelerating voltage.

- **Question 21:**

- The velocity of an electron emitted from an electron gun with potential V is given by:

$$\frac{1}{2}mv^2 = eV$$

- Solving for v , we find the correct speed.
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Photon and X-ray Properties (Questions 19, 22, 23)

- **Question 19:**

- Two different photon energies eject electrons; the ratio of their velocities follows kinetic energy equations.

- **Question 22:**

- The number of photoelectrons follows the **inverse square law**:

$$I \propto \frac{1}{r^2}$$

- Increasing the distance reduces the number of emitted electrons proportionally.

- **Question 23:**

- X-rays follow a range of wavelengths based on the accelerating voltage. The minimum wavelength corresponds to maximum photon energy.