Photoelectric Effect (Questions 4, 5, 7, 8, 9, 11, 12, 13)

The **photoelectric effect** refers to the emission of electrons from a metal surface when light of sufficient frequency is incident on it.

- **Question 4:**
  - The photocurrent depends on the number of emitted electrons, which in turn depends on the light frequency and intensity. If the wavelength (λ) decreases, the frequency increases, leading to more energetic electrons.
  - As λ decreases, the stopping potential increases, affecting the photocurrent.
- **Question 5:**
  - The speed of emitted electrons is given by:

$$v = \sqrt{\frac{2KE}{m}}$$

  - If the wavelength is changed from λ to 5λ/4, the energy changes accordingly, and the new speed follows the proportional relationship.
- **Question 7:**
  - The de Broglie wavelength relation connects photon and electron energy:

$$\lambda_e \propto \frac{1}{\sqrt{E}}, \quad \lambda_p \propto \frac{1}{E}$$

  - Thus, the correct proportionality is:

$$\lambda_p \propto \frac{1}{\sqrt{\lambda_e}}$$

- **Question 8:**
  - Work function (W) is the minimum energy required to eject an electron. If the work function increases, fewer electrons are emitted, reducing the current.
- **Question 9:**
  - Stopping potential (V_s) is the potential needed to stop the emitted electrons:

$$eV_s = h\nu - W$$

  - Given $W = 3.5$ eV, stopping potential is related to the incident energy.
- **Question 11:**
  - The stopping potential is related to the photoelectric equation:

$$eV_s = h(f - f_0)$$

  - Using given values, the threshold frequency can be calculated.

- **Question 12:**
  - The kinetic energy of the emitted electrons follows:

$$KE = h\nu - W$$

  - If incident energy increases by 20%, the kinetic energy increases, allowing for the calculation of work function.
- **Question 13:**
  - The maximum velocity of an electron follows from the energy equation:

$$KE_{\max} = \frac{1}{2}mv^2 = h\nu - W$$

Electric Fields & Motion of Charges (Question 10)

- The motion of an electron in an electric field follows the energy conservation equation:

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

- Given potential difference $V = 20V$, the speed of the electron when it reaches the other plate can be computed.

Photon Emission & Energy Calculations (Questions 6)

- The number of photons emitted per second is calculated using:

$$P = nh\nu$$

  - Given efficiency, we determine the actual number of photons emitted.