Work Function

Minimum energy required to just escape an electron from a metal surface.

$$\phi_0 = h\nu_0 = \frac{hc}{\lambda_0}$$

In electron volts (eV),

$$E(eV) = \frac{hc}{e\lambda}$$

$$= \frac{12375}{\lambda(\mathring{A})} = \frac{12400}{\lambda(\mathring{A})}$$

Photon

Tiny packets of light energy.
Energy of a photon:

$$E = h\nu$$

Mass of Photon

Rest mass of the photon is zero. But its effective mass:

$$E = mc^2 = h\nu$$

$$\Rightarrow m = \frac{E}{c^2} = \frac{h\nu}{c^2} = \frac{h}{c\lambda}$$

Also known as the kinetic mass of the photon.

Momentum of the Photon

$$p = m \times c$$

$$p = \frac{E}{c} = \frac{h\nu}{c} = \frac{h}{\lambda}$$

Einstein's Photoelectric Equation

$$K_{\text{max}} = \frac{1}{2}mv_{\text{max}}^2 = h(\nu - \nu_0) = h\nu - h\nu_0$$

$$K_{\text{max}} = hc\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$$

$$h\nu = h\nu_0 + K_{\text{max}}$$

$$K_{\text{max}} = eV_0\nu_{\text{max}} = \sqrt{\frac{2h(\nu - \nu_0)}{m}}$$

$$K_{\text{max}} = eV_0 = \frac{1}{2}mv_{\text{max}}^2 = eV_0$$

$$= hc\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right) = hc\left(\frac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$$

$$\nu_{\text{max}} = \frac{2hc(\lambda_0 - \lambda)}{m\lambda_0\lambda}$$

$$V_0 = \frac{h}{e}(\nu - \nu_0) = \frac{hc}{e}\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$$

$$= 12345\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right)$$

Dual Nature of Radiation and Matter

Light has a dual nature—wave and particle-like nature.