

Q 5 Consider a metal exposed to the light of wavelength 600 nm. The maximum energy of the electron doubles when the light of wavelength 400 nm is used. Find the work function in eV.

Sol. Let the maximum energies of emitted electrons are K_1 and K_2 when 600 nm and 400 nm visible light are used according to question

$$K_2 = 2K_1$$

$$K_{\max} = hv - \phi = \frac{hc}{\lambda} - \phi$$

$$k_1 = \frac{hc}{\lambda_1} - \phi$$

$$k_2 = \frac{hc}{\lambda_2} - \phi = 2K_1$$

$$\frac{hc}{\lambda_2} - \phi = 2 \left[\frac{hc}{\lambda_1} - \phi \right] = \frac{2hc}{\lambda_1} - 2\phi$$

$$\phi = hc \left[\frac{2}{\lambda_1} - \frac{1}{\lambda_2} \right] \quad (\because hc = 1240 \text{ eV nm})$$

$$\therefore \phi = 1240 \left[\frac{2}{600} - \frac{1}{400} \right] \text{ eV} = \frac{1240}{200} \left[\frac{2}{3} - \frac{1}{2} \right] = 6.2 \frac{(4-3)}{6}$$

$$\text{Work function } \phi = \frac{6.2}{6} = 1.03 \text{ eV}$$