ELECTRON PHOTON

(1) Data

$\phi = 2.3\,eV$

$\lambda = 6800\,\text{Å}$

Solution

$\phi = \frac{hc}{\lambda_0}$

$\therefore \lambda_0 = \frac{6.63\times10^{-34}\times3\times10^{8}}{2.3\times1.6\times10^{-19}}$

$= 5.405\times10^{-7}\,m$

$= 5405\,\text{Å}$

$\because \lambda > \lambda_0$

No photoelectric emission takes place

(2) Data

$\frac{1}{2} m v_{max}^2 = ?$

$\phi = 2.3\,eV$

$\nu = 3\times10^{15}\,Hz$

Solution

$K.E_{max} = h\nu - \phi$

$= \frac{6.63\times10^{-34}\times3\times10^{15}}{1.6\times10^{-19}} - 2.3$

$K.E_{max} = 12.43 - 2.3$

$= 10.13\,eV$

(3) Data

$\phi_p = 2.25\,eV$

$\phi_c = 2.14\,eV$

(a) $\lambda = 5650\,\text{Å}$

$\phi_p = \frac{hc}{\lambda_{0p}}$

$\therefore \lambda_{0p} = \frac{6.63\times10^{-34}\times3\times10^{8}}{2.25\times1.6\times10^{-19}}$

$= 5.525\times10^{-7}\,m$

$= 5525\,\text{Å}$

$\phi_c = \frac{hc}{\lambda_{0c}}$

$\therefore \lambda_{0c} = \frac{6.63\times10^{-34}\times3\times10^{8}}{2.14\times1.6\times10^{-19}}$

$= 5.809\times10^{-7}\,m$

$= 5809\,\text{Å}$

$\therefore \lambda = 5650\,\text{Å}$

$\lambda > \lambda_{0p}$ ∴ No photoelectric effect

& $\lambda < \lambda_{0c}$ ∴ Photoelectric effect will take place for caesium only

(b) $\lambda = 5180\ \text{Å}$

$\therefore \lambda < \lambda_0$

$\therefore$ photoelectric effect will take place for potassium.

& $\lambda < \lambda_0$

$\therefore$ photoelectric effect will take place for caesium also.

(4) ~~Data~~

$\phi = 4.5\ eV$

$v_{max} = ?$

$h\nu = 5.8\ eV$

Solution

$\frac{1}{2} m v_{max}^2 = h\nu - \phi$

$\frac{1}{2} m v_{max}^2 = 5.8 - 4.5$

$= 1.3\ eV$

$\therefore \frac{1}{2} m v_{max}^2 = 1.3 \times 1.6 \times 10^{-19}$

$v_{max}^2 = \frac{2 \times 1.3 \times 1.6 \times 10^{-19}}{9.1 \times 10^{-31}}$

$\therefore v_{max} = 676.1\ km/s$

(5) Data

$\phi = 1.8\ eV$

$V_s = ?$

$\lambda = 4000\ \text{Å}$

$v_{max} = ?$

Solution

$eV_s = h\nu - \phi$

$eV_s = \frac{hc}{\lambda} - \phi$

$eV_s = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{4000 \times 10^{-10} \times 1.6 \times 10^{-19}} - 1.8$

$= 3.108 - 1.8$

$eV_s = 1.308\ eV$

$\therefore V_s = 1.308\ V$

$\therefore V_s = -1.308\ V$

$eV_s = \frac{1}{2} m v_{max}^2$

$1.6 \times 10^{-19} \times 1.308 = \frac{1}{2} \times 9.1 \times 10^{-31} (v_{max}^2)$

$\therefore v_{max} = 678.2 \times 10^3\ m/s$

$= 678.2\ km/s$

(6) $\phi = 2.14\ eV$

$\nu_0 = ?$

$V_S = 0.60\ V$

$\lambda = ?$

Solution

(a) $\phi = h\nu_0$

$\nu_0 = \frac{2.14 \times 1.6 \times 10^{-19}}{6.63 \times 10^{-34}}$

$= 5.164 \times 10^{14}\ Hz$

(b) $eV_S = h\nu - \phi$

$1.6 \times 10^{-19} \times 0.6 = \left[\frac{6.63 \times 10^{-34} c}{\lambda}\right] - \left[\frac{2.14}{1.6 \times 10^{-19}}\right]$

$1.6 \times 10^{-19} \times 0.6 = \left[\frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{\lambda}\right] - [2.14 \times 1.6 \times 10^{-19}]$

$\lambda = 4.537 \times 10^{-7}\ m$

$\lambda = 4537\ \text{Å}$

(7) Data:

$\lambda_1 = 4950\ \text{Å}$

$V_{S_1} = 0.6\ V$

$V_{S_2} = 1.1\ V$

$\phi = ?$

$\lambda_2 = ?$

Solution

$eV_S = h\nu - \phi$

$eV_S = \frac{hc}{\lambda} - \phi$

$1.6 \times 10^{-19} \times 0.6 = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{4950 \times 10^{-10}} - \phi$

$\phi = 4.018 \times 10^{-19} - 0.96 \times 10^{-19}$

$\phi = 3.058 \times 10^{-19}\ J$

$\phi = \frac{3.058 \times 10^{-19}}{1.6 \times 10^{-19}}$

$= 1.911\ eV$

$eV_S = \frac{hc}{\lambda} - \phi$

$1.6 \times 10^{-19} \times 1.1 = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{\lambda_2} - 1.911 \times 1.6 \times 10^{-19}$

$\therefore \lambda_2 = 4.128 \times 10^{-7}\ m$

$\lambda_2 = 4128\ \text{Å}$

(8) Data

$\phi = 4.2 eV$

$v_s = ?$

$\lambda = 2000 \text{ Å}$

$\lambda_0 = ?$

Solution:

$$eV_s = \frac{hc}{\lambda} - \phi$$

$$eV_s = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{2000 \times 10^{-10} \times 1.6 \times 10^{-19}} - 4.2$$

$$eV_s = 6.216 - 4.2$$

$$eV_s = 2.016 \text{ eV}$$

$$V_s = 2.016 \text{ V}$$

$$\phi = \frac{hc}{\lambda_0}$$

$$\lambda_0 = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{4.2 \times 1.6 \times 10^{-19}}$$

$$= 2.959 \times 10^{-7} \text{ m}$$

$$= 2959 \text{ Å}$$