

NCERT Examples Chapter 11
Dual Nature of Radiation And Matter

Ex. 1. Given,

$$\nu = 6 \times 10^{14} \text{ Hz}$$

$$P = 2 \times 10^{-3} \text{ W}$$

(a) Energy of photon

$$E = h\nu$$

$$= 6.63 \times 10^{-34} \times 6 \times 10^{14}$$

$$= 39.78 \times 10^{-20} \text{ J}$$

$$E = 3.98 \times 10^{-19} \text{ J} \quad \underline{\underline{A}}$$

(b) Power emitted = $2 \times 10^{-3} \text{ W}$

No. of photons emitted per second, $N = ?$

$$P = NE$$

$$N = \frac{P}{E} = \frac{2 \times 10^{-3}}{3.98 \times 10^{-19}}$$

$$N = \frac{200 \times 10^{-3+19}}{3.98}$$

$$= \frac{2000 \times 10^{15}}{398}$$

$$N = 5.02 \times 10^{15} \text{ per second}$$

$$N \approx 5 \times 10^{15} / \text{sec} \quad \underline{\underline{A}}$$

Ex. 2 Given,

$$\phi_0 = 2.14 \text{ eV}$$

$$= 2.14 \times 1.6 \times 10^{-19} \text{ J}$$

$$\phi_0 = h\nu_0$$

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

$$\begin{aligned}
 \nu_0 &= \frac{2.14 \times 1.6 \times 10^{-19}}{6.63 \times 10^{-34}} \\
 &= \frac{2.14 \times 1.6}{6.63} \times 10^{-19+34} \\
 &= \frac{342.4}{6.63} \times 10^{15} \\
 &= \frac{3424}{663} \times 10^{14} \\
 \nu_0 &= 5.16 \times 10^{14} \text{ Hz}
 \end{aligned}$$

(b) Given,
stopping potential $V_0 = 0.60 \text{ V}$

$$\lambda = ?$$

$$eV_0 = h\nu - \phi_0$$

$$[K_{\max} = eV_0] \\ \text{as } v = 0$$

$$h\nu = eV_0 + \phi_0$$

$$\frac{hc}{\lambda} = eV_0 + \phi_0$$

$$\lambda$$

$$\frac{\lambda}{hc} = \frac{1}{eV_0 + \phi_0}$$

$$\lambda = \frac{hc}{eV_0 + \phi_0}$$

$$\lambda = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{1.6 \times 10^{-19} \times 0.60 + 2.14 \times 1.6 \times 10^{-19}}$$

$$= \frac{6.63 \times 3 \times 10^{-34+8}}{1.6 \times 10^{-19} (0.60 + 2.14)}$$

$$= \frac{6.63 \times 30 \times 10^{-26+19}}{1.6 \times 2.74}$$

$$= \frac{663 \times 30 \times 10^{-7}}{16 \times 274}$$

$$= \frac{19890 \times 10^{-7}}{4384}$$

$$= 4.54 \times 10^{-7}$$

$$= 454 \times 10^{-9} \text{ m}$$

$$\lambda = 454 \text{ nm}$$

Ans

Ex 3.

(a) For the electron

$$m = 9.1 \times 10^{-31} \text{ kg}$$

$$v = 5.4 \times 10^6 \text{ m/s}$$

$$\lambda = \frac{h}{p}$$

$$= \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{9.1 \times 10^{-31} \times 5.4 \times 10^6}$$

$$= \frac{6.63}{9.1 \times 5.4} \times 10^{-34+31-6}$$

$$= \frac{663}{91 \times 54} \times 10^{-9}$$

$$= \frac{663}{4914} \times 10^{-9}$$

$$= \frac{663}{4914} \times 10^{-9}$$

$$\lambda = 1.35 \times 10^{-10} \text{ m}$$

$$= 0.135 \times 10^{-9} \text{ m}$$

$$\lambda = 0.135 \text{ nm} \quad \underline{A.}$$

$$\begin{array}{r} 4914 \overline{) 6630} \quad (1.35 \\ \underline{4914} \\ 17160 \\ \underline{14742} \\ 24480 \end{array}$$

(b) For the ball

$$m = 150 \text{ g} = 150 \times 10^{-3} \text{ kg}$$

$$v = 30.0 \text{ m/s}$$

$$\lambda = \frac{h}{mv}$$

$$= \frac{6.63 \times 10^{-34}}{150 \times 10^{-3} \times 3000}$$

$$= \frac{221 \times 10^{-34}}{15 \times 3 \times 10}$$

$$= \frac{221}{15} \times 10^{-35}$$

$$= 14.7 \times 10^{-35}$$

$$\lambda = 1.47 \times 10^{-34} \text{ m}$$

* For electron $\lambda = 0.135 \text{ nm}$

* For ball $\lambda = 1.47 \times 10^{-34} \text{ m} \quad \underline{A}$