

CHAPTER-3

X-RAYS

$$2.1 \quad \frac{hc}{\lambda} = \Delta E \Rightarrow \lambda = \frac{hc}{\Delta E} = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{16000 \times 1.6 \times 10^{-19}} \text{ m} = 7.76 \times 10^{-11} \text{ m} = 0.78 \text{ \AA}$$

$$2.2 \quad v = 50000 \text{ V}$$

$$\frac{1}{2}mv_m^2 = qV$$

$$v_m = \sqrt{\frac{2qV}{m}} = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 50000}{9.11 \times 10^{-31}}} \text{ m/s} = 1.32 \times 10^8 \text{ m/s}$$

$$\lambda_{\min} = \frac{12400}{V} \text{ \AA} = \frac{12400}{50000} \text{ \AA} = 0.25 \text{ \AA}$$

$$2.3 \quad \lambda_{\min} = 0.5 \text{ \AA}$$

$$V = \frac{12400}{\lambda_{\min}} = \frac{12400}{0.5} \text{ V} = 24.8 \text{ kV}$$

$$2.4 \quad \lambda_{1\text{swl}} - \lambda_{2\text{swl}} = 0.2 \text{ \AA}, \quad \frac{V_2}{V_1} = 3$$

$$\lambda_{\text{swl}} = \frac{12400}{V} \text{ \AA} \Rightarrow \frac{\lambda_{1\text{swl}}}{\lambda_{2\text{swl}}} = \frac{V_2}{V_1} = 3 \Rightarrow \lambda_{1\text{swl}} = 3\lambda_{2\text{swl}}$$

$$\lambda_{1\text{swl}} - \lambda_{2\text{swl}} = 0.2 \text{ \AA} \Rightarrow \lambda_{1\text{swl}} - \frac{\lambda_{1\text{swl}}}{3} = 0.2 \text{ \AA}$$

$$\frac{2\lambda_{1\text{swl}}}{3} = 0.2 \text{ \AA} \Rightarrow \lambda_{1\text{swl}} = 0.3 \text{ \AA}$$

$$2.5 \quad \text{Heat} = VI - VI \times 1\% = VI - \frac{VI}{100} = \frac{99VI}{100} = \frac{99 \times 80 \times 10}{100} \text{ J} = 792 \text{ J}$$

$$2.6 \quad \lambda_{\text{swl}} = \frac{12400}{V} = \frac{12400}{40000} \text{ \AA} = 0.31 \text{ kV}$$

$$2.7 \quad \mu = 13.9 / \text{cm}, x = 5\text{mm} = 0.5\text{cm}$$

The percentage of the intensity

$$= \frac{I}{I_0} \times 100 = e^{-\mu x} \times 100 = e^{-13.9 \times 0.5} \times 100 = 0.096\%$$

$$2.8 \quad K_{\alpha} = 0.1542\text{nm}, K_{\alpha(\text{impurity1})} = 0.1441\text{nm}, K_{\alpha(\text{impurity2})} = 0.1666\text{nm}, \sigma = 1$$

$$\lambda = \frac{4}{3R(Z-1)^2}$$

$$Z = 1 + \sqrt{\frac{4}{3R\lambda}} \quad \text{with } R = 1.0973731 \times 10^7 \text{m}^{-1}$$

$$Z = 1 + \frac{3.48571 \times 10^{-4}}{\sqrt{\lambda}} = 1 + \frac{3.48571 \times 10^{-4}}{\sqrt{0.1441 \times 10^{-9}}} = 30 \Rightarrow \text{Zn}$$

$$Z = 1 + \frac{3.48571 \times 10^{-4}}{\sqrt{\lambda}} = 1 + \frac{3.48571 \times 10^{-4}}{\sqrt{0.1666 \times 10^{-9}}} = 28 \Rightarrow \text{Ni}$$