$$\Rightarrow \quad \frac{m_e c}{h}\left(\frac{\lambda - \lambda'}{\lambda \lambda'}\right) = \frac{(\cos\theta - 1)}{\lambda \lambda'}$$

$$\Rightarrow \quad \boxed{\lambda' - \lambda = \frac{h}{m_e c}(1 - \cos\theta)}$$ Compton effect

Pb # 36.

$E' = 80\,\text{keV}$ $\qquad E_e = K_e + m_e c^2$

$K_e = 25\,\text{keV}$

From conservation of energy $\quad E_i = E_f$

$$E + m_e c^2 = E' + K + m_e c^2$$

- E: energy of incident photon
- $m_e c^2$ (left side): rest energy of the electron
- E': energy of scattered photon
- K: Kinetic energy of recoil electron
- $m_e c^2$ (right side): rest energy of the recoil electron

$$\Rightarrow \quad E = E' + K = 80 + 25 = 105\,\text{keV}$$

$$E = hf = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E} = \frac{12400\,\text{eV Å}}{105000\,\text{eV}} = \boxed{0.118\,\text{Å}}$$

$$\Delta\lambda = \lambda_c(1 - \cos\theta) = \lambda' - \lambda$$

$$\lambda' = \frac{hc}{E'} = \frac{12400}{80\,000} = 0.155\,\text{Å} \quad \Rightarrow \quad \Delta\lambda = 0.037\,\text{Å}$$

given $\lambda_c = 0.0243\,\text{Å}$

$$1 - \cos\theta = \frac{\Delta\lambda}{\lambda_c} \Rightarrow \cos\theta = 1 - \frac{\Delta\lambda}{\lambda_c} = 1 - 1.52 = -0.52$$

$$\Rightarrow \quad \boxed{\theta = 122.6^\circ}$$