(4) into (5) $\Rightarrow$ $2\lambda\cos\theta - \lambda = \lambda_c - \lambda_c\cos\theta$

or $\boxed{\cos\theta = \dfrac{\lambda_c + \lambda}{2\lambda + \lambda_c}}$

$\lambda_c = 0.0243\ \text{Å}$

$\lambda = \dfrac{hc}{E} = \dfrac{12400\ \text{eV·Å}}{1.02\times10^6\ \text{eV}} = 0.012\ \text{Å}$

$\Rightarrow \cos\theta = \dfrac{0.0243 + 0.012}{2(0.012) + 0.0243} = 0.749$

$\Rightarrow \boxed{\theta = 41.5^\circ}$

Pb # 32.

Equation 2.34 in the textbook $E_e = hf - hf' + m_e c^2$ — (1)

" 2.35 " " $p_e^2 = \left(\frac{hf'}{c}\right)^2 + \left(\frac{hf}{c}\right)^2 - \frac{2h^2ff'}{c^2}\cos\theta$ — (2)

but $E_e^2 = p_e^2c^2 + (m_e c^2)^2$ (for the electron)

$\Rightarrow (hf - hf' + m_e c^2)^2 = \left[\left(\frac{hf'}{c}\right)^2 + \left(\frac{hf}{c}\right)^2 - \left(\frac{2h^2ff'}{c^2}\cos\theta\right)\right]c^2 + m_e^2c^4$

$h^2(f-f')^2 + 2h(f-f')m_e c^2 + \cancel{m_e^2c^4} = h^2(f'^2 + f^2) - 2h^2ff'\cos\theta + \cancel{m_e^2c^4}$

$(f^2 + f'^2 - 2ff') + 2h(f-f')m_e c^2 = h^2(f'^2 + f^2) - 2h^2ff'\cos\theta$

$\Rightarrow -2h^2ff' + 2h(f-f')m_e c^2 = -2h^2ff'\cos\theta$

$(\cos\theta - 1)ff' = (f' - f)\dfrac{m_e c^2}{h}$ but $f = \dfrac{c}{\lambda}$

$\Rightarrow (\cos\theta - 1)\dfrac{c^2}{\lambda\lambda'} = c\left(\dfrac{1}{\lambda'} - \dfrac{1}{\lambda}\right)\dfrac{m_e c^2}{h}$