HW 9/25

3.29) $KE_e = \frac{1}{2}mv^2 = \frac{hc}{\lambda}$

$$v = \sqrt{\frac{2hc}{\lambda m}} \rightarrow v = \sqrt{\frac{2\cdot(6.63\cdot10^{-34})(3\cdot10^8)}{(6.2\cdot10^{-11})(9.11\cdot10^{-31})}} = \boxed{8.4\cdot10^7\ m/s}$$

$(\gamma_u - 1)\, m v^2 = \frac{hc}{\lambda}$

$$(\gamma_u - 1)(9.11\cdot10^{-31})(3\cdot10^8)^2 = \frac{(6.63\cdot10^{-34})(3\cdot10^8)}{6.2\cdot10^{-11}} \rightarrow u = 0.272c \approx \boxed{8.15\cdot10^7\ m/s}$$

3.31) a) $\lambda' - \lambda = \frac{h}{m_e c}(1-\cos\theta) \rightarrow 0.061\cdot10^{-9}\,m - 0.057\cdot10^{-9}\,m = \frac{6.63\cdot10^{-34}}{(9.11\cdot10^{-31})(3\cdot10^8)}(1-\cos\theta$

$\hookrightarrow \boxed{\theta = 130.5^\circ}$

b) ① $\frac{h}{\lambda} - \frac{h}{\lambda'}\cos(130.5^\circ) = \gamma_u m_e u \cos\phi$ (eq 3-4)

② $\frac{h}{\lambda'}\sin(130.5^\circ) = \gamma_u m_e u \sin\phi$ (eq 3-5)

Divide eq 2 by eq 1: $\dfrac{\frac{\sin(130.5^\circ)}{\lambda'}}{\frac{1}{\lambda} - \frac{\cos(130.5)}{\lambda'}} = \tan\phi$

$$\phi = \tan^{-1}\left(\frac{\frac{\sin(130.5)}{0.061\cdot10^{-9}}}{\frac{1}{0.057\cdot10^{-9}} - \frac{\cos(130.5)}{0.061\cdot10^{-9}}}\right) = \boxed{23.9^\circ}$$

3.47) a) $\frac{h}{\lambda} = m_e(10^6 \text{ m/s}) \rightarrow$ $\boxed{\lambda = 7.38 \cdot 10^{-10} \text{ m}}$

b) $\frac{E_{photon}}{KE_{proton}} = \frac{\frac{hc}{\lambda}}{\frac{1}{2}mv^2} = \frac{\frac{(6.63 \cdot 10^{-34})(3 \cdot 10^8)}{(7.38 \cdot 10^{-10})}}{\frac{1}{2}(9.11 \cdot 10^{-31})(10^6)^2} = \boxed{600}$