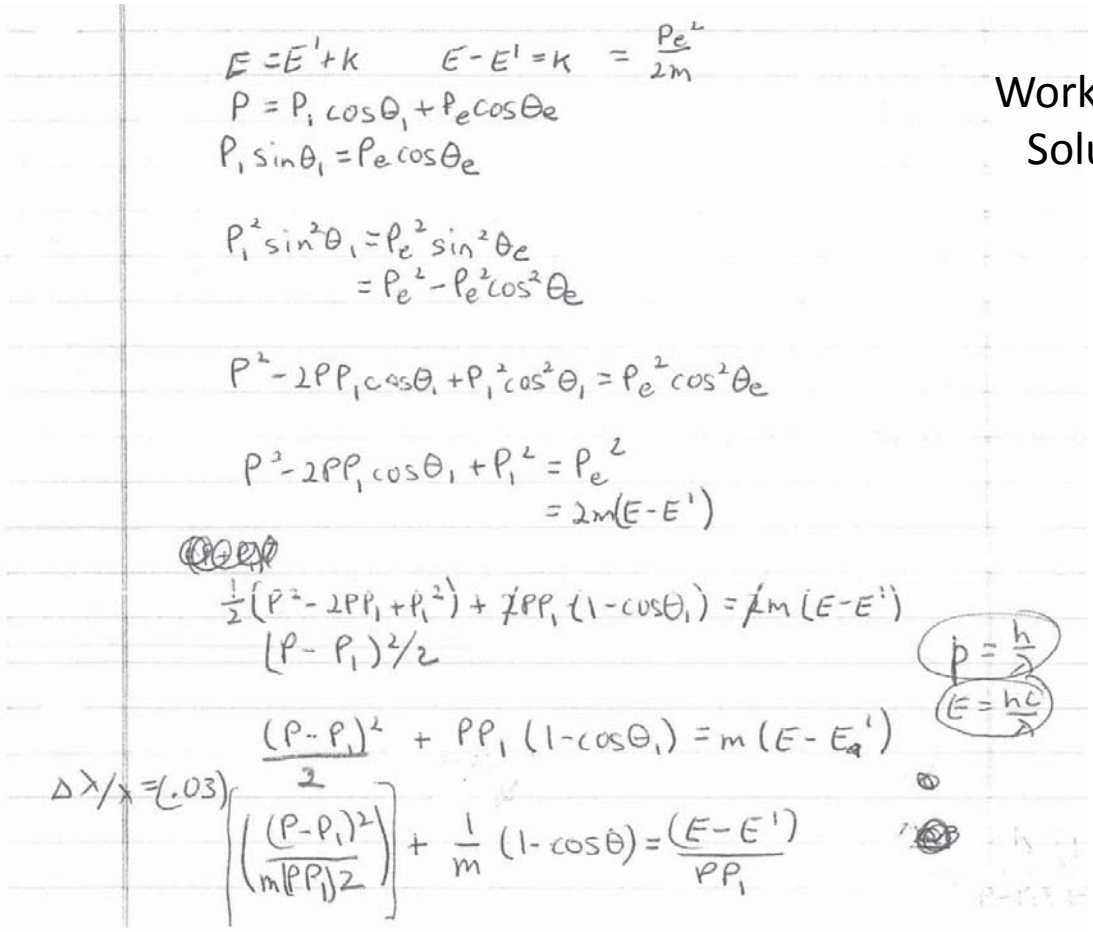
Worksheet 2 Solution



$$\frac{E-E'}{PP_1}=\frac{c}{P_1}-\frac{c}{P}=\frac{c}{h}(\lambda_1-\lambda) \quad \& \quad \frac{(P-P_1)^2}{2mPP_1}=\frac{(\frac{n\nu}{c}-\frac{n\nu_1}{c})^2}{2m\frac{h\nu}{c}\frac{h\nu_1}{c}}=\frac{(\nu-\nu_1)^2}{2m\nu\nu_1}$$

$$\frac{c}{h}(\lambda_1-\lambda)=\frac{1}{m}(1-\cos\theta)+\frac{(\nu-\nu_1)^2}{2m\nu\nu_1}\ ;\ (\lambda_1-\lambda)=\frac{h}{mc}(1-\cos\theta)+\frac{h}{mc}\frac{(\nu-\nu_1)^2}{2\nu\nu_1}$$

$\{135^0\ scatter\}\ (\lambda_1-\lambda)=0.075\,nm-0.071\,nm=0.004\,nm \quad \Delta E_1 \sim (hc/\lambda_1)\Delta\lambda_1/\lambda_1$

$$\Delta\lambda_1=\Delta(\lambda_1-\lambda)\sim\frac{h}{mc}\frac{(\nu-\nu_1)^2}{2\nu\nu_1}=0.00243\,nm\frac{(\frac{c}{0.071\,nm}-\frac{c}{0.075\,nm})^2}{2\frac{c}{0.071\,nm}\frac{c}{0.075\,nm}}=3.7\times10^{-6}\,nm$$

$$\Delta E_1 \sim (1239.6\ eV\,nm/0.07516\ nm)*(3.7\times10^{-6}\,nm/0.07516\ nm)=16{,}528\ eV*0.00005\sim 0.8\ eV$$

The change in the wavelength difference is about 1/2 part in 10000. Same for the change in the outgoing energy. Very tiny given the wide peaks in the book shown for Compton's measurements. Solving on the wolframalpha website gave 0.0751592 nm compared to 0.0751553 nm (used cos theta = 0.71). A difference of 3.9e-6 nm (I rounded for my estimate).