Homework is ~~it.~~ This is much more readable. Thanks. William Jardee 10/12

1) +4 a) the energy of a positron/electron is 0.511 MeV/c^2, So the particle is obviously realitivistic.

$$\lambda = \frac{h}{p} = \frac{hc}{\sqrt{E^2 - (mc^2)^2}} = \frac{hc}{\sqrt{(k+mc^2)^2 - (mc^2)^2}}$$

$m = 0.511$ MeV/c^2 $\qquad$ $k = 450$ MeV

$\lambda = 2.752 \times 10^{-6}$ nm $\boxed{= 2.75\text{fm}}$ ✓

b) using the same math, as this will also be realitivistic:

$m = 938.27$ MeV/c^2 $\qquad$ $k = 450$ MeV

$\lambda = 1.211 \times 10^{-6}$ nm $\boxed{= 1.2\text{fm}}$ ✓

c) This one is not realitivistic, but I already have the values caded in:

$m = 3727$ MeV/c^2 $\qquad$ $k = 450$ MeV

$\lambda = 6.575 \times 10^{-7}$ nm $\boxed{= 0.66\text{fm}}$ ✓

Photon: $\lambda = \frac{hc}{E}$ $\boxed{\Rightarrow 2.76\text{fm}}$ ✓

All these values are less than the photon.

The only one able to probe will be the alpha particle, as:

The hydrogen nucleus is 1.7 fm across, so the proton would work too.

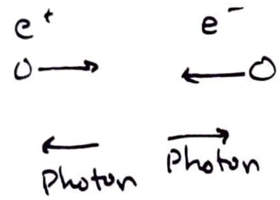
The hydrogen nucleus can actually stop the Alpha particle.

2.
+4

$\phi_2 = \sin^{-1}\left(\frac{n\lambda}{E}\right) \Rightarrow \sin^{-1}\left(\frac{2(0.167)\,nm}{0.215\,nm}\right) = \sin^{-1}\left(\frac{0.334\,nm}{0.215\,nm}\right)$

arc sin is only defined for -1 to 1, So ϕ_2 is undefined. What this reflects is the electron Being reflected back into the material, thus it's not detected outside the material.

3.
+2



a) 3×10^6 m/s $< 0.1\,c \rightarrow$ Non-realitivistic ✓

$\lambda = \frac{h}{p} = \frac{hc}{mvc} = \frac{hc}{mc^2\left(\frac{v}{c}\right)}$

$m = 0.511\ MeV/c^2$

$\frac{v}{c} = 0.01$

$\boxed{= 0.243\,nm}$ ✓

b) the energy will be evenly split for everything, so:
(non-realitivistic)

$k = \frac{1}{2}mv^2 = \frac{1}{2}mc^2\left(\frac{v}{c}\right) = E_{photon}\ \boxed{= \cancel{25\,eV}}$

$E = hf = \frac{hc}{\lambda} \rightarrow \lambda = \frac{hc}{E} = \frac{hc}{\frac{1}{2}mc^2\left(\frac{v}{c}\right)^2} = \frac{2hc}{mc^2\left(\frac{v}{c}\right)^2}\ \boxed{= \cancel{485}\,nm}$

$P = \frac{E}{c} \Rightarrow \boxed{\cancel{25\,eV/c}}$

The electron and positrons TOTAL energy goes into the photons, including their mass energy.

c) Wavelength is not conserved.

$$\lambda_e = \cancel{\frac{hc}{mc^2(\frac{v}{c})^2}} \quad \frac{hc}{mc^2(\frac{v}{c})}$$

$$\lambda_{photon} : \frac{2hc}{(mc^2)(\frac{v}{c})^2}$$

Consistent

ratio of $2\left(\frac{c}{v}\right)^{2}$ → this is not a pure conservation of ~~momentum~~. Wavelength.