PIXE Homework ***Physics 100*** ***Union College***

1. What is the speed of an alpha particle after it leaves the accelerator? The bias voltage applied across the quartz bottle is 5 kV for Helium. (Hint: the alpha particle (2 protons + 2 neutrons) has a charge of +2 when it leaves the bottle, a +1charge when it accelerates to the terminal, and a +2 charge when it leaves the terminal.)

2. If the radius of the alpha particle's orbit is 34.4cm (as the proton,) what magnitude of magnetic field is required to steer the alpha particle down the 30^0 beamline?

3. What are the K_α and K_β wavelengths for the following elements: He (Z=2), Li(Z=3), Cu(Z=29), Ni(Z=28), Fe(Z=26), Au(Z=79)? What are the corresponding x-ray energies?

4. What is the ratio of the K_α wavelengths of uranium(Z=92) to carbon(Z=6)?

5. What is the ratio of the K_β wavelengths of tungsten(Z=74) to calcium(Z=20)?

6. If a spectrograph (a graph of the energy or wavelength spectrum) had a wavelength resolution of $\Delta\lambda = 10^{-12}$ m, would it be able to separate the K_α lines for platinum(Z=78) and gold(Z=79)? (Resolution means that anything smaller than this value, and I won't be able to distinguish the lines from each other.)

7. What corresponding energy resolution for $\Delta\lambda$ given in problem 6? (In other words, given $\Delta\lambda$ above, what is the difference in energies, ΔE that two elements must have so I can tell them apart?)

8. What are the two shortest wavelengths for a molybdenum(Z=42) atom?

9. An unknown single element target is used in a PIXE experiment and characteristic x-rays are produced with wavelengths of $1.55\text{x}10^{-10}$m and $1.31\text{x}10^{-10}$m. What is the elemental make up of the target?

10. Show that the Moseley's law for K_α radiation may be expressed as

$\sqrt{f} = \sqrt{\frac{3}{4}\left(\frac{13.6eV}{h}\right)}(Z-1)$ where *f* is the x-ray frequency.