Name PIXE Homework #3 - Physics 100 Union College Fall 2014

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Matriculation at the College is taken to signify implicit agreement with the Academic Honor Code, available at <u>honorcode.union.edu</u>. It is each student's responsibility to ensure that submitted work is his or her own and does not involve any form of academic misconduct.

For the homework assignments, you may consult for guidance, if needed; your instructors lecture notes, the physics department help center, the writing center, your instructor, other physics and astronomy department instructors, other textbooks, or the Internet. Any work that is not explicitly your own must be cited. You may not copy solutions from anywhere. If you are unclear on anything, you are expected to ask your instructor for clarification regarding, but not limited to, collaboration, citations, and plagiarism. Ignorance is not an excuse for breaching academic integrity.

1. If a spectrograph (a graph of the number of x-rays versus energy or wavelength) had a wavelength resolution of $\Delta\lambda = 10^{-12}$ m, would you be able to see as separate the K_{α} lines for platinum(Z=78) and gold(Z=79)? (Resolution means that anything smaller than this value of $\Delta\lambda$, and I would not be able to distinguish the lines (peaks) as being separate from each other.)

2. What is the corresponding energy resolution for $\Delta\lambda$ given in problem 1? (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?)

3. What are the two shortest wavelengths for a Zinc(Z=30) atom?

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

5. 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.