*Name*_____

PIXE Homework #1 - Physics 100

Union College Fall 2024

Due Date: Monday, September 9, 2024, in class. *No late assignments accepted.*

1. Explain the main components of the Pelletron particle accelerator and the significance of each.

2. Explain the charge exchange process that occurs for a helium ion.

3. What is the kinetic energy (in electron-volts eV) of the He ion after our machine has accelerated it? Hints: Use the work-kinetic energy theorem to and calculate the work done in each of the stages of the accelerator and the bias voltage applied across the quartz bottle is $+3.8kV$ for Helium. In addition, the alpha particle (2 protons and 2 neutrons) has a charge of $+2e$ when it leaves the bottle, a $-1e$ charge when it accelerates towards the terminal, and a $+2e$ charge when it accelerates away from the terminal.

4. From the kinetic energy you calculated in question 3, what is the speed in meters per second ($\frac{m}{s}$) of an alpha particle after it leaves the accelerator?

5. If the radius of the alpha particle's orbit is $34.4cm$ (exactly the same as that of the proton,) what magnitude of magnetic field B in Teslas is required to steer the alpha particle down the 30^0 beamline?