

**Problem 1** (10 pts)

In a Compton scattering experiment, the scattered photon has wavelength 1.24 Angstrom and the scattered electron has kinetic energy 26.32 eV.

- (a) What is the wavelength of the incident photon, in Angstrom?
- (b) What is the scattering angle for the photon, in degrees?
- (c) What is the scattering angle for the electron, in degrees?

**Problem 2** (10 pts)

In a Rutherford scattering experiment with  $\alpha$  particles with kinetic energy 20MeV scattering off a silver (Ag) foil ( $Z=47$ ), it is found that Rutherford's  $1/\sin^4(\theta/2)$  law is well satisfied for all angles  $\theta$ .

- (a) What can you conclude about the radius of the Ag nucleus from this information?
- (b) It is found that a fraction 1/18,000 of incident particles scatter at angles  $\theta > 120^\circ$ . What fraction of incident particles scatter at angles  $\theta > 60^\circ$ ?
- (c) When the energy of the incident  $\alpha$  particles is increased to 25MeV, the ratio of number of particles scattered at angles  $\theta > 120^\circ$  to number of particles scattered at angles  $\theta > 60^\circ$  is different from what was found in (b). (i) is it larger or smaller? (ii) What can you conclude about the radius of the Ag nucleus from this information?

**Problem 3** (10 pts)

An electron is in a Bohr orbit of a hydrogen-like ion. It makes a transition to the lowest energy state emitting a photon of wavelength 60.78Angstrom.

- (a) What is the atomic number ( $Z$ ) of this ion?
- (b) What is the value of  $n$  for the initial state?
- (c) If instead of emitting a photon this electron absorbed a photon when it is in this initial state, what would be the largest possible wavelength of that photon?

**Justify all your answers to all problems**