Problem W4:

(a) Find the distance of closest approach when α-particles with kinetic energy of 6 MeV scatter from Cu nuclei ($Z = 29$).

(b) How much energy would be needed for the α to penetrate in to the nuclear radius (about 5 fm for Cu)?

Problem W5:

Find the following quantities for an electron in the $n=2$ state of hydrogen:

(a) the orbit radius (in nm);

(b) the electron's speed (as a fraction of c);

(c) its kinetic energy (in eV);

(d) its potential energy (in eV).

Problem W6:

The "ionization energy" is the energy required to remove an electron from an atom. Find the ionization energy of

(a) a hydrogen atom in the $n=3$ level;

(b) a He^+ ion in the $n=2$ level.

Problem W7:

Hydrogen atoms in the ground state are irradiated with UV light of wavelength 59.0 nm. Find the kinetic energy of the ejected electrons assuming that the photons are absorbed. (This is basically the photoelectric effect on hydrogen atoms.)

Problem W8:

In our derivation of the Bohr model formulas we assumed that the electron moves but that the nucleus remains fixed (as if its mass were infinite). In reality, the nucleus also moves a little. If the nuclear motion is taken into account, the only effect in our formulas is that the electrom mass is replaced everywhere by the "reduced mass"

$$\mu = \frac{m_e M}{m_e + M}$$

where M is the mass of the nucleus. See problem 32 in the text for more details.

Using this idea, find the wavelength difference, $\Delta\lambda$, between the $n=3 \to n=2$ transitions in normal hydrogen ($M \simeq 1\text{u}$) and deuterium ($M \simeq 2\text{u}$).

Problem W9:

Muonic hydrogen consists of a muon (like an electron but with a mass $m_\mu = 105.7\,\text{MeV/c}^2$) bound to a proton. Use the Bohr model to find the energy and radius of the lowest orbit, and the wavelength of the $n = 2 \to n = 1$ transition. As in the preceeding problem you should use the reduced mass for m.