Physics 2170, Spring '95 **Homework #3**
Due Wed, Feb 8

Reading for this week: F+T Chapter 1.4, 1.5, 1.7-1.13
(Optional: Beiser (5th ed) Ch. 4.1-4.6)

1) F+T 1-4

2) F+T 1-5

3) F+T 1-13 (a and b only)

4 a) What is the impact parameter, b, of a 5.0 MeV alpha particle that is scattered by 5 degrees when it approaches a gold nucleus?
b) What fraction of a beam of 5.0 MeV alpha particles incident upon a gold foil 400 nm thick is scattered by *more* than 90 degrees?

5 a) How many different wavelengths appear in the spectrum of hydrogen atoms *initially* in the n=5 state? (why?)
b) How much energy is required to *remove* an electron which is in the n=5 state from a hydrogen atom?

6) Extra Credit!

When an excited atom emits a photon, the linear momentum of the photon must be balanced by the recoil momentum of the atom. As a result, some of the excitation energy of the atom goes into the kinetic energy of its recoil. Modify the energy conservation equation:

initial electron energy - final electron energy = photon energy
$E_i - E_f$ = $h\nu$

to take this recoil effect into account. (The excitation energy, $E_i - E_f$ is a fixed quantity) Call the mass of the *atom,* M) (Answer is $E_i - E_f = h\nu(1 + h\nu / 2Mc^2)$
b) Find the ratio between the recoil energy and the photon energy for the n=5 -> n=1 transition in hydrogen, for which $E_i - E_f$ is 13.1 eV. Is the effect a major one?