Physics 820 homework due Mon Oct 7

Reading: Chapters 3.7-11, 4.1-7

Problems:

1. A proton of energy 4 MeV scatters off a second proton at rest. One proton comes off at an angle of 30° in the lab system. What is its energy? What is the energy and scattering angle of the second proton?

2. Show that the drag force on a satellite moving with velocity v in the earth's upper atmosphere is approximately $f_D = \rho A v^2$ where ρ is the atmospheric density and A is the cross-sectional area perpendicular to the direction of motion. Assume that the air molecules are moving slowly compared with v and that their collisions with the satellite are completely inelastic, i.e. the whole kinetic energy of relative motion is converted into heat.

3. From the last subject exam:
Discuss the 2-dimensional motion of a particle moving in an attractive central-force described by the force law $f(r) = -k/r^\alpha$, where k is positive and $3 > \alpha > 2$.
(a) Write down the equations of motion in polar coordinates;
(b) Show how conservation laws can be used to derive the formal equation for the orbit of motion;
(c) Describe the nature of the orbits for various possible initial energies and angular momenta. (Graphical methods can be very useful.)

4. Goldstein, Problem 3-27.

5. Goldstein, Problem 4-6.