Physics CS 31 **Fall 2014**

Set #9 - for Tues Dec. 9

Read HR&K	Ch. 6, Ch. 7, Ch. 12 (skip 12.4), Ch. 13
Read K&K	Ch. 4, Ch. 5 - Sects. 5.10, 5.11, Ch. 6 - Sects. 6.1 - 6.3, 6.5.
Read Feynman Vol. 1	Ch. 10

From HR&K:

Ch. 6 Problems 7, 17.
Ch. 12 Problem 6.
Ch. 13 Exercise 15.

From K&K:

Ch. 5 Problems 5.18. **Extra Credit 5.10, 5.19**
Ch. 6 Problems 6.5, 6.9.

1. Consider the problem of a water droplet falling in the atmosphere. As the droplet passes through a cloud it acquires mass at a rate proportional to its instantaneous mass $M(t)$. That is, if M is the mass of the droplet at time t, then $\frac{dM}{dt} = kM$, where k is a proportionality constant. Consider a droplet of initial mass M_o that enters a cloud with velocity v_o. Assume no resistive force and find:
a) The mass of the droplet as a function of time.
b) The velocity of the droplet as a function of time.

2. A lunar module of total mass M_o is at height H above the surface of the Moon and is descending vertically at speed v_o, when a rocket is ignited to produce a soft landing. The mass of the fuel decreases at a constant rate with respect to time, and the gas is ejected at a speed of 2400 m/s relative to the module. If the module touches the lunar surface with zero velocity and the module's mass at the end of the burn lasting 350 sec is $\frac{2}{3}M_o$, evaluate v_o and H. (Assume that the acceleration due to gravity at the surface of the Moon is 1.62 m/s^2).

3. Two railway cars of masses m_1 and m_2 are moving along a track with velocities v_1 and v_2 respectively. The cars collide, and after the collision the velocities are v_1' and v_2' respectively. Show that the change in kinetic energy of the system will be a maximum if the cars couple together.

4. An electron, mass m, collides head-on with an atom, mass M, initially at rest. As a result of the collision, a characteristic amount of energy E is stored internally in the atom. What is the minimum initial speed v_{o} that the electron must have?