From HR&K:

Ch. 6 Problems 3, 7, 17.
Ch. 7 Exercises 6, 20.
Ch. 12 Problem 6.
Ch. 13 Exercise 15.

From K&K:

Ch. 4 Problems 4.4, 4.20, 4.23, 4.27. Extra Credit 4.3, 4.11, 4.21

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 $M_0$ that enters a cloud with velocity $v_0$. 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 $M_0$ is at height $H$ above the surface of the Moon and is descending vertically at speed $v_0$, 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 $\frac{2}{3}M_0$, evaluate $v_0$ 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 $v_0$ that the electron must have?