PHY 212 Sixth week assignment:

Reading: Study sections 18.1 through 18.11 of Reese. Compared to the previous two chapters this one should be a little more easy- going.

Tues, Oct 3: Lecture. There will be a 15 min. quiz during this period too.

Homework problems to be handed in at the beginning of the Workshop on Oct 4: problems 68 of Chapter 17 and 9, 11 and 14 of chapter 18.

Wed, Oct 4: In this workshop you will first, in order to review the important concepts of the "work-energy theorem" and the "law of conservation of energy" give a rough derivation of both of them starting from Newton's second law, F=ma.

For simplicity consider motion in one dimension. Also, regard $v = \frac{\Delta x}{\Delta t}$ to be interpreted as the ratio of the two small quantities Δx and Δt. Don't worry about taking limits.

Consider that an object of mass m is moving in an electric field (or a gravity field) which causes a force F(x) on it.

a) Show that while the object moves through a distance Δx, the work done on it ($F\Delta x$) may be rewritten as

$$\Delta W = m \frac{\Delta V}{\Delta t} \Delta x$$

b) Show that this may be rewritten as $\Delta W = m \frac{\Delta x}{\Delta t} \Delta V$

c) Approximating $\frac{\Delta x}{\Delta t} = v$, show that it may be finally rewritten as

$$\Delta W = \Delta\left(\tfrac{1}{2} m v^2\right) = \Delta(KE) \qquad (1)$$

which is the work-energy theorem (work done = increase in kinetic energy). Next, define the potential energy, PE of the object by

$$F(x) = -\frac{\Delta(PE)}{\Delta x}$$

d) Show that the work done on the object when it moves through Δx is given by

$$\Delta W = -\Delta(PE) \qquad (2)$$

e) From (1) and (2) show

$$\Delta(KE + PE) = 0$$

which is the law of conservation of total energy, $\mathcal{E}$ = KE + PE. You just showed this to be true for any small interval. Any large interval is just the sum of small intervals so it is also true for large intervals. It is safe to conclude that (KE + PE) does not change as the object moves. Often this is written $(KE + PE)_{initial} = (KE + PE)_{final}$.

Next, consider question 24 on page 827 and problems 65 of chapter 17 and 12 of chapter 18.

Thurs, Oct 5: Lecture.

Homework problems to be handed in at the beginning of the Workshop on Fri, Oct 6: problems 8, 26, 53 and 57 of chapter 18.

Fri, Oct 6: In this workshop first practice 3 dimensional vectors with the exercise: Starting with the vectors $\mathbf{V} = \mathbf{i} + \mathbf{k}$ and $\mathbf{W} = 2\mathbf{j} + \mathbf{k}$ what is $\mathbf{V} + \mathbf{W}$, its magnitude and the cosines of the angles it makes with the x, y and z axes? Next consider problems 21, 30 and 46 of chapter 18.