

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 2: Lecture.

Homework problems to be handed in at the beginning of the Workshop on Oct 3: problems 68 of Chapter 17 and 9, 11 and 14 of chapter 18.

Wed, Oct 3: 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

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

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

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

- e) From (1) and (2) show

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

which is the law of conservation of total energy, $E = KE + PE$.

You just showed this to be true for any small interval Δx .

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 4: Lecture.

Homework problems to be handed in at the beginning of the Workshop on Fri, Oct 5: problems 8, 26, 53 and 57 of chapter 18.

Fri, Oct 5: 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.