Engineering Physics I   Name ____________________
PHYS 1210   Spring 2015

Discussion 5 – Work and Kinetic Energy (Ch 6)

Approaches to Mechanics

1. Kinematics (Ch 1-3): *describes how things move, but not much about why*
2. Forces (Ch 4-5): *describes why things move, but not much about how*
3. Energy (Ch 6-7): *a bit of both why and how things move*
4. Momentum (Ch 8): *finally lets us look at two objects*
5. Rotation (Ch 9-11): *everything in Ch 1-8 but angular*

Equations

$$W = \vec{F} \cdot \vec{d} = Fd\cos\theta$$

$$K = \tfrac{1}{2}mv^2$$

$$W = \Delta K$$

$$W = \int \vec{F} \cdot d\vec{l} = \int F\,dx$$

$$P = \frac{\Delta W}{\Delta t} = \vec{F} \cdot \vec{v}$$

My Problem Solving Approach (for Energy)

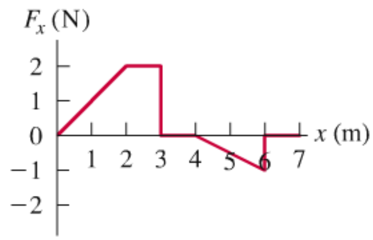
1. 2 pictures: start and end separate
2. Identify forms of Energy
3. Do Math
4. Sanity Check

Problems (Young & Freedman, 13e)

6.5 •• A 75.0-kg painter climbs a ladder that is 2.75 m long leaning against a vertical wall. The ladder makes a 30.0° angle with the wall. (a) How much work does gravity do on the painter? (b) Does the answer to part (a) depend on whether the painter climbs at constant speed or accelerates up the ladder?

6.41 • A force $\vec{F}$ is applied to a 2.0-kg radio-controlled model car parallel to the x-axis as it moves along a straight track. The x-component of the force varies with the x-coordinate of the car as shown in Fig. E6.41. Calculate the work done by the force $\vec{F}$ when the car moves from (a) $x = 0$ to $x = 3.0$ m; (b) $x = 3.0$ m to $x = 4.0$ m; (c) $x = 4.0$ m to $x = 7.0$ m; (d) $x = 0$ to $x = 7.0$ m; (e) $x = 7.0$ m to $x = 2.0$ m.

Figure **E6.41**



6.69 •• **CP BIO Whiplash Injuries.** When a car is hit from behind, its passengers undergo sudden forward acceleration, which can cause a severe neck injury known as *whiplash.* During normal acceleration, the neck muscles play a large role in accelerating the head so that the bones are not injured. But during a very sudden acceleration, the muscles do not react immediately because they are flexible, so most of the accelerating force is provided by the neck bones. Experimental tests have shown that these bones will fracture if they absorb more than 8.0 J of energy. (a) If a car waiting at a stoplight is rear-ended in a collision that lasts for 10.0 ms, what is the greatest speed this car and its driver can reach without breaking neck bones if the driver's head has a mass of 5.0 kg (which is about right for a 70-kg person)? Express your answer in m/s and in mph. (b) What is the acceleration of the passengers during the collision in part (a), and how large a force is acting to accelerate their heads? Express the acceleration in m/s^2 and in g's.