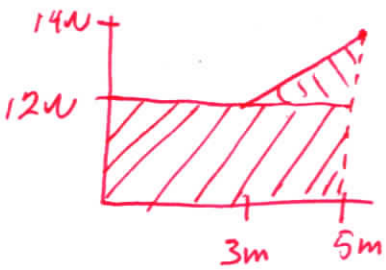
Level I Answer Key Pd1

Work and Energy

AT work and energy(19)

Directions: Solve the following problems. Each is worth 5 points. Show all work.

1) A constant force of 12N is required push a box 3 m across a floor. At the 3 m mark, the floor surface becomes irregular resulting in a constantly increasing force required as the box is moved an additional 2 m. The max force applied to the box is 14 N. Determine the total work done in pushing the box. (note...lit might be convenient to sketch a graph of the Force vs distance)



$\frac{1}{2}(2N)(2m) = 2J$

$(5m)(12N) = 60J$

$62J$

2) The Steel Force at Dorney Park in Allentown, PA has a height of 200 feet and a drop of 205 feet. The speed at the bottom of the hill is claimed to be 75 mph. Ideally, what would an expected speed be at the bottom of the hill?

$PE = KE$

$mgh = \frac{1}{2}mv^2$

$\sqrt{2gh} = v$

$(205\,ft)\left(\frac{12in}{1ft}\right)\left(\frac{2.54cm}{1in}\right)\left(\frac{1m}{100cm}\right) = 62m$ $(62.5m)$

$\sqrt{2gh} = \sqrt{(2)(9.8\frac{m}{s^2})(62.5m)} = 34.9 \approx 35\,m/s$

$\left(35\frac{m}{s}\right)\left(\frac{1mi}{1609m}\right)\left(\frac{3600s}{1hr}\right) = 78.3\,mi/hr$

3) A cart has a mass of 23kg. Determine the force required to accelerate the cart from rest to 15 m/s in a distance of 14m.

$W = KE$

$Fx = \frac{1}{2}mv^2$

$F = \frac{mv^2}{2x} = \frac{(23kg)(15\,m/s)^2}{(2)(14m)} = 185\,N$

4) How much work needs to be done to stop a 2,000kg car (realistic value) moving at 20m/s?

$W = KE$

$W = \frac{1}{2}mv^2$

$W = \left(\frac{1}{2}\right)(2{,}000\,kg)(20\,m/s)^2$

$W = 400{,}000\,J$

5) A spring is used to "cushion the blow" and stop a (12m/s) moving 15kg object. Determine the spring constant required to stop the object in a distance of 0.75m

$$KE = W$$

$$\frac{1}{2}mv^2 = \frac{1}{2}Kx^2$$

$$mv^2 = Kx^2$$

$$\frac{mv^2}{x^2} = K$$

$$\frac{(15kg)(12\,m/s)^2}{(.75m)^2} = 3840\ N/m$$

6) A spring rate of 54N/m is compressed 42cm. Determine the work done compressing the spring.

$W = \frac{1}{2}Kx^2$

$W = \left(\frac{1}{2}\right)(54\,N/m)(.42m)^2$

$W = 4.76\,J$

7) A 200 watt motor is used to lift a 32kg box. How long will it take to lift the box 2.3m

$$P = \frac{W}{t}$$

$$t = \frac{W}{P} = \frac{mgh}{P} = \frac{(32\,kg)(9.8\,m/s^2)(2.3\,m)}{200\,watt}$$

$$3.6\,s$$

8) Determine the work done when carrying a 120pound box a distance of 32 feet across a level surface.