Work & Energy

AT Energy (13)

Directions:

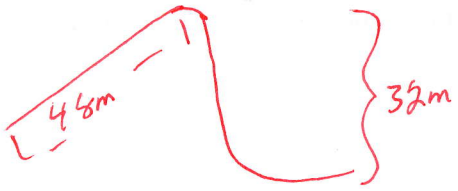
1) A cart is rolling at a speed of 12 m/s. If it has a weight of 340 N, determine the mass of the cart.

$W = mg$

$\frac{W}{g} = m = \frac{340\,N}{9.8\,m/s^2} = 34.6\,kg$

Level I Key Pd 1

2) A 3500 kg roller coaster train is pulled up a hill that is 32 m high. The length of the hill is 48 m long and the chain that pulls the train applies a 33kN force to the train. Determine the resistive force acting on the train.



PE of Train @ Top $\Rightarrow$ $PE = mgh = (3500\,kg)(9.8\,m/s^2)(32\,m) = 1.098\times10^6\,J$

"Ideal" Work To the Top $\Rightarrow$ $1.098\times10^6\,J$

"Ideal" Force To the Top $\Rightarrow$ $W = Fx$

$$\frac{W}{x} = F = \frac{1.098\times10^6\,J}{48\,m} = 2.29\times10^4\,N$$

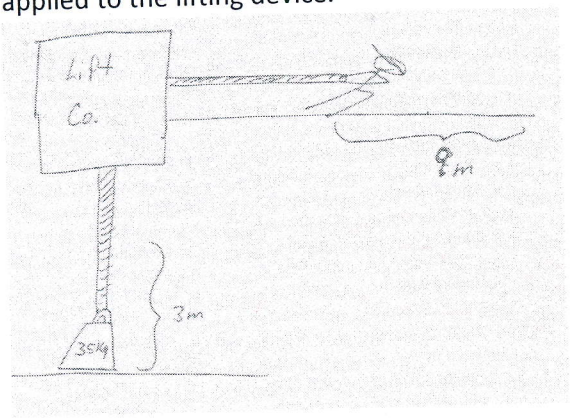
$22.9\,kN$

Diff Between Ideal & Actual Would Be Friction

$33\,kN - 22.9\,kN = 10.1\,kN$

Level I Key Pd 1

3) A simple machine is used to lift a 35kg mass to a height of 3m. The device that is used to lift the mass is moved through a distance of 9m. Determine the ideal force that would need to be applied to the lifting device.



Weight of 35kg Object

$W = mg = (35kg)(9.8 m/s^2)$

$W = 343N$

$IMA = \frac{9m}{3m} = 3$

$F_{out} = 343N$

$F_{in} = \frac{343N}{3} = 114N$

Level I Key Pd 1

4) A 65kg person starts at rest and accelerates to 8m/s in a time of 0.4 seconds. They then need to stop quickly. Determine the work that must be done to them to bring them to rest.

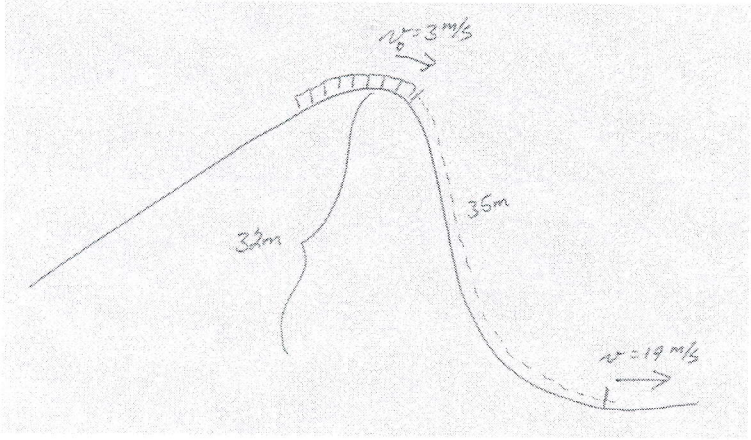
$\Delta E = W$

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

$\left(\frac{1}{2}\right)(65\text{kg})(8\text{m/s})^2 = 2080\text{ J}$

Level I Key Pd 1

5) A roller coaster train tops a 32m tall hill at 3m/s. At the bottom of the hill, the train is traveling at 19 m/s. Determine the overall average resistive force acting on the train considering the length of the track going down the hill is 35 m.



$KE_0 + PE_0 = KE + W$

$\frac{1}{2}mv_0^2 + mgh = \frac{1}{2}mv^2 + F_x$

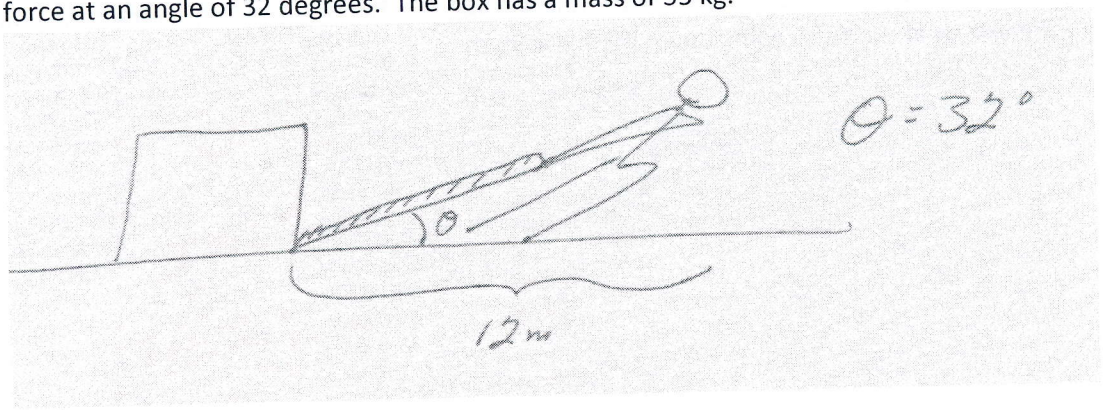
$\frac{\frac{1}{2}mv_0^2 + mgh - \frac{1}{2}mv^2}{x}$

$\frac{10{,}000\text{kg}\left[\left(\frac{1}{2}\left(3\frac{m}{s}\right)^2 + \left(9.8\frac{m}{s^2}\right)(32m) - \left(\frac{1}{2}\right)\left(19\frac{m}{s}\right)^2\right]}{35m}$

$F = 39{,}000\,N$

Level I Key Pd 1

6) Determine the work that is done to the box by the person if the person pulls with a 240N force at an angle of 32 degrees. The box has a mass of 35 kg.



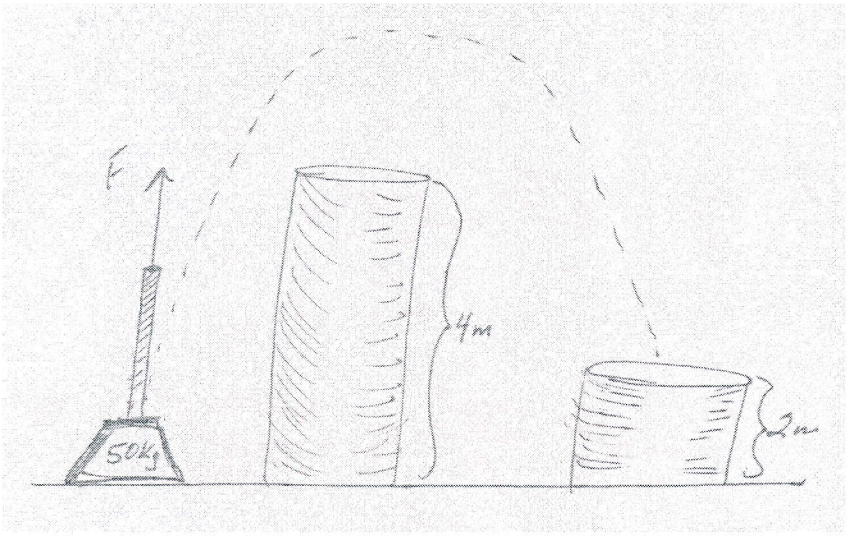
$W = F(\cos\theta)x$

$(240N)(\cos 32^\circ)(12m)$

$W = 2442\,J$

Level I Key Pd 1

7) Determine the work that is done to the 50 kg mass if it is lifted up and over a 4 m tall and set to rest on a 2m high column. The mass is lifted with a 12 m long heavy rope.



$W = PE$

$W = mgh = (50kg)(9.8\frac{m}{s^2})(2m)$

$W = 980J$

Level I Key Pd 1

8) A motor is rated 25h.p. (18,650 W). Determine how long it will take to lift 1500kg roller coaster train to the top of 22m high hill.

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

$$t = \frac{mgh}{P} = \frac{(1500kg)(9.8 m/s^2)(22m)}{(18650 W)}$$

$$t = 17s$$

Level I Key Pd 1

9) A spring cannon with a spring constant of 480N/m is used to launch a 30 g ball. The spring is compressed 21 cm, and then released to launch the ball. Determine the speed of the ball when launched.

$W = \frac{1}{2}kx^2 = KE$

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

$kx^2 = mv^2$

$\sqrt{\frac{kx^2}{m}} = v = \sqrt{\frac{(480 N/m)(.21 m)^2}{.03 kg}} = 26.6 m/s$ ~~58 m/s~~