key Level I Physics

Work & Energy

AT Energy (14)

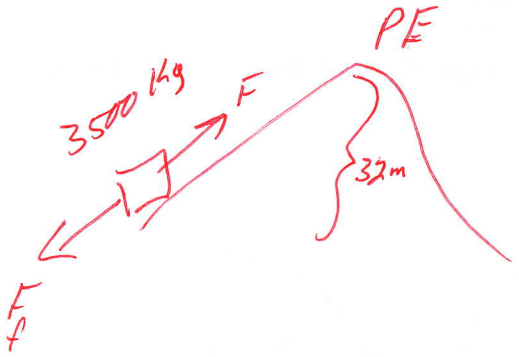
Directions:

1) A cart is rolling at a speed of 3 m/s. If it has a weight of 19.6 N, determine the mass of the cart.

$W = mg$

$\frac{W}{g} = m = \frac{19.6\,N}{9.8\,m/s^2} = 2\,kg$

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.



$$PE + W_{friction} = W_{Done\ To\ Top}$$

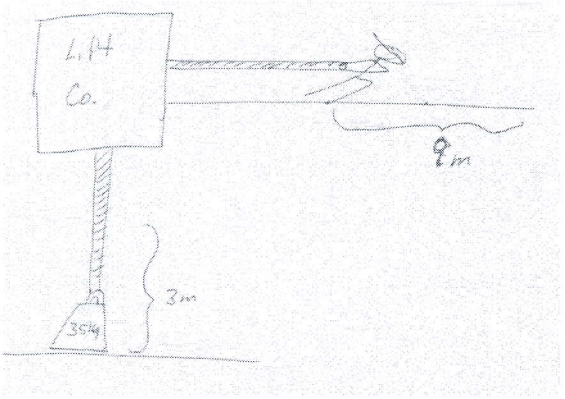
$$mgh + F_f x = Fx$$

$$F_f = \frac{Fx - mgh}{x}$$

$$F_f = \frac{(33\times10^3 N)(48m) - (3500kg)(9.8m/s^2)(32m)}{(48m)}$$

$F_f = 10\ kN$

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.



$MA = 3$

$\frac{F_{out}}{F_{in}}(ideal) = 3$

$\frac{F_{out}}{3} = F_{in}$

$\frac{mg}{3} = F_{in}$

$\frac{(35kg)(9.8 m/s^2)}{3} = 114N$

4) A 65kg person starts at rest and accelerates to 9.5m/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.

$KE = 2nd$

$\Delta KE = W$

$KE - KE_0 = W$

$KE = W$ (In This Case

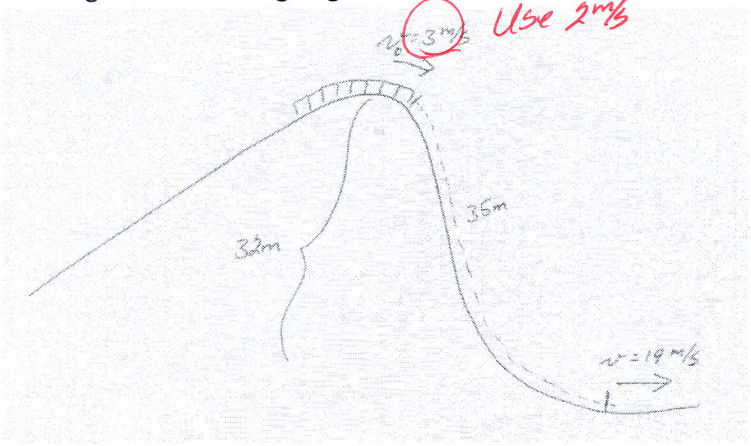
$\frac{1}{2}mv^2 = \left(\frac{1}{2}\right)(65kg)(9.5\,m/s)^2$

$W = 2930\,J$

5) A roller coaster train tops a 32m tall hill at 2m/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.

Use 2 m/s

$m = 1{,}000$ Kg



$$PE + KE_0 = KE + W$$

$$mgh + \tfrac{1}{2}mv_0^2 = \tfrac{1}{2}mv^2 + Fx$$

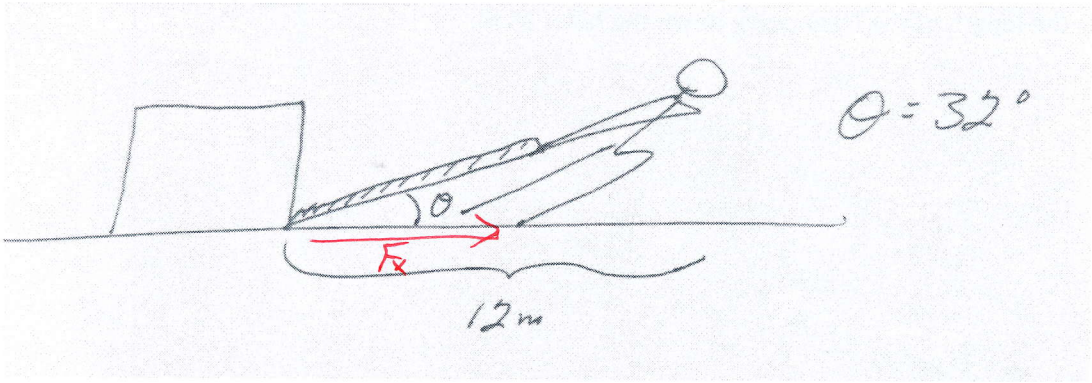
$$\frac{mgh + \frac{1}{2}mv_0^2 - \frac{1}{2}mv^2}{x} = F$$

$$\frac{m\left(gh + \frac{1}{2}v_0^2 - \frac{1}{2}v^2\right)}{x} = F$$

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

$$3860\,N = F$$

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.



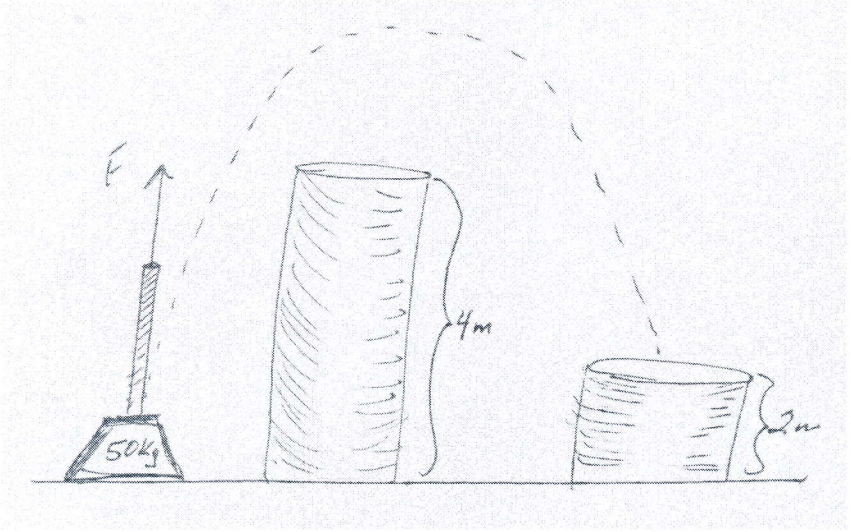
$W = F_x x$

$W = F\cos\theta\, x$

$W = (240N)\cos(32°)(12m)$

$W = 2442\ J$

7) Determine the work that is done to the 50 kg mass if it is lifted up and over a 4 m tall obstacle and set to rest on a 2m high column. The mass is lifted with a 12 m long 3 kg heavy rope.



$\Sigma PE = W$

$mgh = W$

$(50kg)(9.8\ m/s^2)(2m) = W$

$980J = W$

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

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

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

$$t = 17s$$

9) A spring cannon with a spring constant of 320 N/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.

$W = KE$

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

$\sqrt{\frac{Kx^2}{m}} = v$

$\sqrt{\frac{(320\,N/m)(.21\,m)^2}{.03\,kg}} = 21.7\,m/s$