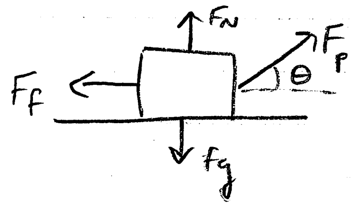
Work, Energy, Power

(1) $W = Fs = (25\,N)(.8\,m) = \underline{20\,J}$

(2) $W = Fs = mgs = (5.00\,kg)(9.81\,ms^{-2})(.4\,m) = \underline{19.6\,J}$

(3)



x

$\Sigma F = 0$

$F_f = F_p \cos\theta$

y

$\Sigma F = 0$

$F_N + F_p \sin\theta = F_g$

$F_N = F_g - F_p \sin\theta$

$F_f = \mu F_N$

$F_p \cos\theta = \mu(F_g - F_p \sin\theta)$

$F_p \cos\theta + \mu F_p \sin\theta = \mu F_g$

$F_p = \dfrac{\mu F_g}{\cos\theta + \mu \sin\theta}$

$W = Fs$

$= (F_p \cos\theta)\, s$

$= \dfrac{\mu F_g \cos\theta\; s}{\cos\theta + \mu \sin\theta}$

$= \dfrac{.4(20\,kg)(9.81\,ms^{-2})\cos 37\,(8\,m)}{\cos 37 + .4 \sin 37}$

$= \underline{480\,J}$

(4) $F = kx$

$k = \dfrac{F}{X_1}$

$W = E_p = \frac{1}{2} k x_2^2$

$= \frac{1}{2}\left(\frac{F}{X_1}\right) X_2^2$

$= \frac{1}{2} \dfrac{(0.200\,kg)(9.81\,ms^{-2})}{(.1\,m)} (.05\,m)^2$

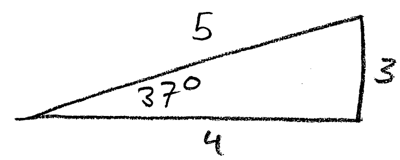
$= \underline{0.02\,J}$

(5) power $= Fv = (14000\,N)(3.0\,ms^{-1}) = \underline{4.2 \times 10^4\,W}$

⑥ $W = Fs = \Delta E = \frac{1}{2}mv^2 \qquad u = 0$

$$F = \frac{1}{2}\frac{mv^2}{s} = \frac{1}{2}\frac{(9.11\times10^{-31}\,kg)(2\times10^{7}\,ms^{-1})^2}{(.5\times10^{-2}\,m)} = \underline{3.6\times10^{-14}\,N}$$

⑦ $\Sigma E_{before} = \Sigma E_{after}$



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

$$mgh - F_f s = \frac{1}{2}mv^2$$

$$F_f = \frac{mgh - \frac{1}{2}mv^2}{s}$$

$$= \frac{3kg\left(9.81ms^{-2}(3m) - \frac{1}{2}(2ms^{-1})^2\right)}{5m} = \underline{16\,N}$$

⑧ $\Sigma E_{before} = \Sigma E_{after}$

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

$$x = \sqrt{\frac{2mgh}{k}} = \sqrt{\frac{2(.3kg)(9.81ms^{-2})(.4m)}{200\,Nm^{-1}}}$$

$$= \underline{.1\,m}$$

⑨ $\Sigma E_{before} = \Sigma E_{after}$

$$\frac{1}{2}mv_1^2 - W_f = mgh + \frac{1}{2}mv_2^2$$

$$F_f = \frac{\frac{1}{2}mv_1^2 - mgh - \frac{1}{2}mv_2^2}{s}$$

$$= \frac{(2000kg)\left(\frac{1}{2}(20ms^{-1})^2 - (9.81ms^{-2})(10m) - \frac{1}{2}(5ms^{-1})^2\right)}{40m}$$

$$F_f = \underline{4000\,N}$$

(10) $E_b = mgh_b$ $\qquad E_a = mgh_a$

$$\text{Fraction lost} = \frac{E_b - E_a}{E_b} = \frac{mgh_b - mgh_a}{mgh_b}$$

$$= \frac{h_b - h_a}{h_b} = \frac{2.0m - 1.6m}{2.0m} = \underline{0.20}$$

the majority of the energy is lost to heat.

(11) $\sum E_b = \sum E_a$

$$\frac{1}{2}\cancel{m}v^2 + \cancel{m}gh_b = \cancel{m}gh_a$$

$$h_a = \frac{\frac{1}{2}v^2 + gh_b}{g} = \frac{\frac{1}{2}(10ms^{-1})^2 + (9.81ms^{-2})(20m)}{9.81ms^{-2}}$$

$$= 25m$$

No it does not make it the top of the other hill. It only goes up 25m.

(12) $\sum E_b = \sum E_a$

$$\frac{1}{2}kx^2 - W_f = 0$$

$$F_f = \frac{\frac{1}{2}kx^2}{s} = \frac{\frac{1}{2}(30Nm^{-1})(.20m)^2}{.7m} = \underline{0.9N}$$