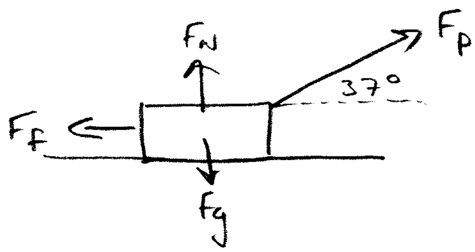
Work and Energy #2

① $W = Fd\cos\theta = (25N)(.8m) = \underline{20J}$

②



for constant speed
$F_p \cos 37 = F_f$
$F_f = \mu F_N$

F_N: $F_N + F_p \sin 37 - F_g = 0$
$F_N = mg - F_p \sin 37$

$F_f = \mu F_N$
$= \mu(mg - F_p \sin 37)$

$F_p \cos 37 = F_f = \mu(mg - F_p \sin 37)$

$F_p \cos 37 = \mu mg - \mu F_p \sin 37$

$F_p \cos 37 + \mu F_p \sin 37 = \mu mg$

$F_p(\cos 37 + \mu \sin 37) = \mu mg$

$F_p(\cos 37 + 0.4 \sin 37) = .4(20kg)(9.8 m/s^2)$

$F_p = 75.43 N$

$W = Fd\cos\theta$
$= (75.43 N)(8.0 m)\cos 37$
$= \underline{482 J}$

(7) $E_b = E_a$

$\frac{1}{2}mv^2 - F_f d = mgh + \frac{1}{2}mv'^2$

$\frac{1}{2}(2000\,kg)(20\,m/s)^2 - F_f(40\,m) = (2000\,kg)(9.8\,m/s^2)(10\,m) + \frac{1}{2}(2000\,kg)(5\,m/s)^2$

$F_f = -4475\,N$

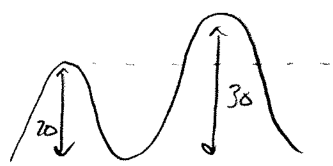
(8) Energy loss = $E_{after} - E_{before}$

fractional loss = $\frac{E_{after} - E_{before}}{E_{before}} = \frac{mgh_a - mgh_b}{mgh_b}$

$= \frac{1.6\,m - 2.0\,m}{2.0\,m} = -.2$ (negative just indicates loss of energy)

- Energy turned into heat, sound

(9)



$E_b = E_a$

$\frac{1}{2}mv^2 = mgh$ Solve for h
if $h > 10$ then the cart makes it to the top

$\frac{1}{2}(10\,m/s)^2 = (9.8\,m/s^2)h$

$h = 5.1\,m$

The roller coaster does not make it up the second hill. It only goes 5.1 m higher than it started so it made it 25.1 m up the second hill.

③ $W = E = \frac{1}{2} k x^2$

$$F = kx$$
$$(.2\,kg)(9.8\,m/s^2) = k(.1\,m)$$
$$k = 19.6\,N/m$$

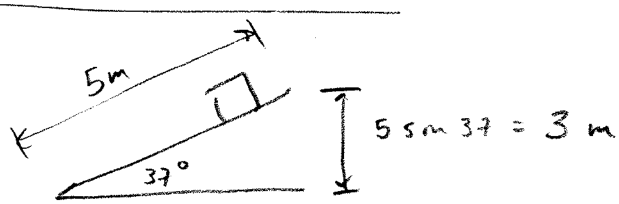
$$= \frac{1}{2}(19.6\,N/m)(.05\,m)^2$$
$$= \underline{0.0245\,J}$$

④ $W = E$

$$Fd = \frac{1}{2} m v^2$$
$$F(.005\,m) = \frac{1}{2}(9.1 \times 10^{-31}\,kg)(2 \times 10^7\,m/s)$$

$$\underline{F = 1.82 \times 10^{-21}\,N}$$

⑤



$$E_b = E_a$$
$$mgh - W_f = \frac{1}{2} m v^2$$
$$(3\,kg)(9.8\,m/s^2)(3\,m)^2 - W_f = \frac{1}{2}(3\,kg)(2\,m/s)^2$$

$$W_f = 82.2\,J$$
$$W_f = F_f d$$
$$82.2\,J = F_f(5\,m)$$
$$\underline{F_f = 16.4\,N}$$

⑥ $E_b = E_a$

$$mgh = \frac{1}{2} k x^2$$

$$(.3\,kg)(9.8\,m/s^2)(.4\,m) = \frac{1}{2}(200\,N/m)\,x^2$$

$$\underline{x = 0.11\,m}$$

(10) $\frac{1}{2}kx^2 = W_f = f_f d$

$\frac{1}{2}(30\,N/m)(.2\,m)^2 = F_f\,(.7\,m)$

$\underline{F_f = 0.86\,N}$