Physics 4A, Chpt 8: 32, 38, 40
48, 64, 78

(32) $E_i = E_f$

$U_i + KE_i = U_f + KE_f$

$mgh + 0 = mg2R + 0$

$\Rightarrow h = 2R$

(38) $E_A = E_B$

(a) $mg(3.8) = mg(2.6) + \frac{1}{2}mv^2$

$\Rightarrow v = \sqrt{2g(3.8-2.6)}$

$= \sqrt{23.52}$

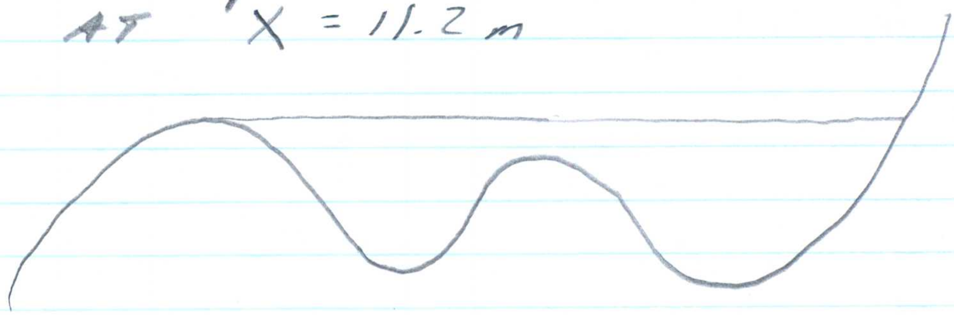
$= 4.85 \frac{m}{s}$

(b) $v = \sqrt{2g(3.8-1.3)}$

$= \sqrt{49}$

$= 7 \frac{m}{s}$

(38c) Draw horizontal line from point A: it intersects at $X = 11.2\ m$



(40) Turning points exist when $KE = 0$:

$$E_{TOT} = KE + U$$

$$= 0 + U$$

$$3.5 = 7 - 8x + 1.7x^2$$

$$\Rightarrow 1.7x^2 - 8x + 3.5 = 0$$

$$x = \frac{+8 \pm \sqrt{64 - 23.8}}{2(1.7)}$$

$$\boxed{x = .49 \text{ and } 8.7}$$

(48) $U(x) = 286(x-x_e)^2 - 6.22\times10^{12}(x-x_e)^2$

$$F = -\frac{dU}{dx}\bigg|_{x=.10\,nm} = 576(x-x_e) - 12.44\times10^{12}(x-x_e)$$

$$= -\Big(572(.10-.0741)\times10^{-9}m - 12.44\times10^{12}(.10-.0741)\times10^{-9}m\Big)$$

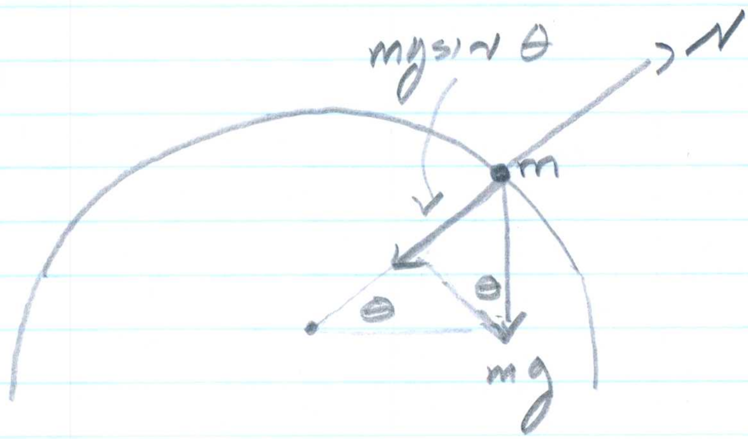
$$= 322.196\ N$$

(64) $$P = \frac{dE}{dt} = \frac{d(mc^2)}{dt}$$

$$\Rightarrow \frac{dm}{dt} = \frac{P}{c^2} = \frac{3.85\times10^{26}}{(3\times10^8)^2}$$

$$\Rightarrow \frac{dm}{dt} = 4.28\times10^9\ \frac{kg}{s}$$

(78)



- Think circular motion and find the speed at which the normal force is zero:

$$\Sigma \vec{F} = m\vec{a}$$

$$N - mg\sin\theta = -\frac{mv^2}{R}$$

with $N \to 0$

$$mg\sin\theta = \frac{mv^2}{R}$$

$$v^2 = Rg\sin\theta$$

Also, conservation of energy gives:

$$E_{top} = E_f \qquad \Rightarrow$$

$E_{top} = mgR$

$E_f = mgR\sin\theta + \frac{1}{2}mv^2$

$\Rightarrow mgR = mgR\sin\theta + \frac{1}{2}mv^2$ from previous page

$= mgR\sin\theta + \frac{1}{2}m(Rg\sin\theta)$

$\Rightarrow 1 = \sin\theta + \frac{1}{2}\sin\theta$

$\Rightarrow \frac{3}{2}\sin\theta = 1$

$\Rightarrow \sin\theta = \frac{2}{3}$

$\Rightarrow$ Bug leaves head at $\sin\theta = \frac{2}{3}$ or

at height : $R\sin\theta = \frac{2}{3}R$

Bug leaves at $\frac{2}{3}R$ from bottom which is $\frac{1}{3}R$ from top.