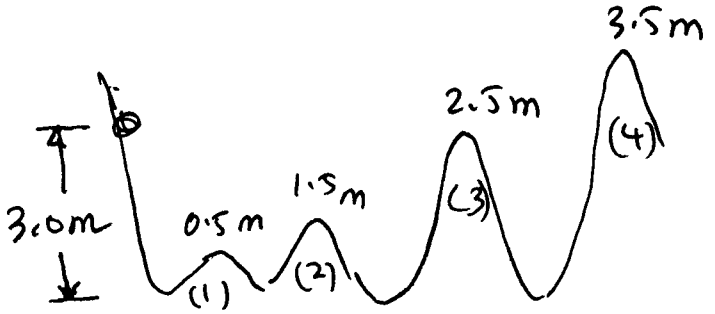
Q5



(a) hill #4.

(b) go back to its initial position

(c) $a = \frac{v^2}{r}$

Since all hill heights have identical tops, r is same for all hill heights.

Greatest centripetal acceleration means greatest v. From conservation of mechanical energy

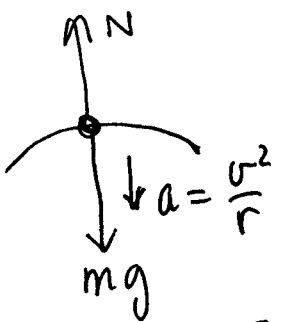
$$K_i + U_i = K_f + U_f$$

$$0 + mgy_i = \frac{1}{2}mv_f^2 + mgy_f$$

$$mg(y_i - y_f) = \frac{1}{2}mv_f^2$$

$$v_f^2 = 2g\underbrace{(y_i - y_f)}_{\text{greatest for hill (1).}}$$

(d)

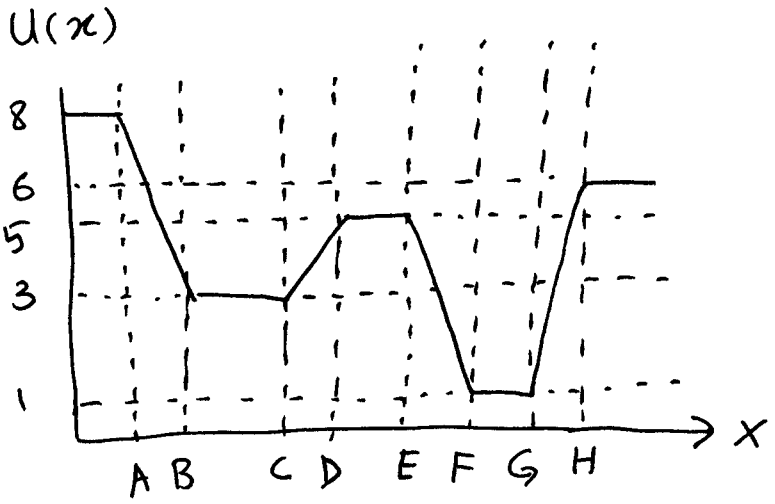


Newton's Second Law $N - mg = -m\frac{v^2}{r}$

$$N = \underbrace{mg - m\frac{v^2}{r}}_{\text{greatest for smallest } v}$$

$\Rightarrow$ N greatest for hill (3).

Q6



(a) $F = -\frac{dU}{dx}$ = − slope of U(x) curve.

$F_{AB} > F_{CD} > F_{BC} = F_{DE}$

(b) $E_{mech} < 5\ J$

(c) $E_{mech} < 5\ J$

(d) $E_{mech} < 6\ J$

(e) $E_{mech} = K + U = \text{constant}$

↑ maximum when U minimum

K greatest for FG region.

(f) region DE.

P1

$$U = \frac{k}{2}x^2$$

$$25 = \frac{k}{2}(0.075)^2$$

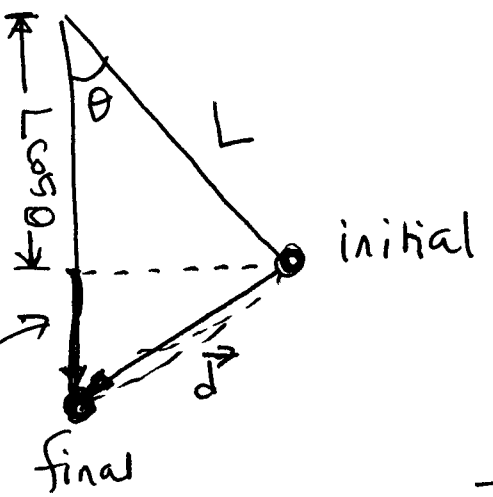
$$k = \frac{2(25)}{(0.075)^2} = 8.9 \times 10^3 \text{ N/m}$$

P8

(a) $W_g = \vec{F}_g \cdot \vec{d}$

$= F_g$ (projection of $\vec{d}$ along F_g)

$W_g = mg(L - L\cos\theta)$



(b) $\Delta U = mgy_f - mgy_i$

$= mg(y_f - y_i)$

$= mg(-(L - L\cos\theta))$

$= -mg(L - L\cos\theta)$

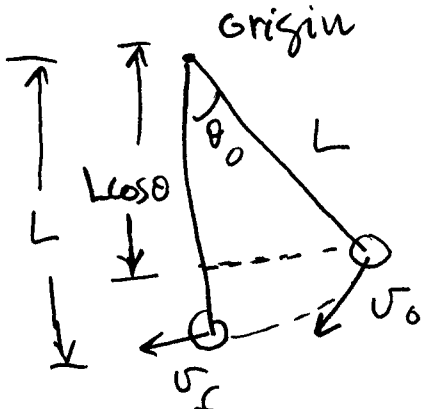
projection of $\vec{d}$ along $\vec{F}_g$

(c) $U_i = mg(L - L\cos\theta)$

(d) increase since increasing θ, means $\cos\theta$ decreasing.

Q18

(a) conservation of mechanical energy



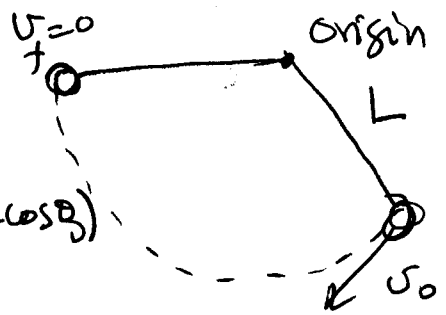
$$K_f + U_f = K_i + U_i$$

$$\frac{1}{2}mv_f^2 + mg(-L) = \frac{1}{2}mv_0^2 + mg(-L\cos\theta_0)$$

$$v_f^2 - 2L = v_0^2 - 2L\cos\theta_0$$

$$v_f = \sqrt{v_0^2 + 2L - 2L\cos\theta_0}$$

(b)

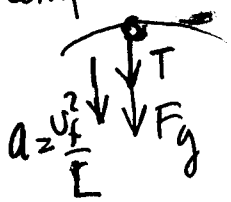


$$K_f + U_f = K_i + U_i$$

$$0 + 0 = \frac{1}{2}mv_0^2 + mg(-L\cos\theta_0)$$

$$v_0 = \sqrt{2gL\cos\theta_0}$$

(c) To have the cord remaining straight, Tension = 0 and the F_g is compensated by centripetal acceleration



newton second laws $-T - mg = -m\frac{v_f^2}{L} \Rightarrow v_f^2 = gL$ (T = 0)

$$K_f + U_f = K_i + U_i$$

$$\frac{1}{2}m(v_f^2) + mgL = \frac{1}{2}mv_0^2 + mg(-L\cos\theta_0)$$

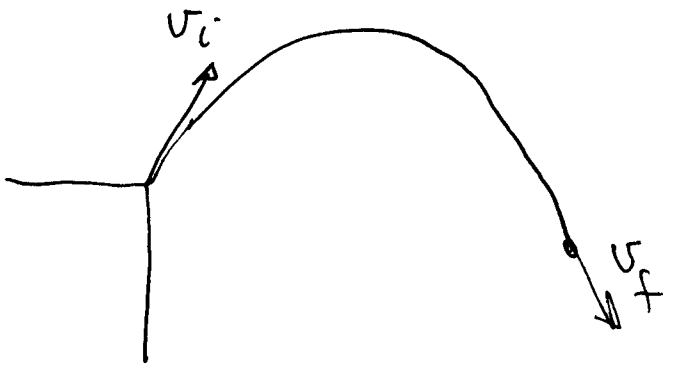
$$\frac{1}{2}gL + gL = \frac{1}{2}v_0^2 - gL\cos\theta_0$$

$$\frac{3}{2}gL + gL\cos\theta_0 = \frac{1}{2}v_0^2$$

$$v_0 = \sqrt{3gL + 2gL\cos\theta_0}$$

(d) (a) increases and (b) and (c) decrease.

P22



$$v_i = (18\hat{i} + 24\hat{j})\ m/s$$

$$\Delta U + \Delta K = 0$$

$$\Delta U = -\Delta K$$

$$= -\left(\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2\right)$$

$$= \frac{1}{2}(v_i^2 - v_f^2)$$

$$v_i = \sqrt{18^2 + 24^2} = 30\ m/s$$

v_f along x

$v_{f,x} = v_{i,x}$
$v_{f,x} = 18\ m/s$
} projectile motion, no acceleration along x

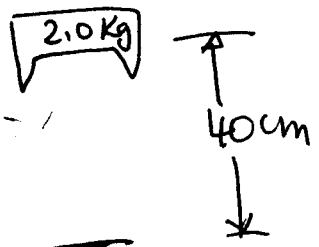
along y

$$v_{f,y} = v_{i,y} - gt$$
$$= 24 - (9.8)(6.0)$$
$$= -34.8\ m/s$$

$$v_f = \sqrt{18^2 + (34.8)^2} = 39.2 \text{ m/s}$$

$$\Delta U = \frac{1}{2}(30^2 - 39.2^2) = -320 \text{ J}$$

P25



Conservation of Mechanical energy

$$K_i + U_i = K_f + U_f$$

$$0 + mg(0.4) = 0 + mg(-d) + \frac{k}{2}d^2$$

$$2(9.8)(0.4) = -2(9.8)d + \frac{1960}{2}d^2$$

$$2(9.8)(0.4) = -2(9.8)d + 980d^2$$

divide by 9.8

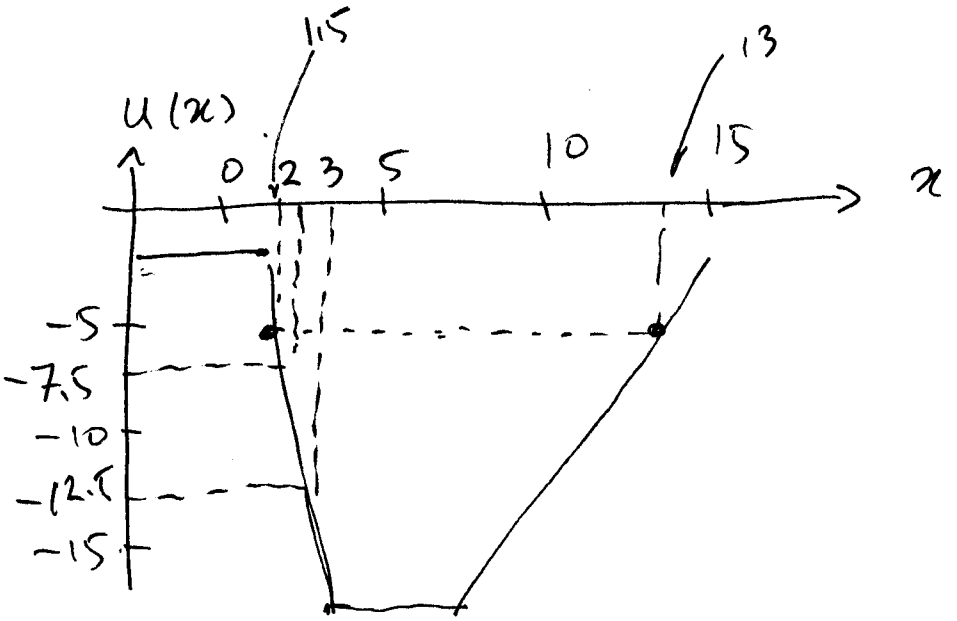
$$(0.8) + 2d - 100d^2 = 0$$

$$50d^2 + d - 0.4 = 0$$

$$d = \frac{-1 + \sqrt{1 - 4(50)(0.4}}{2(50)}$$

$$= .08 \text{ m}$$

P36



(a) $F(x) = -\left(\frac{dU(x)}{dx}\right)$ ← slope of the U curve at $x = 2$ m.

$$\frac{\Delta U}{\Delta x} = \frac{-12.5-(-7.5)}{3-2}$$

$$= -5 \text{ N}$$

$F = 5$ N in the positive x direction.

(b) We need to know the mechanical energy

$$E_{mech} = K + U$$

↑ ↖ from graph $= -7.5$ J

$$\frac{1}{2}(2.0)(1.5)^2 = 2.25 \text{ J}$$

$$E_{mech} = 2.25 - 7.5 = -5.25$$

so it will move between $x = 1.5$ to 13 m.

(c) at $x = 7$, $U = -17.5$

$$E_{mec} = K + U$$

$$-5.25 = \frac{1}{2}mv^2 - 17.5$$

$$v^2 = 2(-5.25+17.5)/2 \Longrightarrow v = 3.5 \text{ m/s}$$

Oct 21, 01

CH8-Rec-8

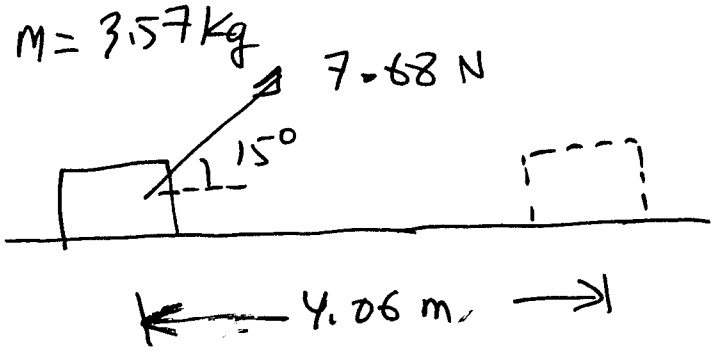
P41

(a) $W = \vec{F} \cdot \vec{d}$

$= Fd\cos\theta$

$= (7.68)(4.06)\cos 15^\circ$

$= 30.1\ J$



(b) $W = \Delta K + \Delta U + \Delta E_{th}$

$= 0 + 0 + \Delta E_{th}$ ← constant speed

$\Delta E_{th} = 30.1\ J$

(c) $\Delta E_{th} = f_k d \Rightarrow f_k = \frac{30.1}{4.06}$

$\mu_k = \frac{f_k}{N} = \frac{f_k}{mg} = 0.21$