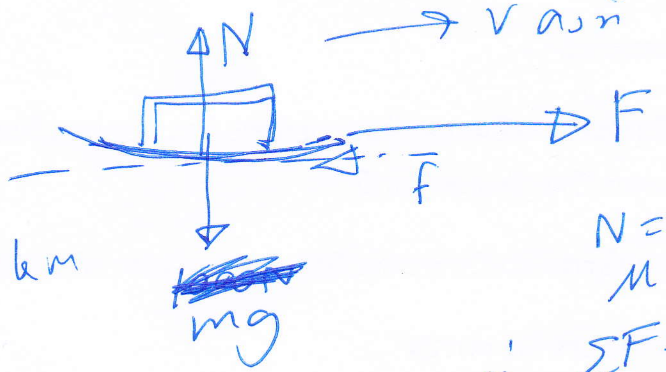
เฉลย พลังงาน

และการส่งผ่านพลังงาน

(4.1)



$\downarrow g = 10\ m/s^2$

$S = 2\ km$

$N = mg$

$\mu = 0.15,\ m = 100\ kg$

(ก) $W_F = FS$, แต่ $\Sigma F = 0$

$F = f = \mu N$

$= fS = \mu mgS$

$= 0.15 \times 1000 \times 2 \times 10^3$

$= 300 \times 10^3\ J = 300\ kJ$ #

(ข) $W_f = -fS = -\mu mgS$

$= -300\ kJ$

(4.2) $W_F = \int_1^5 F\,dx = \int_1^5 (3x^2 - 4)\,dx$

$= (x^3 - 4x)\Big|_{x=1}^{5}$

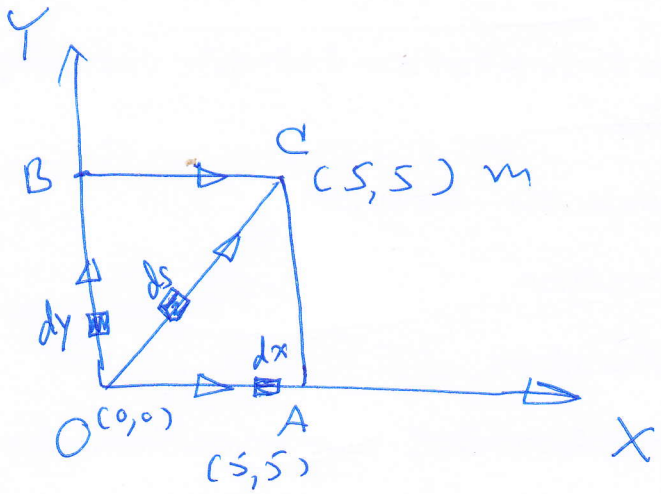
$= (125 - 1) - 4(5 - 1) = 124 - 16$

$= 108\ J$

งานเนื่องจากแรงลัพธ์ $= W_F - W_f$

$= 108 - 2 = 106\ J$ #

4.3



$$\vec{ds} = (dx)\hat{i} + (dy)\hat{j}$$

$$W_{OBC} = \int_{(0,0)}^{} F\,ds = W_{OB} + W_{BC}$$

$$= \int_0^5 (3\hat{i} + 4\hat{j}) \cdot dy\,\hat{j} \quad \cancel{= 4\int_0^5 dy = 20\ J}$$

$$+ \int_0^5 (3\hat{i} + 4\hat{j}) \cdot dx\,\hat{i}$$

$$= 4\int_0^5 dy + 3\int_0^5 dx = 20 + 15 = 35\ J$$

$$W_{OAC} = W_{OA} + W_{AC} = \int_0^5 (3\hat{i} + 4\hat{j}) \cdot dx\,\hat{i}$$

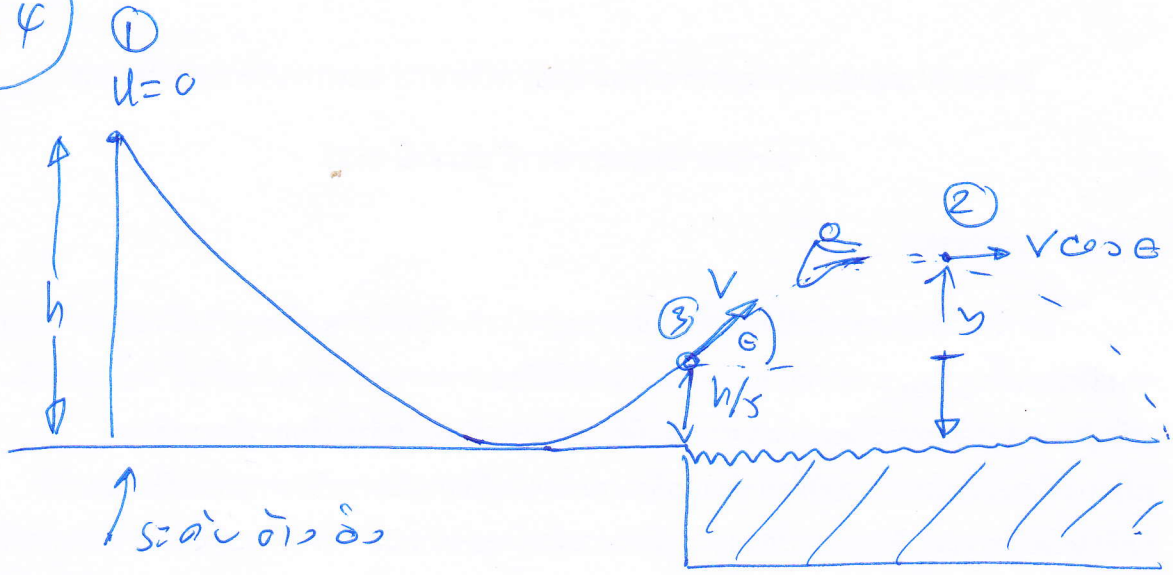
$$+ \int_0^5 (3\hat{i} + 4\hat{j}) \cdot dy\,\hat{j}$$

$$= 3\int_0^5 dx + 4\int_0^5 dy = 15 + 20 = 35\ J$$

$$W_{OC} = \int_{(0,0)}^{(5,5)} (3\hat{i} + 4\hat{j}) \cdot (dx\,\hat{i} + dy\,\hat{j})$$

$$= 3\int_0^5 dx + 4\int_0^5 dy = 15 + 20 = 35\ J \ \#$$

4.4



$$E_1 = E_2$$

$$mgh = mg(y) + \frac{1}{2}m(V\cos\theta)^2 \quad \text{——— (1)}$$

$$E_3 = E_2$$

$$\frac{1}{2}mv^2 + mg\left(\frac{h}{5}\right) = mgy + \frac{1}{2}m(V\cos\theta)^2$$

$$E_1 = E_3$$

$$mgh = mg\frac{h}{5} + \frac{1}{2}mv^2$$

$$\frac{1}{2}mv^2 = mg\frac{4h}{5} \quad \text{——— (2)}$$

Πλυς (2) στο (1) ⟹

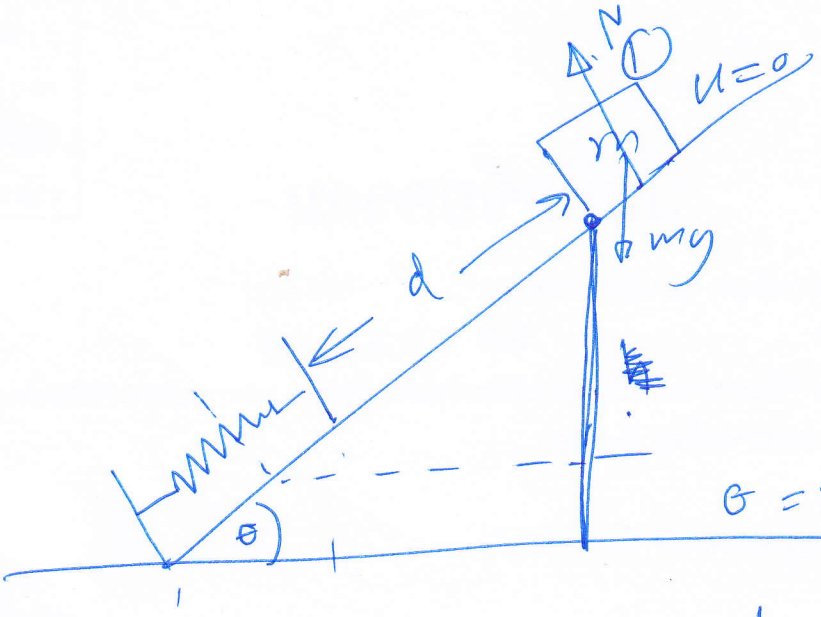
$$mgh = mgy + \frac{1}{2}mv^2\cos^2\theta$$

$$= mgy + mg\frac{4h}{5}\cos^2\theta$$

$$y = h - \frac{4h}{5}(1-\sin^2\theta) = \frac{h}{5} + \frac{4h}{5}\sin^2\theta$$

$$= \frac{h}{5}(1+4\sin^2\theta) \quad \text{———} \quad \#$$

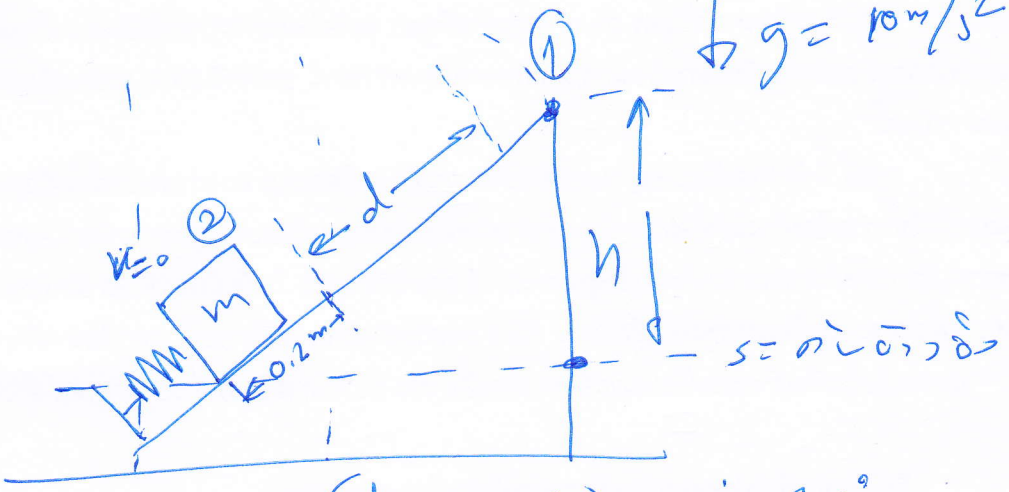
(4.3)



$m = 3\ kg$

$k = 400\ N/m$

$g = 10\ m/s^2$



$$h = (d + 0.2)\sin 30°$$

$$E_1 = E_2$$

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

$$30(d + 0.2)\tfrac{1}{2} = \frac{1}{2}400 \times (0.2)^2$$

$$30d + 6 = 400 \times 0.04$$

$$= 16$$

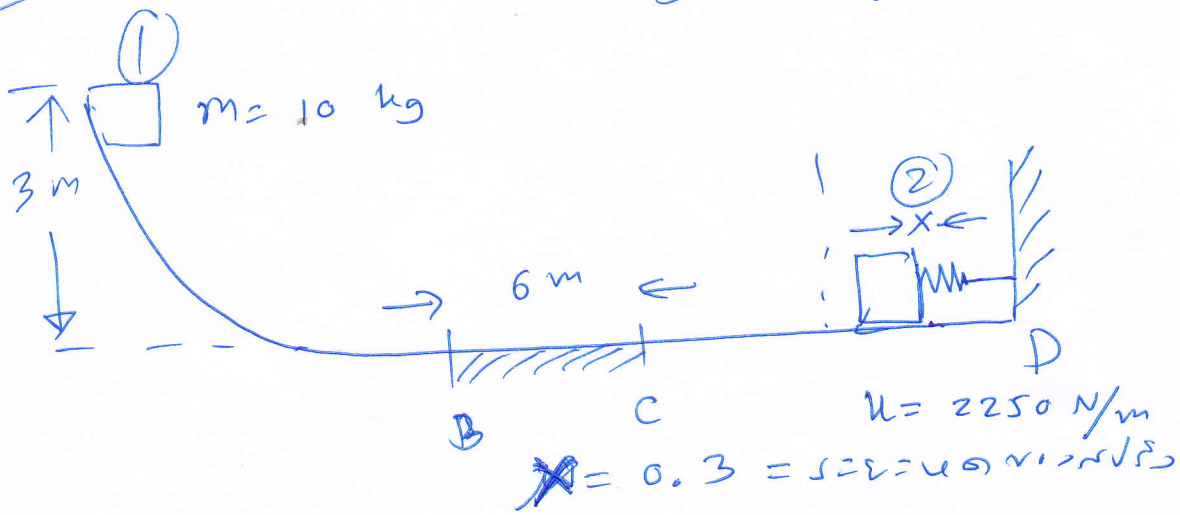
$$30d = 10$$

$$d = \frac{10}{30}$$

$$= 0.33\ m \quad \#$$

4,6

$g = 10\ m/s^2$



$\mu = 0.3$

$W_{ext} = E_2 - E_1$

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

$-\mu mg s = \frac{1}{2}kx^2 - mgh$

$-\mu 100 \times 6 = \frac{1}{2} \times 2250 \times (0.3)(0.3) - 100 \times 3$

$-600\mu = 101.25 - 300$

$\mu = \frac{300 - 101.25}{600} = 0.33125$ #

4,7

(a) $W = E_2 - E_1 = \frac{1}{2}mv^2 = \frac{1}{2} \times 1500 \times 100$

$= 75000 J = 75\ kJ$

(b) $P_{rata} = \frac{W}{t} = \frac{75\ kJ}{3\ s} = 25\ kW$

4.8

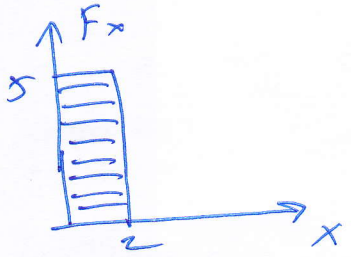
$W_{0\to 2m} = 5 \times 2 = 10\ J$

$= E_2 - E_1^{\,0}$

$10 = \frac{1}{2}mv^2 = \frac{1}{2} \times 5v^2$

$v^2 = \frac{20}{5} = 4$

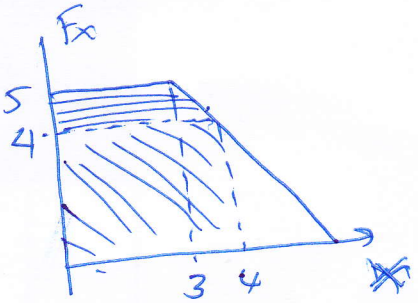
$v = 2\ m/s$



$W_{0-4m} = 4 \times 4 + \frac{1}{2} \times 1(3+4)$

$= 16 + 3.5$

$= 19.5\ J$



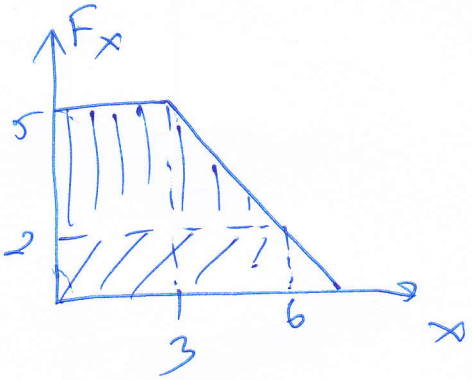
ทดสอบ $W_{0-4m} = \frac{1}{2}mv^2$

$19.5 = \frac{1}{2} \times 5v^2$

$v^2 = \frac{39}{5} = 7.8 \Rightarrow v = 2.79\ m/s$

$W_{0-6m} = 2 \times 6 + \frac{1}{2} \times 3(3+6)$

$= 12 + 13.5 = 25.5\ J$



ทดสอบ $W_{0-6m} = \frac{1}{2}mv^2$

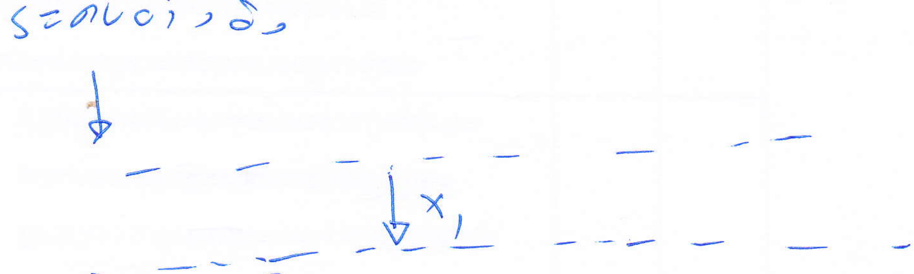
$25.5 = \frac{1}{2} \times 5v^2$

$v^2 = \frac{51}{5} = 10.2 \Rightarrow v = 3.19\ m/s$

#

(4.9)

(ก)

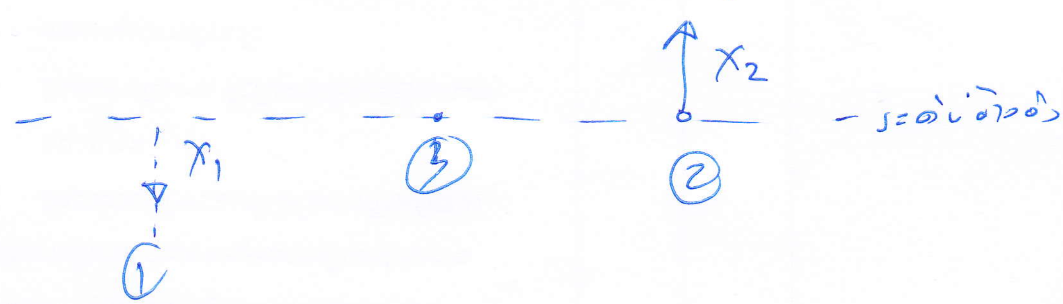


$$E = \frac{1}{2}kx_1^2 - mgx_1$$

$$= \frac{1}{2} \times 2.5\times10^4 \times (0.1)^2 - 250(0.1)$$

$$= 125 - 25 = 100 \text{ J} \quad \#$$

(ข)



$$E_1 = E_2$$

$$100 \text{ J} = mgx_2$$

$$100 = 250x_2$$

$$x_2 = \frac{100}{250} = 0.4 \text{ m} \quad \#$$

(ค)

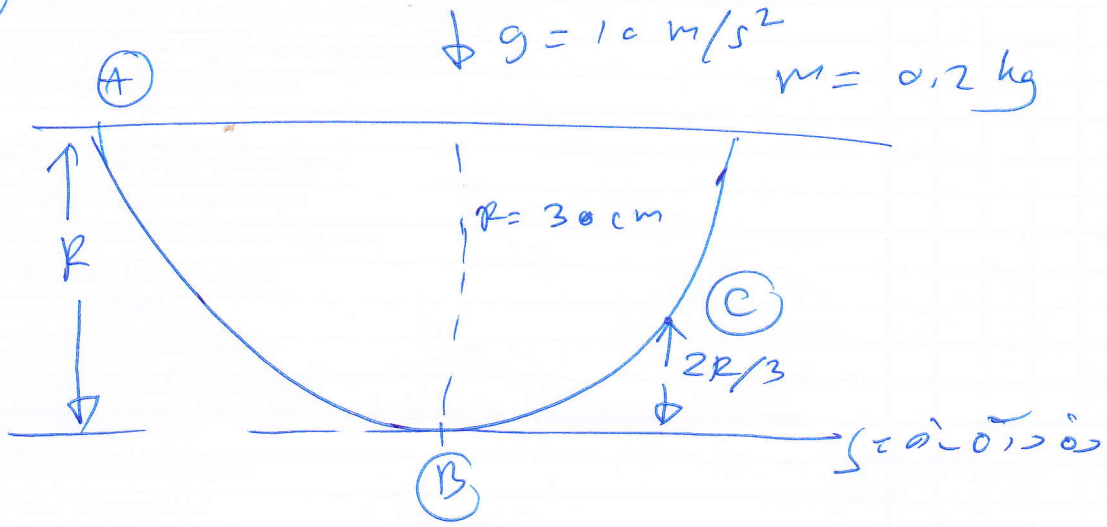
$$E_1 = E_3$$

$$100 = \frac{1}{2}mv^2 = \frac{25}{2}v^2$$

$$v^2 = \frac{200}{25} = 8$$

$$v = \sqrt{8} = 2\sqrt{2} \quad \text{m/s} \quad \#$$

4.10



(1) $E_{PA} = mgR$, $E_{PB} = 0$

$= 0.2 \times 10 \times 0.3 = 0.6$ J

(2) $E_{uB} = E_{PA} = 0.6$ J

(3) $E_{kB} = 0.6 = \frac{1}{2} m v^2 = \frac{0.2}{2} v^2$

$v^2 = 6 \Rightarrow v = \sqrt{6}$ m/s

(4) $E_{PA} = E_{PC} + E_{uC} = 0.6$

$E_{PC} = mg\left(\frac{2R}{3}\right) = 0.2 \times 10 \times \frac{2 \times 0.3}{3}$

$= 0.4$ J

$\Rightarrow$ $E_{uC} = 0.6 - E_{PC} = 0.6 - 0.4$ J

$= 0.2$ J #

4.11

$$W = \vec{F} \cdot \vec{s}$$

$$P = \frac{W}{t} = \frac{\vec{F} \cdot \vec{s}}{t} = \vec{F} \cdot \vec{v}$$

ไม่มี $v = u + at = 0 + at$

ไม่มี $F = ma \Rightarrow a = \frac{F}{m}$

$$\Rightarrow P = Fv = Fat$$

$$= F\left(\frac{F}{m}\right)t = \frac{F^2 t}{m} \quad \#$$

4.12

$m = 80 \times 10^3$ kg

$V = 900$ km/hr $= \frac{900 \times 10^3}{3600}$ m/s

$= 250$ m/s

10 km

$E = E_k + E_p$

$= \frac{1}{2}mv^2 + mgh$

$= \frac{1}{2} \times 80 \times 10^3 \times (250)^2 + 80 \times 10^3 \times 10 \times 10 \times 10^3$

$= 2.5 \times 10^9 + 8 \times 10^9 = 10.5 \times 10^9$ J

$= 10.5$ GJ $\#$