

Homework #2

1(a)

$$\vec{v} = 3\hat{i} - 18t^2\hat{j}$$

(b)

$$\vec{a} = -36t\hat{j}$$

2.

(a)

$$V^2 = V_0^2 + 2aS$$

$$V = \sqrt{2 \times 1.9 \times 200} = 2\sqrt{190} \\ \approx 27.57$$

$$h = 200 \sin 35^\circ \approx 114.72$$

$$y_{\text{Max}} = h + \frac{V_y^2}{2g}$$

$$\approx 114.72 + 12.75 \approx 127.47 \text{ m}$$

(b)

$$h + V_y \cdot t - \frac{1}{2}gt^2 = 0, \quad t \approx 6.71$$

$$x_{\text{Max}} = V_x \cdot t + 200 \cos 35^\circ$$

$$\approx 151.62 + 163.83 \approx 315.45 \text{ m}$$

3.

(a)

$$\frac{72}{(6+12)} = 4 \text{ m/s}^2$$

(b)

$$12 \times 4 = 48 \text{ N}$$

(c)

$$6 \times 4 = 24 \text{ N}$$

4.

$$\frac{mv^2}{r} = mg + N_B$$

$$\frac{0.8 \times V^2}{5} = 0.8 \times 9.8 + 6$$

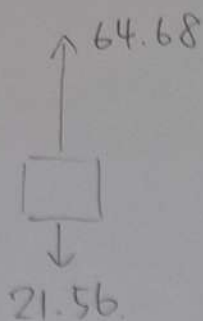
$$V \approx 9.3$$

$$\frac{mv^2}{r} = N_A - mg$$

$$\frac{0.8 \times (9.3)^2}{5} = N_A - 0.8 \times 9.8$$

$$N_A \approx 21.68 \text{ N}$$

5.



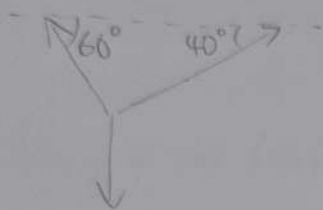
$$2.2 \times 9.8 = 21.56$$

$$21.56 \times 3 = 64.68$$

$$\frac{(64.68 - 21.56)}{2.2} = 19.6 \text{ m/s}^2 \uparrow$$

6.

(a)



$$T_{60^\circ} \cos 60^\circ = T_{40^\circ} \cos 40^\circ$$

$$\because \cos 60^\circ < \cos 40^\circ$$

$$\therefore T_{60^\circ} > T_{40^\circ}$$

(b)

當 T_{60° 達 5000 N,

$$T_{40^\circ} = \frac{5000 \cos 60^\circ}{\cos 40^\circ} \doteq 3263.5 \text{ N}$$

$$W_{\text{Max}} = T_{60^\circ} \sin 60^\circ + T_{40^\circ} \sin 40^\circ$$

$$\doteq 6427.9$$

$$m = \frac{W_{\text{Max}}}{g} \doteq 655.9 \text{ kg}$$

7.

$$a = \frac{m_c g}{(m_A + m_B + m_c)}$$

$$f_{\text{Max}} = \mu_s m_B g \geq m_B a$$

$$\Rightarrow a \leq \mu_s g$$

$$\frac{m_c g}{(m_A + m_B + m_c)} \leq \mu_s g$$

$$m_{c\text{Max}} = \frac{0.75(8+5)}{1-0.75} = 39 \text{ kg} \neq$$

8.

(a)

$$ma = mg - c v^2 \neq$$

(b)

達終端速度 V_t , $a=0$

$$\rightarrow 0 = mg - c V_t^2, \quad V_t = \sqrt{\frac{mg}{c}} \neq$$

(c)

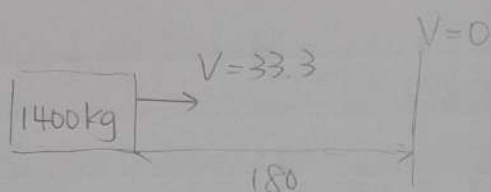
$$\frac{V(t)}{V_t} = \tanh\left(\frac{g}{V_t} t\right)$$

$$V(t) = V_t \cdot \tanh\left(\frac{g}{V_t} t\right) = V_t \frac{1 - e^{-2\left(\frac{gt}{V_t}\right)}}{1 + e^{-2\left(\frac{gt}{V_t}\right)}} \neq$$

(d)

$$V_t = \sqrt{\frac{mg}{c}} = \sqrt{\frac{60 \times 9.8}{0.430}} \doteq 36.98 \neq$$

9.



(a)

$$V^2 = V_0^2 + 2aS$$

$$0 = (33.3)^2 + 2a \times 180$$

$$a = -3.08 \text{ m/s}^2$$

(b)

$$F_{\text{avg}} = m \cdot |a|$$

$$= 1400 \times 3.08 = 4312.35 \text{ N}$$

(c)

$$F_{\text{avg}} = \mu_s mg$$

$$4312.35 = \mu_s \times 1400 \times 9.8, \quad \mu_s = 0.31$$

10.

$$f = \mu Mg \sin \theta$$

(a) 當摩擦 force 向下: $F_s = Mg \sin \theta + \mu Mg \cos \theta$

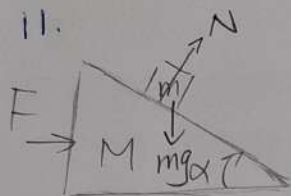
$$x_{\text{伸}} = \frac{F_s}{k} = \frac{Mg (\sin \theta + \mu \cos \theta)}{k}$$

(b)

當摩擦 force 向上: $F_s = Mg \sin \theta - \mu Mg \cos \theta$

$$x_{\text{壓縮}} = \frac{F_s}{k} = \frac{Mg (\sin \theta - \mu \cos \theta)}{k}$$

11.



(a)

$$\begin{cases} N \cos \alpha = mg \\ N \sin \alpha = ma \end{cases} \quad a = g \tan \alpha$$

$$F = (M+m) \cdot a = (M+m) \cdot g \tan \alpha$$

(b)

保持高度 \rightarrow 小於最大靜摩擦力

$$|m(g \sin \alpha - a \cos \alpha)| \leq \mu mg \cos \alpha$$

12.

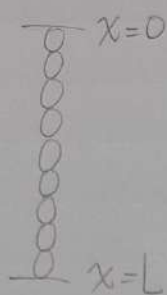
$$V^2 = V_0^2 + 2aS$$

$$0 = (-30)^2 + 2 \cdot a \times (-80) \quad , \quad a = 5.625$$

$$F - mg = ma$$

$$F = m(a+g) = 20(5.625 + 9.8) = 308.5 \text{ N}$$

13.



$$T(x) = pg(L-x)$$

$$k' \cdot dx = k \cdot L$$

$$k' = k \frac{L}{dx}$$

$$dL = \frac{T(x)}{k'} = \frac{pg(L-x)}{kL} dx$$

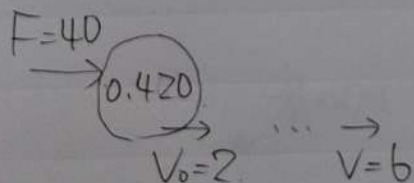
$$\Delta L = \int_0^L dL = \frac{pg}{kL} \int_0^L (L-x) dx$$

$$= \frac{pg}{kL} \left[Lx - \frac{1}{2}x^2 \right]_0^L$$

$$= \frac{pg}{kL} \cdot \frac{L^2}{2} = \frac{pgL}{2k}$$

$$\text{總長} = L + \Delta L = L + \frac{pgL}{2k} *$$

14.

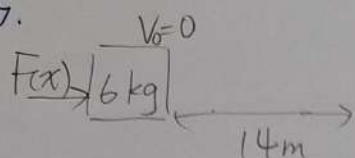


$$\Delta K = \frac{1}{2} \times 0.420 \times (6^2 - 2^2) = 6.72$$

$$W = Fd = \Delta K$$

$$d = \frac{\Delta K}{F} = \frac{6.72}{40} = 0.168 \text{ m} *$$

15.



$$F(14) = 18 - 0.530 \times 14 = 10.58$$

$$F_{avg} = \frac{F(0) + F(14)}{2} = 14.29$$

$$W = F_{avg} \times \Delta \vec{x}$$

$$= 14.29 \times 14 = 200.06$$

$$W = \Delta K = \frac{1}{2} \times 6 \times (V^2 - V_0^2) = 200.06$$

$$V \approx 8.17 \text{ m/s}^*$$

16.

$$(a) \quad \frac{5}{10} \times 3600 = 1800, \quad \text{run: } E = 700 \times 1800 = 1.26 \times 10^6 \text{ J}$$

$$\frac{5}{3} \times 3600 = 6000, \quad \text{walk: } E = 290 \times 6000 = 1.74 \times 10^6 \text{ J}^*$$

$$\Rightarrow \text{run} < \text{walk}^*$$

(b)

走路所需時間較長,

累積消耗能量較多