H.W. (I)

2.70

P1, $x_1(t) = 6t^2 + 3t + 2$

P2, $a_2(t) = -8t$,
$V_2(0) = 15$

for P1, $V_1(t) = 12t + 3$

P2, $V_2(t) = -4t^2 + \text{const}$,

$\because V_2(0) = 15 = \text{const}$,

$\Rightarrow V_2(t) = -4t^2 + 15$

$V_1 = V_2 \Rightarrow 12t + 3 = -4t^2 + 15$

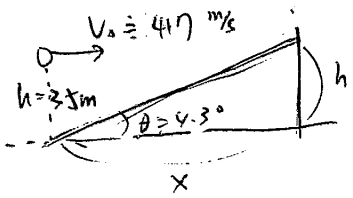
$\Rightarrow 4t^2 + 12t - 12 = 0$

$\Rightarrow t^2 + 3t - 3 = 0$

$t_m = \frac{-3 \pm \sqrt{9+12}}{2} = \frac{-3+\sqrt{21}}{2}$

$V_1(t_m) = V_2(t_m) = -18 + 6\sqrt{21} + 3 = 6\sqrt{21} - 15$ #

2.74

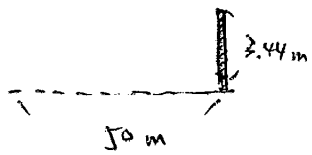


$\frac{h}{x} = \tan 4.3°$

$x = V_0 t \Rightarrow \frac{h}{V_0 t} = \tan 4.3°$

$\Rightarrow t = \frac{35}{417} \cot 4.3° \doteq 1.116$ s #

4-49,



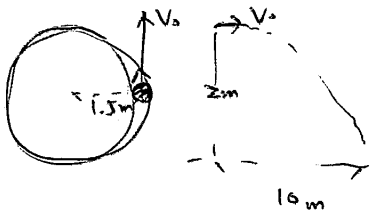
$\begin{cases} V_x = 25\cos\theta \\ V_y = 25\sin\theta - gt \end{cases}$ $\quad \begin{cases} x = (25\cos\theta)\cdot t \\ y = (25\sin\theta)t - \frac{1}{2}gt^2 \end{cases}$

$\because 50 = t \cdot 25\cos\theta \Rightarrow t = 2\sec\theta$

$\therefore 3.44 = 50\tan\theta - \frac{1}{2}g\sec^2\theta$

$\Rightarrow$ (a) 31°, (b) 63°

4.67,



$\begin{cases} V_0 t = 10\text{m} \\ 2 = \frac{1}{2}gt^2 \Rightarrow t = \frac{2}{\sqrt{g}} \end{cases}$

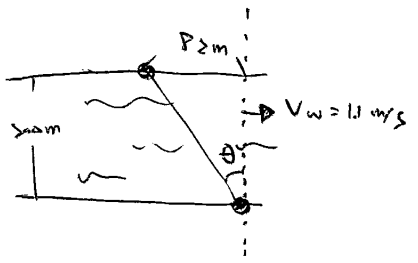
$\Rightarrow V_0 = \frac{10\sqrt{10}}{2} = 5\sqrt{10}$

$g = 10$ m/s²

$V_0 = r\omega \Rightarrow \omega = \frac{5}{1.5}\sqrt{10} = \frac{10}{3}\sqrt{10}$

$a = r\omega^2 = 166.7$ m/s² #

4. 82



$$S_t = \sqrt{200^2 + (82 + 1.1t)^2}$$

$$\Rightarrow t \doteq 48 \text{ (s)} \quad \#$$

$$\theta \doteq 34^\circ \quad \#$$

4. 111 (a) $V = \frac{2\pi R}{T} = \frac{2\pi (6.37 \times 10^6)}{86400} \doteq 463$ m/s

$$a = \frac{V^2}{R} \doteq 0.0337 \text{ m/s}^2 \quad \#$$

(b) $a = \frac{4\pi^2 R}{T^2} = 9.8 \text{ m/s}^2 \Rightarrow T = 2\pi\sqrt{\frac{R}{a}} = 84$ min #

5. 11. $X(t) = 3 + 4t + ct^2 - 2t^3$

$V(t) = 4 + 2ct - 6t^2$

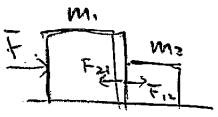
$a(t) = 2c - 12t$

$F(t) = m\,a(t)$

$\therefore F(3) = 2(2c - 36) = -36$

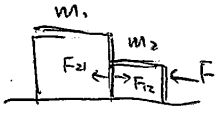
$\Rightarrow c = 9$ (m/s²) #

5. 55



(a) $F = 3.2$ N $= (2.3 + 1.2)\,a_{total} \Rightarrow a_{total} = \frac{32}{35}$ m/s²

$F_{12} = 1.2 \times \frac{32}{35} \doteq 1.1$ N #



(b) $F_{12} + (-F) = 1.2 \times \left(-\frac{32}{35}\right)$

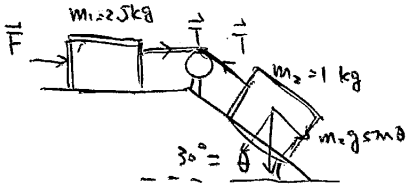
$\Rightarrow F_{12} = 3.2 - 1.1 = 21$ N #

(c) ∵ $m_1 > m_2$，且兩者 m_1、m_2 皆有 a 之加速度

∴ F_{12} in (b) is larger than F_{12} in (a)

APOLLO

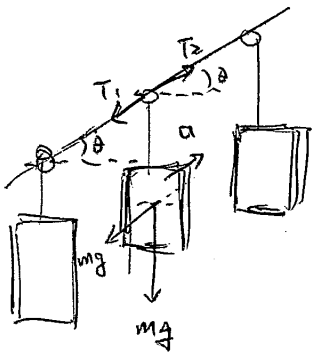
5.64



(a) $\begin{cases} F + T = m_1 a \\ m_2 g \sin\theta - T = m_2 a \end{cases} \Rightarrow \begin{cases} a = 2.1\ m/s^2 \\ T = 2.8\ N \end{cases}$ #

(b) $T = 0 \Rightarrow \begin{cases} F = m_1 a \\ m_2 g \sin\theta = m_2 a \end{cases} \Rightarrow \begin{cases} a = 4.9\ m/s^2 \\ F = 12.25\ N \end{cases}$ #

5.66,

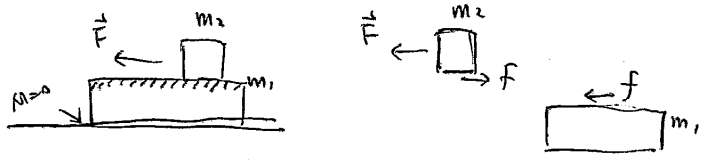


$T_2 - T_1 - mg\sin\theta = ma$

$\Rightarrow \Delta T \doteq 1.8 \times 10^4\ N$ #

$m = 2500\ kg$.

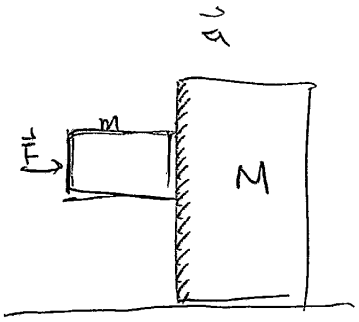
6.24

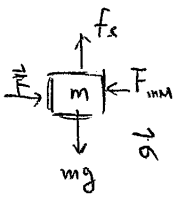


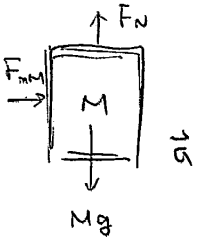
$\begin{cases} f - F = m_2 a_2 \\ -f = m_1 a_1 \end{cases}$

$\begin{cases} a_2 = \dfrac{\mu_k m_2 g - F}{m_2} \doteq -6.1\ m/s^2 \\ a_1 = \dfrac{-\mu_k m_2 g}{m_1} \doteq -1.2\ m/s^2 \end{cases}$

6.35







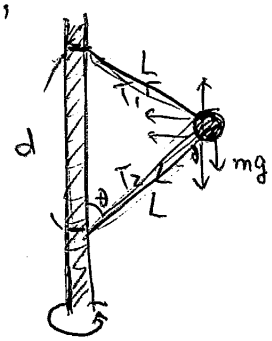
$F = (m+M)\,a$

$\Rightarrow a = \dfrac{F}{m+M}$

$$\begin{cases} f_s = mg \\ F - F_{mM} = ma \end{cases} \Rightarrow \begin{cases} \mu_s F_{mM} = mg \\ F - F_{mM} = \dfrac{m}{m+M} F \end{cases}$$

$$\Rightarrow F = \frac{mg}{\mu_s\left(1 - \frac{m}{M+m}\right)} \doteq 5.6 \times 10^2 \text{ N}$$

6.59,



$$\begin{cases} T_1 \sin\theta + T_2 \sin\theta = \dfrac{mv^2}{L\sin\theta} \\ T_1 \cos\theta - T_2 \cos\theta - mg = 0 \end{cases}$$

$$\Rightarrow \begin{cases} \frac{3}{4} T_1 + \frac{3}{4} T_2 = \frac{1.34}{1.7} v^2 \\ \frac{1}{2} T_1 - \frac{1}{2} T_2 - 1.34 \times 9.8 = 0 \end{cases}$$

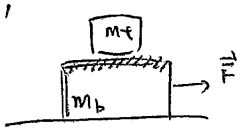
(a) $T_2 \doteq 8.94$ N

(b) 37.9 N

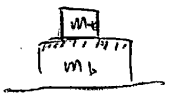
(c) 6.45 m/s

(d) radially inward.

6.61,



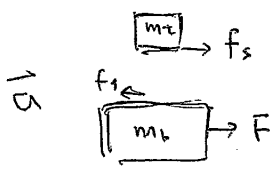
μ_s ?



$12 = \mu_s m_t g \Rightarrow \mu_s \doteq 0.31$

$\therefore f_s$ maximum $= 12$ N

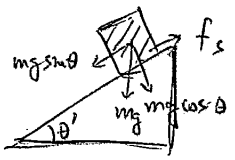
(a)



$$\begin{cases} F = (m_b + m_t)\,a \\ f_s = m_t a \\ F - f_s = m_b a \end{cases} \Rightarrow \begin{cases} F = 27 \text{ N} \\ a = 3 \text{ m/s}^2 \end{cases}$$

#

6.76,



$f_s = mg\cos\theta \cdot \mu_s$

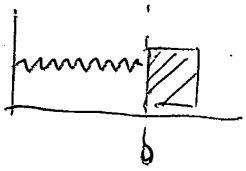
$mg\sin\theta = mg\cos\theta = \mu_s$

$\Rightarrow \mu_s = \tan^{-1}\theta'$

$\tan^{-1}\theta' = \mu_s \Rightarrow \theta' \doteq 21.8°$

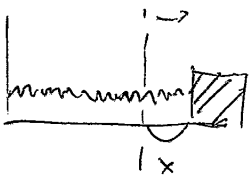
$\therefore \phi = \theta - \theta' \doteq 23.2°$ #

7.33,



(a) $F_x = \frac{1}{2}kx^2 \Rightarrow x \doteq 0.12\ m$ #

(b) $W = Fx = 3 \times 0.12 = 0.36\ J$ #



(c) $-0.36\ J$ #

(d) $F_x = K + \frac{1}{2}kx^2 \Rightarrow K = \frac{-1}{2}kx^2 + F_x = -25(x-\frac{3}{50})^2 + \frac{9}{100}$

when $x = 0.06\ m$

K is maximum #

(e) $0.09\ J$ #

7.39, $\bar{F}(x) = cx - 3x^2$, along x-axis

$W = \Delta K \Rightarrow \int_0^3 F(x)\,dx = \Delta K = 11 - 20 = -9$

$\Rightarrow \left(\frac{c}{2}x^2 - x^3\right)\Big|_0^3 = -9$

$\Rightarrow \frac{9}{2}c - 27 = -9$

$\Rightarrow c = 4\ (N/m)$ #

7.52, $P = \frac{dW}{dt} \Rightarrow P\,dt = dW = d\left(\frac{1}{2}mv^2\right)$ ($W = \Delta K$)

$\Rightarrow P\,dt = mv\,dv$

$\Rightarrow P\int_0^t dt = \int_0^{v_t} mv\,dv$

$\Rightarrow Pt = \frac{1}{2}mv_t^2$

$L = \int_0^T v_t\,dt$

$= \int_0^T \left(\frac{2Pt}{m}\right)^{1/2} dt$

$= \sqrt{\frac{2P}{m}}\left(\frac{2}{3}\right)T^{3/2}$

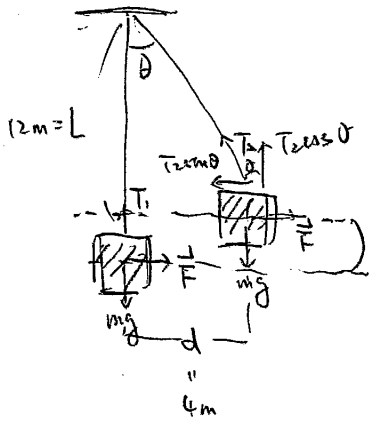
$\Rightarrow P = \frac{9mL^2}{8}T^{-3}$

$\therefore dP = \frac{-27mL^2}{8}T^{-4}\,dT$

$\Rightarrow dT = \frac{T}{-3P}\,dP$ #

7.57,

(a) $\begin{cases} T_2 \sin\theta = F \\ T_2 \cos\theta = mg \end{cases} \Rightarrow \begin{cases} T = 2391\ N \\ F = 797\ N \end{cases}$ #



(b) $W = \Delta K = 0$

(c) $W_g = \vec{F}_g \cdot \vec{\Delta s}$

$= |mg| \times |L(1-\cos\theta)|\ (-1)$

$\doteq -1547\ J$ #

(d) 0

(e) $\because W = \Delta K = 0$

$\Rightarrow W_F = -W_g = 1547\ J$ #

(f) F is not invariant !!

7.80,

$$W = \int_{x_1}^{x_2} F(x)\,dx$$

$$= \int_{0.15}^{1.2} e^{(-2x^2)}\,dx \quad \text{很複雜...}$$

$\doteq 0.47\ J$ #