(1) (a)

$$V = \frac{dr}{dt} = \frac{d}{dt}(3.00t\hat{i} - 6.00t^3\hat{j}) = 3.00\hat{i} - 18.00t^2\hat{j}$$

$$V(t) = 3.00\hat{i} - 18.00t^2\hat{j}$$

(b) $a = \frac{dv}{dt} = (3.00\hat{i} - 18.00t^2\hat{j})' = 0 - 36.00t\hat{j}$

$v = u + at$

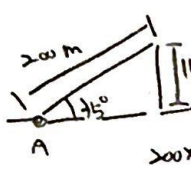
(c) position at $t = 1.00s$ $= 3.00\hat{i} - 6.00\hat{j}$ m

velocity $= 3.00\hat{i} - 18.00\hat{j}$ m/s

$r = 3.00\hat{i} - 6.00\hat{j}$ m

$V = 3.00\hat{i} - 18.00\hat{j}$

(2)



(a) 最大斜推地高度 (u = 初速 = 0)

$\cos 35° = 0.819$

$\sin 35° = 0.573$

$v^2 = u^2 + 2ad$

$200 \times \sin 35° \quad V^2 = 0 + 2 \times 1.9 \times 200$

$V = 27.57$ m/s

$V\sin\theta = 15.82$, $V = 27.57$ m/s, $35°$, $V\cos\theta = 22.58$

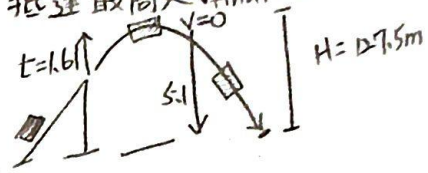
$V_{final}^2 = V_{initial}^2 + 2g\Delta y$

$0 = 15.82 + 2 \times 9.8 \times \Delta y$, $\Delta y = 12.78$ m

$H = 114.7 + 12.78 = 127.48 = 127.5$

$A = (a) = 127.5$ m ✱

抵達最高点 $V_{final} = 0$



(b) 最大水平射程

$t_{up} = \frac{V_f - V_i}{g} = \frac{0 - 15.82}{-9.8} = 1.61s$ (斜面出發到最高点的 time (s))

$h = V_i t + \frac{1}{2}gt^2$, $h = H = -127.5$

$V_i = 0$ (在最高点開始) (最高点落回地面的 time (s))

$-127.5 = \frac{1}{2} \times (9.81) \times t^2$, $t = 5.10s$ ⇒ 離開 ▲ 後花 1.61 + 5.1 到地面

$(1.61 + 5.1) \times 22.58 = 151.5118$

$151.5118 + 163.83 = 315.3348 = 315.3$

$200 \times \cos 35° = 163.83$

$A = 315.3$ m ✱

(3)

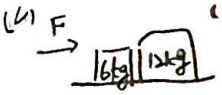
(a) $F = m \cdot a$

$72N = (6+12) \cdot a$

$72N = 18 \cdot a$

$\Rightarrow a = 4$ m/s² ✱

(c) (i)

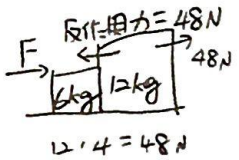


$F = m \cdot a$

$24 = 6 \times 4$

$A = 24N$ ✱

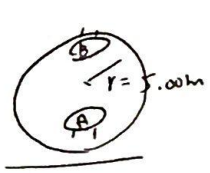
(ii)



$12 \cdot 4 = 48N$

$A = 48N$ ✱

(4)



the normal force = $\frac{mv^2}{r} = \frac{0.8 \times 8615}{5} = 13.84$

$0.800kg \times 9.8 = 7.84N$

$13.84 = 向心力 - 7.84$

$\Rightarrow 向心力 = 13.84 + 7.84 = 21.68N$

the normal force 走向力 = 6.00N

$7.84 + 6.00 = \frac{mv^2}{r} = \frac{0.800 \times v^2}{5}$ (向心力)

重力 $= Wg = 9.8 \frac{m}{s} \times 0.800 kg = 7.84N$

$v^2 = \frac{13.84 \times 5}{0.8} = 86.5$

$v = 9.3$

(5)

magnitude (大小)

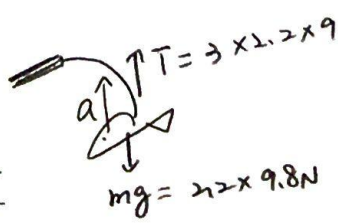
合力 $= (3-1) \times (2.2 \times 9.8N)$

$F = m \cdot a$

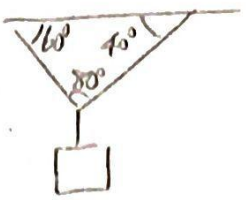
$2 \times 2.2 \times 9.8 = 2.2 \times a$

$a = 2 \times 9.8 = 19.6$ m/s²

direction (in (a))

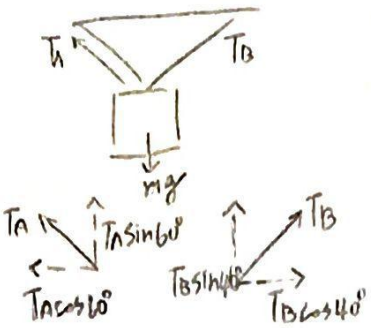


④



令左繩為 T_A
右繩為 T_B.

$180° - 60° - 40° = 80°$



最強 rope 的 greatest T

物重 $= T_A \sin 60° + T_B \sin 40°$ $= 5000 \times \frac{\sqrt{3}}{2} + 5000 \times 0.643$

$= 4330.12 + 3213.5 = 7543.6$

$T_A \cos 60° = T_B \cos 40°$ (滿足淨力平衡) $\fallingdotseq 7544$

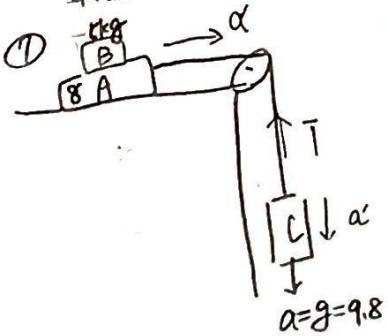
$\cos 60° < \cos 40°$

$\Rightarrow T_A > T_B$

(a) A= 左繩施力/壓力較大

(b) 最重可承受多少? 7544 N

⑦



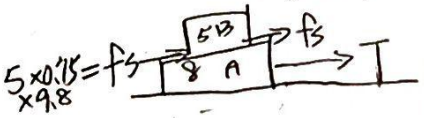
$\mu_s = 0.750$

含 T=?

A 和 B 不分離的情況下最大作用力=?

$\rightarrow a' = \mu g$

施力物 = mc



$(m_A + m_B + m_C) = m_C \cdot g$ (m: 質量, F: 力)

$7.35 \times (13 + m_C) = m_C \times 9.8$

$5 \times 9.8 \times 0.75 = 5 \times a$

$13 \times 7.35 = (9.8 - 7.35) m_C$

$a' = 7.35$

$\frac{13 \times 7.35}{2.45} = m_C = 39$

A= 39kg

8.

drag force $\propto v^2$ $f_d = \underset{\text{④}}{c}v^2$

$v_末 = v_初 + 2\frac{dv}{dt}d$

$v_末 = 0 + 2\times\frac{dv}{dt}\times d$

$mg - f_d = 9.8m - cv^2 = m\frac{dv}{dt}$

終端速度 $= v_t$

$mg = cv_t^2 \Rightarrow \frac{g}{c} = \frac{v_t^2}{m} \Rightarrow \frac{c}{m} = \frac{g}{v_t^2}$

$v = \sqrt{\frac{mg}{c}}$

$\frac{dv}{dt} = g - \frac{c}{m}v^2$

$\frac{dv}{dt} = g - \frac{g}{v_t^2}\cdot v^2$

$\frac{dv}{dt} = g\left(1 - \frac{v^2}{v_t^2}\right)$

$\frac{dv}{\left(1-\frac{v^2}{v_t^2}\right)} = g\,dt$ 令 $\frac{v}{v_t} = u$, $dv = v_t\,du$

$\int\frac{dv}{(1-u^2)} = \int\frac{v_t\,du}{(1-u^2)} = gt + C$

$\int\frac{1}{1-u}du = -\ln|(1-u)| + C$

$\int\frac{1}{1+u}du = \ln|(1+u)| + C$

$= \frac{1}{2}v_t\times\left(-\ln|1-u| + C + \ln|(1+u)| + C\right) = \frac{1}{2}\ln\frac{1+u}{1-u}v_t + C = \tanh^{-1}(u)v_t + C$

(a) $9.8m - c\left(2\frac{dv}{dt}d\right)^2 = m\frac{dv}{dt}$

(b) $\sqrt{\frac{mg}{c}} = \sqrt{\frac{9.8m}{c}} = v$

(c) $\frac{dv}{dt} = g\left(1 - \frac{v^2}{v_t^2}\right)$

(d) 5.555

(d)

$v_t^2 = \frac{60\times9.8}{0.430} = 1367.44$

$v \approx 36.98\,m/s$

$0.9\times36.98 = \tanh\left(\frac{9.8t}{36.98}\right)\cdot 36.98$

$\frac{9.8t}{36.98} = \tanh^{-1}(0.9)$

$t \fallingdotseq 5.555$

$w = \tanh x$, $w = \frac{e^{2x}-1}{e^{2x}+1} \Rightarrow w(e^{2x}+1) = e^{2x}-1 \Rightarrow e^{2x} - we^{2x} = w+1$

$e^{2x}(1-w) = w+1$

$e^{2x} = \frac{w+1}{1-w}$

$2x = \ln\frac{1+w}{1-w}$

$x = \tanh(w)$

$\tanh^{-1}(w) = x = \frac{1}{2}\ln\frac{1+w}{1-w}$

$\frac{gt}{v_t} + C = \tanh^{-1}\left(\frac{v}{v_t}\right) + C$

$\frac{v}{v_t} = \tanh\left(\frac{g}{v_t}t\right)$

$v(t) = \tanh\left(\frac{g}{v_t}t\right)\cdot v_t$ ($v_t = \sqrt{\frac{mg}{c}}$)

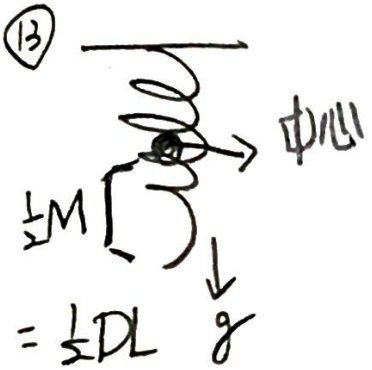
⑫ $F-mg=ma$

$F=m(a+g)$

$=20(9.8-5.625)$

$F=83.5N$ $A=83.5N$

⑬



$=\frac{1}{2}DL$

$F=\frac{1}{2}DL\cdot g=k\Delta x$

$\frac{\frac{1}{2}DLg}{k}=\Delta x$

$L'=\underset{origin}{L}+\frac{\frac{1}{2}DLg}{k}=L(1+\frac{Dg}{2k})$

受自己的½重量牽引

$A=L(1+\frac{\rho g}{2k})$

⑭

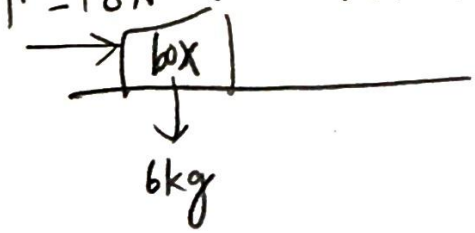
$J=F\cdot S=40\times 5m$

$F=a\times 0.42=40\Rightarrow a=95.2$

$2as=V_t^2-V_0^2=36-4=2\times 95.2\times s\Rightarrow s=0.1680$

$A=0.1680m$

⑮



$x=14m$ 的 velocity = ?

$F=18-(0.53)\times 14$

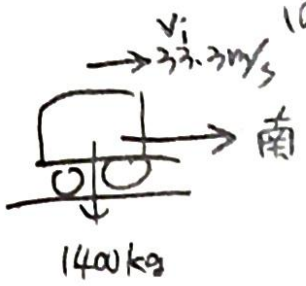
$=18-7.42=10.58=m\cdot a=6\times a\Rightarrow a=1.76\bar{3}$

$\frac{V}{t}=a=1.76\bar{3}=\frac{V}{14}\Rightarrow V=24.68\bar{6}$ #

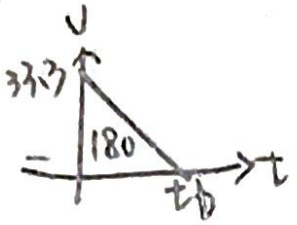
⑯ $5.0km\div 10=\frac{1}{2}hr$ $\frac{1}{2}\times 700=350w$ $1w=1J/s=60\times 60J$

$5km\div 3=\frac{5}{3}hr$ $\frac{5}{3}\times 290=483.\bar{3}$ $350\div 3600\fallingdotseq 0.097\bar{2}J$

⑨



(a)



$t_b \times 33.3 = 360 \Rightarrow t_b = 10.810$

$a \cdot 10.810 = 33.3 \Rightarrow a = 3.080$

(a) $3.080\ m/s^2$, 朝北

(b) 4312.67 N

(c) 0.31433

(b) $F = m \cdot a$

$4312.67 = 3.080 \times 1400\ kg$

(c) $1400\ kg \times f_s \times 9.8 = 4312.67$

$f_s = 0.31433$

⑩

$F = kx$

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

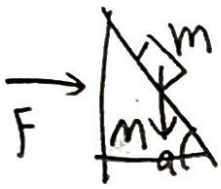
$\frac{mg\sin\theta - mg\times\mu_s\cos\theta}{k} = x$

(a) $\frac{Mg(\sin\theta - \mu_s\cos\theta)}{k}$ stretch

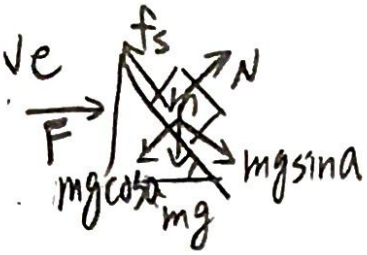
(b) $\frac{Mg(\sin\theta + \mu_s\cos\theta)}{k}$ compressed

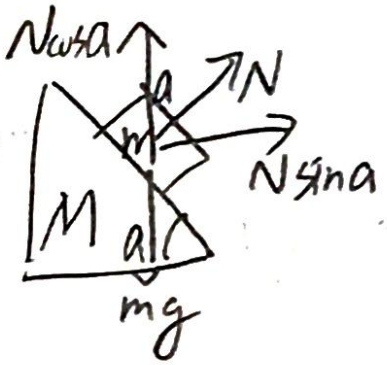
$kx - mg\sin\theta - mg\cos\theta\,\mu_s = 0$

⑪



(a) M 不 move





$N_m \cos\alpha = mg$

$F - N_m \sin\alpha = (m+M)\cdot a'$

$F - \frac{mg}{\cos\alpha}\sin\alpha = (m+M)a'$

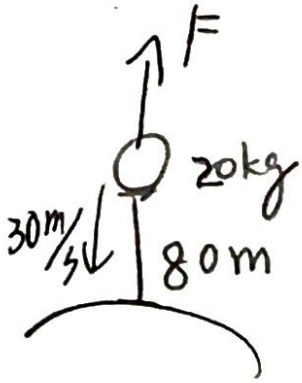
(a) $F = mg\tan\alpha + (m+M)a'$

$\Sigma a'$ = move accelation

$mg\cos\alpha \times \mu_s = mg\sin\alpha$

(b) $\mu = \tan\alpha$

⑦



$V_0 = 30\ m/s$

$V_f^2 = V_0^2 + 2ah$

$0 = 30 + 2 \times a \times 80 \Rightarrow a = -5.625$

$483.5 \div 3600 \fallingdotseq \underline{0.13425\,J}$ ※

A=因 $\frac{700}{10} < \frac{290}{3}$ ※

11 11

70 96.6