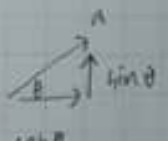
114601506 呂彥寧

1. (a) $3\hat{i} - 18t^2\hat{j}$

(b) $\frac{d^2\vec{r}}{dt^2} = -36t\hat{j}$

(c) $\vec{r}(1) = 3\hat{i} - 6\hat{j}$ $\frac{d\vec{r}}{dt} = 3\hat{i} - 18\hat{j}$

2. (a)



$U^2 = 2 \times 1.9 \times 200$ $U^2 = 760$ $\sin 35° = 0.574$

$\frac{|\sqrt{760}\sin 35°\hat{j}|^2}{2 \times 9.8} = 4$ $4 = 12.77$

$(200 \times 0.574 + 114.8) = 127.57$

114.8

$H = 127.57\,m$ #

(b) $U = \sqrt{760} \approx 27.57$ $27.57 \sin 35° \approx 15.82$

$4 = 15.8t + \frac{1}{2}(-9.8)t^2 + 114.8$ $\cos 35° = 0.819$

$4.9t^2 - 15.8t - 114.8 = 0$

$t = \frac{15.8 + 49.98}{9.8} \approx 6.71$

$27.57 \times 6.71 \times \cos 35° \approx 151.51$

$H = 151.51\,m$ #

3. (a) $F = ma$

$72 = 18a$ $\quad a = 4\ m/s^2$ #

(b) $12 \times 4 = 48$ $\quad F = 48\ N$ #

(c) $6 \times 4 = 24$ $\quad F = 24\ N$ #

4. $a = \frac{v^2}{r}$ $\quad F = \frac{mv^2}{r}$

上: $F = mg + N_2$

$\frac{0.8 \cdot v^2}{5} = 0.8 \cdot 9.8 + 6 = 13.84$

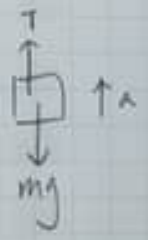
下: $F = N_1 - mg$

$13.84 = N_1 - 0.8 \times 9.8$

$N_1 = 21.68$

$F = 21.68\ N$ #

5.



$T - mg = 3W - W$

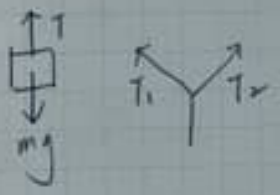
$2W = 2 \times 2.2 \times 9.8 = 43.12$

$F = 2.2a = 43.12$

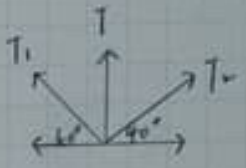
$a = 19.6$

$a = 19.6\ m/s^2$ #

6.



(a)



$T_{1x} = T_1 \sin 30°$ $T_{1y} = T_1 \cos 30°$

$T_{2x} = T_2 \sin 50°$ $T_{2y} = T_2 \cos 50°$

$\because \sin 30° < \sin 50°$ $\therefore T_1 > T_2$

T_1 #

(b) $T_1 \sin 30° = T_2 \sin 50°$

$\sin 50° = 0.766$

$\cos 50° = 0.643$

$T_2 = \dfrac{5000 \times \frac{1}{2}}{0.766}$

$T = 5000 \cos 30° + 5000 \cdot \dfrac{\sin 30°}{\sin 50°} \cdot \cos 50°$

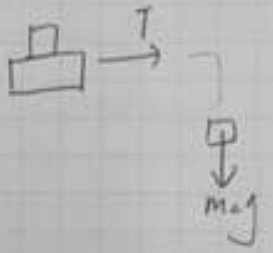
$= 5000 \times 1.275 = 6375$

$T = 6375\ N$ #

7. $m_B a = f$

$m_A a = T - f$

$m_c g = m_c a + T$



$m_B a + m_A a + T = 13a$

$m_c g = 13a + m_c a$ $\quad a = \frac{m_c g}{m_c + 13}$

$\frac{m_c g}{m_c + 13} \le \mu g$ $\quad m_c \le (m_c + 13)\mu$

$m_c(1-\mu) \le 13\mu$

$m_{c\,Max} = \frac{13\mu}{1-\mu} = \frac{13 \times 0.75}{0.25} = 39$

$m_{c\,Max} = 39\,kg$ #

18.(d) $v_t = \sqrt{\frac{60 \cdot 9.8}{0.49}} \approx 76.98\ m/s$

$0.9 = \tan(h) \cdot \left(\frac{gt}{v_t}\right)$

$\tan(h) \cdot ar \cdot 0.9 = \frac{1}{2}\left(\ln \frac{1+x}{1-x}\right)$

$= \frac{1}{2}\left(\ln \frac{0.9}{0.1}\right) = \frac{1}{2}[\ln(19)] \approx 1.49$

$\frac{76.98}{9.8} \times 1.49 = 5.547\,s$

8.d #

8. (a) $m \cdot \frac{dv}{dt} = mg - cv^2$ #

(b) Let $\frac{dv}{dt} = 0$ $\quad mg - cv_t^2 = 0$ $\quad v_t = \sqrt{\frac{mg}{c}}$ #

(c) $\frac{dv}{dt} = g - \frac{cv^2}{m}$

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

$\int g\,dt = \int \frac{dv}{1 - \frac{v^2}{v_t^2}}$ $\quad \tan(h) \cdot ar \cdot \left(\frac{v}{v_t}\right) = \frac{gt}{v_t}$

$\frac{v}{v_t} = \tan(h) \cdot \left(\frac{gt}{v_t}\right)$ $\quad v(t) = v_t \cdot \tan\left(\frac{gt}{v_t}\right)$ #

9. (a) $v^2 = u^2 + 2as$

$11.1^2 + 2 \times 180 \times a = 0$

$-40a = 123.21$ $\quad a \approx -3.08\ m/s^2$ #

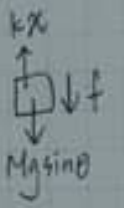
(b) $F = ma$

$1400 \times (-3.08) = 4312$ $\quad F = -4312\ N$ #

(c) $4312 = \mu \times F_{RC} = f$

$\mu = \frac{4312}{1400 \times 9.8}$ $\quad \mu \approx 0.314$ #

10. (a)



$kx = Mg\sin\theta + \mu Mg\cos\theta$

$x_{Max} = \frac{Mg(\sin\theta + \cos\theta)}{k}$ #

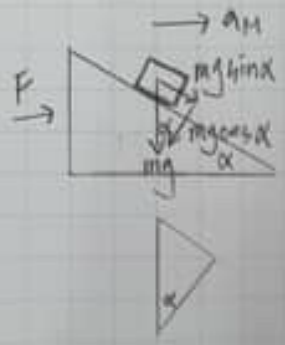
(b)

$kx - Mg\sin\theta = \mu Mg\cos\theta$

$x = \frac{Mg(\mu\cos\theta - \sin\theta)}{k}$ #

11. (a)

$$\begin{cases} F = (m+M)a \\ a = \dfrac{F}{m+M} \end{cases}$$



$$\begin{cases} y: N\cos\alpha = mg \\ x: N\sin\alpha = m \cdot \dfrac{F}{(m+M)} \end{cases}$$

$$\tan\alpha \cdot mg = m \cdot \frac{F}{(m+M)}$$

$$F = (m+M)g\tan\alpha \quad \#$$

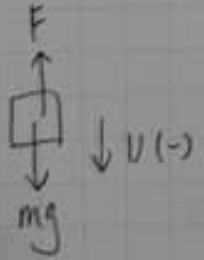
(b)

$$\begin{cases} mg = N\cos\alpha + f_s\sin\alpha \\ N\sin\alpha - f_s\cos\alpha = m \cdot \dfrac{F}{(m+M)} \end{cases}$$

$$N = \frac{mg - \mu mg\cos\alpha\sin\alpha}{\cos\alpha}$$

$$F = \frac{M+m}{m}(\tan\alpha mg - \tan\alpha\,\mu mg\cos\alpha\sin\alpha) \quad \#$$

12.



$$0 = 30^2 + 2 \times a \times 80$$

$$a = \frac{-900}{160} \qquad a = -\frac{45}{8}$$

$$-\frac{45}{8} \times 20 + 20 \times 9.8 = F$$

$$-112.5 + 196 = F \qquad F = 83.5 \quad \#$$

13.

14. $W = F \times d = \frac{1}{2} m v^2$ $\quad b^2 + 2^2 = 32$

$\frac{1}{2} \times 0.42 \times 32 = 40 d$

$d = \frac{0.21 \times 32}{40} = 0.168$

$\underline{D = 0.168}$ #

15.

$F(14) = 18 - 0.53 \times 14 = 10.58$

$W = \frac{118 \cdot (10.58) - N}{N} = 200.06$

$200.06 = \frac{1}{2} \cdot 12 \cdot V^2$

$V = 8.1667 \text{ m/s}$ #

16.

$t_r = 0.5h \quad 0.5 \times 60 \times 60 = 1800 s$

$t_w = \frac{5}{3}h \quad \frac{5}{3} \times 60 \times 60 = 6000 s$

$700 \times 1800 = 1.26 \times 10^6 \quad (E_r)$

$290 \times 6012 = 1.74 \times 10^6 \quad (E_w)$

$E_w > E_r$

$E = 1.74 \times 10^6 J$ #