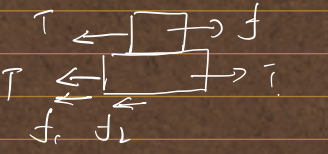
2.3 A: $T-\mu_1 m_A g = m_A a$

B: $F-\mu_1 m_A g-\mu_2(m_A+m_B)g-T=m_B a$.

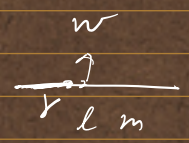
$\Rightarrow F=13.4$ N.



2.18. $T(r)-T(r+dr)=\frac{dm}{dl}\cdot\omega^2 r=-T(dr)$

由 $l\to r$ 积分. $T(r)=-\int_l^r r\,dr\cdot\frac{m}{l}\omega^2=\frac{m\omega^2}{2l}(l^2-r^2)$

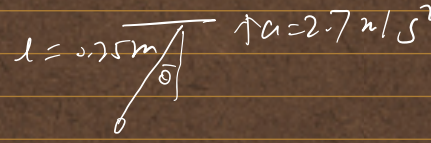
故 $T(r)=\frac{m\omega^2}{2l}(l^2-r^2)$



2.19.

$T\cos\theta-mg=ma$ $T\sin\theta=m\omega^2 l\sin\theta$

$\Rightarrow T=\frac{12.5}{\sqrt{3}}$ N $\omega=\frac{10}{\sqrt{3}}$ rad/s



2.20. B: $mg-F_N=ma_B$

A: $(Mg+N)\sin\theta=Ma_A$

几何: $\sin\alpha=a_B/a_A$

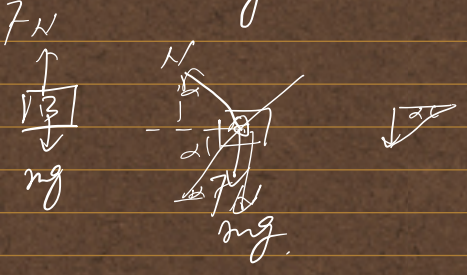
$N\sin\alpha=Ma_A\cos\alpha$.

$(M+m)g-N\cos\alpha=ma_B+Ma_A\sin\alpha$. $\theta=\alpha$

$\Rightarrow a_A=\frac{(M+m)g\sin\theta}{M+m\sin^2\theta}$ 沿斜面向下

$\Rightarrow a_{B\to A}=\vec{a}_B-\vec{a}_A=-\vec{a}_A\cos\theta=\frac{M+m}{M+m\sin^2\theta}\sin\theta\cos\theta$. 水平向右

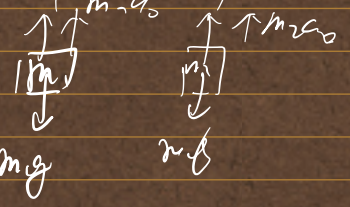
$\Rightarrow N=\frac{(M+m)Mg\cos\theta}{M+m\sin^2\theta}$



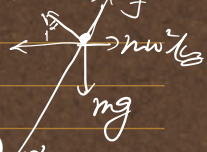
2.21. 以升降机为参考.

$m_1 g-T-m_1 a_0=m_1 a$ $T+m_2 a_0-m_2 g=m_2 a$

$\Rightarrow a=\frac{(m_1-m_2)(g-a_0)}{m_1+m_2}$ $T=\frac{2m_1 m_2(g-a_0)}{m_1+m_2}$



2.27.



① $f=\mu(mg\cos\alpha+m\omega^2 l\cos\alpha\sin\alpha)$

$F_N\sin\alpha=f\cos\alpha+m\omega^2 l\cos\alpha$

$F_N\cos\alpha+f\sin\alpha=mg$

$\Rightarrow l_1=\frac{g}{\omega^2}\cdot\frac{\tan\alpha-\mu}{\mu\sin\alpha+\cos\alpha}$

② $f=\mu(mg\cos\alpha+m\omega^2 l\cos\alpha\sin\alpha)$

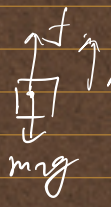
$F_N\sin\alpha+f\cos\alpha=m\omega^2 l\cos\alpha$

$F_N\sin\alpha=f\sin\alpha+mg$

$\Rightarrow l_2=\frac{g}{\omega^2}\cdot\frac{\tan\alpha+\mu}{\cos\alpha-\mu\sin\alpha}$

故 $\frac{(\tan\alpha-\mu)g}{\omega^2(\mu\sin\alpha+\cos\alpha)}\le l\le\frac{(\tan\alpha+\mu)g}{\omega^2(\cos\alpha-\mu\sin\alpha)}$

2.28.



以 m_2 向下的方向为正. 假定 m_1 的加速度为 a_1, m_2 为 a_2.

$m_2g-f-m_2a_1=m_2a$

$\Rightarrow a_1=\frac{(m_2-m_1)g-m_2a}{m_1+m_2}$ 向上

$T-m_1g=m_1a_1$ 且 $T=f$

$a_2=a_1+a=\frac{(m_2-m_1)g+m_1a}{m_1+m_2}$ 向下 $f=\frac{m_1m_2(2g-a)}{m_1+m_2}$

同理 $a_1=\frac{(m_1-m_2)g+m_2a}{m_1+m_2}$ 向下 $a_2=\frac{(m_2-m_1)g+m_1a}{m_1+m_2}$ 向下

$f=\frac{m_1m_2(2g-a)}{m_1+m_2}$

2.30

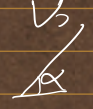
(1). $I=\int_0^{0.4}F(t)dt=\int_0^{0.1}200tdt+\int_{0.1}^{0.3}20dt+\int_{0.3}^{0.4}(80-200t)dt$

$=100t^2\Big|_0^{0.1}+20t\Big|_{0.1}^{0.3}+(80t-100t^2)\Big|_{0.3}^{0.4}$

$=8\ N\cdot s$

$\bar{F}=\frac{I}{t}=20N$

(2) $I+mv_0=mv\Rightarrow v=\frac{11}{3}m/s$



2.44.

选系统为研究对象.

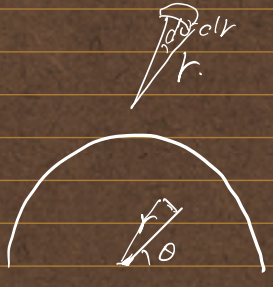
$MV_1=mv_2$ 且 $v_1+V_1=u\Rightarrow v_1=\frac{m}{M+m}u$ 故 $V_0'=V_0\cos\alpha+\frac{m}{M+m}u$

$X=V_0'\frac{V_0\sin\alpha}{g}=(V_0\cos\alpha+\frac{mu}{M+m})\frac{V_0\sin\alpha}{g}$

2.48.

水平方向动量守恒. $mV_0=M\Delta V\Rightarrow \Delta V=\frac{m}{M}V_0$

$(N_1-mg)\Delta t=mv\quad N_2=Mg\Rightarrow \bar{N}=\frac{mv}{\Delta t}+(m+M)g.$

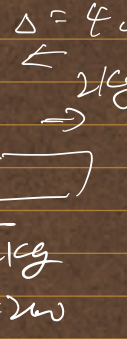


2.50.

$x_c=0.\quad M=\frac{1}{2}\pi R^2\cdot\delta$

$y_c=\frac{1}{M}\int y\,dm=\frac{1}{M}\int r\sin\theta\cdot r\,d\theta\cdot dr\cdot\delta=\frac{4R}{3\pi}$

故质心位矢 $(0,\frac{4R}{3\pi})$



2.64

$F\cdot\Delta t=m_{车}\cdot\Delta V_{车}+m_{货}\Delta V_{货}\Rightarrow F=10800N$

2.68

变质量质点方程

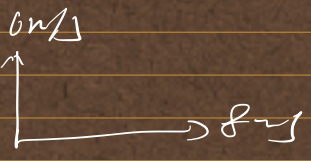
$$m\frac{dv}{dt}=F+(v_b-v_a)\cdot\frac{dm}{dt}\Rightarrow a=\frac{u}{m}(v_b-v_a)$$

2.72.

$$mv=\int F(t)dt \Rightarrow v=9m/s \quad W=\frac{1}{2}mv^2\Rightarrow W=81J$$

2.73.

$$v(1)=(8i+6j)\ m/s$$



$$\vec{F}=ma=0.6N$$

$$P=\vec{F}\cdot\vec{v}\Rightarrow P=4.8W$$

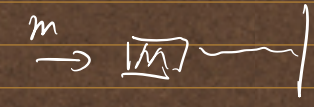
2.82.

(1) $\oint[(-6x)-(4)x^3]dx=0$. F为保守力

(2). $Ep=-\int_0^{0.1}F(x)dx=0.030J$

(3) $\frac{1}{2}mv^2=\int_{0.2}^{0.1}F(x)dx=\sqrt{0.61}\ m/s$

2.90.

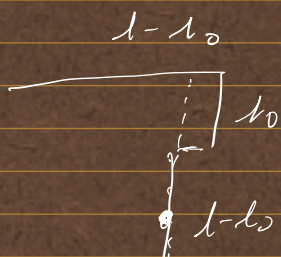


$$\frac{1}{2}(M+m)v^2=\int_0^{0.1}dx\,dx+\mu(m+M)gl \quad (M+m)V=mv_0$$

$$\Rightarrow v_0=\frac{225\sqrt{46}}{2\sqrt{5}}\ m/s$$

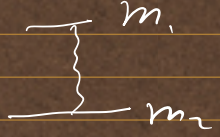
2.91.

$$mg\frac{l-l_0}{l}\cdot\left(l_0+\frac{l-l_0}{2}\right)=\frac{1}{2}mv^2\Rightarrow v=\sqrt{\frac{l^2-l_0^2}{l}g}$$



2.98.

初状态. $\Delta x_1 = \frac{-m_1 g}{k}$ 后. $\Delta x_2 = \frac{m_2 g}{k}$ $\Delta x = \frac{m_1+m_2}{k} g$



$\frac{1}{2} k (\Delta x_1 + \Delta h)^2 = m_1 g \cdot (\Delta x_1 + \Delta h + \Delta x_2)$

$\Rightarrow \Delta h = \sqrt{m_1^2 + 2 m_1 m_2} \frac{g}{k}$ $T = k \cdot \Delta h$

$\Rightarrow T = \sqrt{m_1^2 + 2 m_1 m_2} g$

2.110.

$m v_1 = M V_2$ $\frac{1}{2} M V_2^2 + \frac{1}{2} m (\frac{v_1}{\cos\alpha})^2 = mgh$ 且 $\vec{v}_{物对地} = \frac{\vec{v}_1}{\cos\alpha} + \vec{V}_2$

$\Rightarrow \vec{v}_{物对地} = \sqrt{\frac{(M+m\cos\alpha)^2}{M(M+m\cos^2\alpha)} 2gh}$

$E = \frac{m^2 g h \cos^2\alpha}{M + m\cos^2\alpha}$

2.125.

$Mg = m \frac{v_0^2}{r_0}$ $(M+M_2)g = m \frac{v^2}{r}$ $r_0 \cdot m v_0 = r \cdot m v$ 且 $(M+M_2) g = m \omega^2 r$

$\Rightarrow r = 21\ cm$. $\omega = 16.4\ rad \cdot s^{-1}$

2.128.

$m(V+v) = -MV$ 又 $M = m \Rightarrow V = \frac{1}{2} v$