

## 第二周

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2.3

2.3 A

2.3 B

$$\begin{cases} m_A a_1 = F_T - \mu_{AB} m_A g \\ m_B a_2 = F - F_T - \mu_{AB} m_A g - \mu_{B\text{地}} (m_A + m_B) g \end{cases}$$

$\Rightarrow F = 13.19 \text{ N}$

2.18

Diagram showing a rod of length  $l$  and mass  $m$  rotating with angular velocity  $\omega$ . A small element of length  $\Delta r$  is shown at a distance  $r$  from the center. The tension  $T(r)$  and  $T(r+\Delta r)$  are indicated.

$$\lim_{\Delta r \rightarrow 0} \frac{T(r+\Delta r) - T(r)}{\Delta r} = \frac{dT}{dr} = -\frac{dr}{l} \frac{m\omega^2 r}{dr} = -\frac{m\omega^2 r}{l}$$

$$\Rightarrow dT = -\frac{m\omega^2 r}{l} dr$$

$$\Rightarrow \int_0^{T(r)} dT = \int_l^r -\frac{m\omega^2 r}{l} dr$$

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

## 2.19



$$\uparrow a_0 \quad (1) F_{Ty} = m(a_0 + g) = 6.25 \text{ N}$$

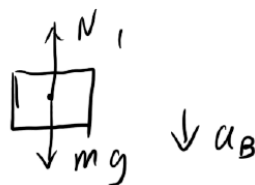
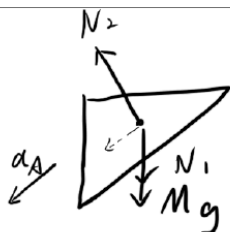
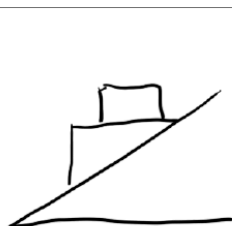
$$F_T = \frac{F_{Ty}}{\cos 30^\circ} = 7.21 \text{ N}$$

$$(2) F_{Tx} = F_T \sin 30^\circ$$

$$m \omega^2 l \sin 30^\circ = F_{Tx}$$

$$\omega = \frac{7.21}{0.5 \cdot 0.25} = 7.59 \text{ rad/s}$$

## 2.20



$$(1) \begin{cases} M a_A = (Mg + N_1) \sin \alpha \\ m a_B = (mg - N_1) \\ a_A \sin \alpha = a_B \end{cases}$$

$$\Rightarrow a_1 = a_A \cos \alpha = \frac{(M+m)g \sin \alpha \cos \alpha}{M + m \sin^2 \alpha}$$

$$(2) \text{显然 } a_2 = -a_1 = -\frac{(M+m)g \sin \alpha \cos \alpha}{M + m \sin^2 \alpha}$$

$$(3) N_1 = m(g - a_B)$$

$$= m \left( g - \frac{(M+m)g \sin^2 \alpha}{M + m \sin^2 \alpha} \right)$$

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

2.21

$$\begin{cases} m_1 a = m_1 g' - T \\ m_2 a = T - m_2 g' \\ g' = g - a_0 \end{cases} \Rightarrow a = \frac{(m_1 - m_2)(g - a_0)}{m_1 + m_2}$$

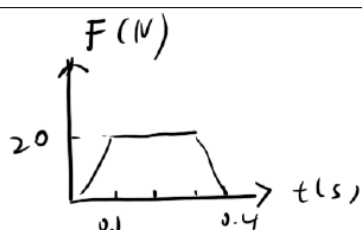
$$T = \frac{2m_1 m_2 (g - a_0)}{m_1 + m_2}$$

2.28



$$\begin{cases} m_2 a_2 = m_2 g - f \\ m_1 a_1 = m_1 g - T \\ f = T \\ a = a_1 + a_2 \end{cases} \Rightarrow \begin{cases} a_1 = \frac{m_1 g + m_2 a - m_2 g}{m_1 + m_2} \\ a_2 = \frac{m_2 g + m_1 a - m_1 g}{m_1 + m_2} \\ f = \frac{m_1 m_2 (2g - a)}{m_1 + m_2} \end{cases}$$

2.30



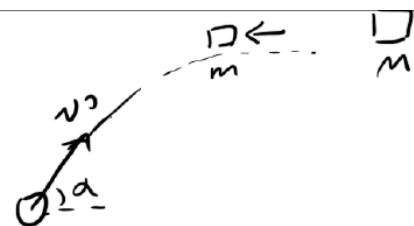
$$(1) I = \sum F(t) \Delta t = 6 \text{ N} \cdot \text{s}$$

$$\bar{F} = \frac{I}{\Delta t_{\text{总}}} = 15 \text{ N}$$

$$v - v_0 = I$$

$$v = 3 \text{ m/s}$$


## 2.44



$$\begin{cases} (m+M)v_0 \cos \alpha = Mv_1 + mv_2 \\ v_2 - v_1 = -u \end{cases} \Rightarrow v_1 = \frac{(m+M)v_0 \cos \alpha + mu}{m+M}$$

$$x = v_1 \cdot \frac{v_0 \sin \alpha}{g} = \left( v_0 \cos \alpha + \frac{mu}{m+M} \right) \frac{v_0 \sin \alpha}{g}$$

## 2.48



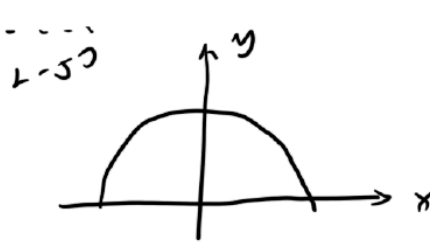
$$M \Delta V + m(0 - v_0) = 0$$

$$\Delta V = \frac{mv_0}{M}$$

$$m(-v) = mg \Delta t + M g \Delta t - \bar{N} \Delta t$$

$$\bar{N} = (m+M)g + \frac{mv}{\Delta t}$$

## 2.50



$$x_c = 0$$

$$y_c = \frac{\int y dm}{\int dm} = \frac{-\frac{1}{3} (R^2 - y^2)^{\frac{3}{2}} \Big|_0^R \cdot 2\sigma}{\frac{1}{2} \pi R^2 \sigma}$$

$$= \frac{4R}{3\pi}$$

$$dm = \sigma \cdot 2\sqrt{R^2 - y^2} dy$$