第三周

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2.64

$$F = v_1' \frac{dm_1}{dt} + v_2' \frac{dm_2}{dt}$$

$$= 1.08 \times 10^4 N$$

2.68

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

$$\Rightarrow a = \frac{\mu(v_b - v_a)}{m}$$

2.72

$$a = \frac{F}{m} = 2t$$

$$v = \int_0^v dv = \int_0^t a\,dt = t^2$$

$$A = \int_0^A dA = \int_0^x F\,dx = \int_0^t Fv\,dt = \int_0^t 4t^3\,dt = 81\,J$$

2.74

(1) $\oint \vec{F}\,d\vec{r} = \int_0^x F\,dx + \int_x^0 F\,dx = \int_0^x (-6x - 4x^3)\,dx + \int_x^0 (-6x - 4x^3)\,dx$

$= 0$

$\therefore$ 保守力

(2) $E_p = \int_x^0 (-6x - 4x^3)\,dx = 3x^2 + x^4$

$x = 0.1\,m$ 时，$E_p = 0.0301$

(3) $\frac{1}{2}mv^2 = \int_{0.2}^{0.1} (-6x - 4x^3)\,dx$

$v = 0.78\,m/s$

2.90

$$m v_0 = (m+M)V$$

$$-fx = \frac{1}{2}kx^2 - \frac{1}{2}(M+m)V^2$$

$$f = \mu(M+m)g = 17.64\,N$$

$$\therefore v_0 = 3.19\,m/s$$

2.91

$$\int_a^l -\mu m g \frac{L-x}{l}dx = \left(\frac{1}{2}mv^2 - \frac{1}{2}mgl\right) - \left(0 - \frac{mga^2}{2L}\right)$$

$$v = \sqrt{\frac{g}{l}\left[(l^2-a^2) - \mu(l-a)^2\right]}$$

2.98

$$F + m_1 g = kx_1$$

$$kx_2 \geq m_2 g$$

$$\frac{1}{2}kx_2^2 + m_1 g x_2 = \frac{1}{2}kx_1^2 - m_1 g x_1$$

$$F \geq (m_1 + m_2)g$$

2.110

(1) $m(v'\cos\alpha - V) - MV = 0$

$$\frac{m}{2}\left[(v'\cos\alpha - V)^2 + (v'\sin\alpha)^2\right] + \frac{1}{2}MV^2 = mgh$$

$$v' = \sqrt{2gh\frac{M+m}{M+m\sin^2\alpha}}$$

$$V = \frac{m\cos\alpha}{M+m}\sqrt{2gh\frac{M+m}{M+m\sin^2\alpha}}$$

(2) $$A = \frac{1}{2}MV^2 - 0$$

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

2.125

$$M_1 g = m\omega_0^2 r_0$$

$$(M_1 + M_2)g = m\omega^2 r$$

$$m r^2 \omega = m r_0^2 \omega_0$$

$$\omega_0 = 12.6\ \text{rad/s}$$

$$\omega = 16.5\ \text{rad/s}$$

$$r = 21.7 \times 10^{-2}\ \text{m}$$

2.129

$$nV - m(v - V) = 0$$

$$V = \frac{v}{2}$$