

一、选择题

- 2.1.1. 答: B
2.1.2. 答: A, G
2.1.3. 答: D
2.1.4. 答: A
2.1.5. 答: B
2.1.6. 答: D
2.1.7. 答: B
2.1.8. 答: C
2.1.9. 答: A
2.1.10. 答: A, B, C
2.1.11. 答: C, D
2.1.12. 答: A, B, D
2.1.13. 答: C
2.1.14. 答: B, C
2.1.15. 答: B
2.1.16. 答: B, C
2.1.17. 答: C
2.1.18. 答: A
2.1.19. 答: B
2.1.20. 答: B
2.1.21. 答: A
2.1.22. 答: C
2.1.23. 答: C
2.1.24. 答: B
2.1.25. 答: A
2.1.26. 答: C
2.1.27. 答: B
2.1.28. 答: A

二、填空题

- 2.2.1. 答: $a_1 = 1.5 \text{ m} \cdot \text{s}^{-2}$, $v_1 = \sqrt{5.4} \text{ m} \cdot \text{s}^{-1}$
2.2.2. 答: $v = \frac{3}{2}t^2 + 10t + 2$, $y = \frac{1}{2}t^3 + 5t^2 + 2t + 3$
2.2.3. 答: $v = 12 \text{ m} \cdot \text{s}^{-1}$, $x = 9 \text{ m}$
2.2.4. 答: $v(t) = \frac{mg}{k} \left[1 - \exp\left(-\frac{k}{m}t\right) \right]$, $v_m = \frac{mg}{k}$
2.2.5. 答: $5h \geq 3L$; $T_1 = \frac{2h}{L-h}mg$; $T_2 = \frac{3L-h}{L-h}mg$ 。
2.2.6. 答: $I = x_0 \sqrt{mk}$
2.2.7. 答: $\vec{L}_0 = m\omega A^2 \hat{k}$, $\vec{L}_{z_0} = m\omega A^2 \hat{k} - m\omega z_0 A \sin \omega t \hat{j} - m\omega z_0 A \cos \omega t \hat{i}$, $L_z = m\omega A^2$
2.2.8. 答: $\vec{M} = yf \hat{k}$, $M_z = yf$, $\vec{L} = m(xv_y - yv_x) \hat{k}$, $L_z = mxv_y - myv_x$
2.2.9. 答: $A = Pt$, $E_k = \frac{1}{2}mv_0^2 + Pt$
2.2.10. 答: $A_1 = 73 \text{ J}$
2.2.11. 答: 负功, $A = k \frac{x_1 - x_2}{x_1 x_2}$, $v_1 \geq \sqrt{\frac{2k}{m} \frac{x_1 - x_2}{x_1 x_2}}$, $v_2 = 0$, $v_1 = \sqrt{\frac{2k}{mx_1}}$

2.2.12. 答: $A = 864 \text{ J}$

2.2.13. 答: $A = 3 \text{ J}$

2.2.14. 答: $E_{p1} = \frac{1}{2}kr_0^2 + \frac{1}{2}kr^2 - kr_0r$, $E_{p2} = \frac{1}{2}kr^2 - kr_0r$

2.2.15. 答: 保守, $E_p = \frac{1}{2}ax^2 - \frac{1}{3}bx^3$, $x_0 = \frac{a}{b}$, $v_0 = \sqrt{\frac{a^3}{3mb^2}} = \frac{a}{b}\sqrt{\frac{a}{3m}}$

2.2.16. 答: $A_1 = \frac{1}{2}kL^2$, $A_2 = kL^2$, $E_{k1} = 0$, $E_{k2} = \frac{1}{2}kL^2$,

2.2.17. 答: $E_{p1} = kx_0^2$, $E_{p2} = -\frac{1}{2}kx_0^2$, $E_p = \frac{1}{2}kx_0^2$

2.2.18. 答: $\Delta E_p = -125 \text{ J}$

2.2.19. 答: $A = Gmm_E \left(\frac{1}{R_2} - \frac{1}{R_1} \right)$

三、计算题

2.3.1.: (1) $N = 3mg \cos \theta - 2mg$ (2) $a_t = g \sin \theta$

2.3.2.: (1) $v = \sqrt{2gl \sin \theta}$ (2) $T = 3mg \sin \theta$

2.3.3.: (1) $H = \frac{mv_0^2}{2(mg+f)}$ (2) $v_1 = v_0 \sqrt{\frac{mg-f}{mg+f}}$ (3) $P = mgv_1 = mgv_0 \sqrt{\frac{mg-f}{mg+f}}$

2.3.4.: (1) $y_{\max} = \frac{mv_0}{k} - \frac{m^2g}{k^2} \ln \left(\frac{kv_0}{mg} + 1 \right)$ (2) $t_1 = \frac{m}{k} \ln \left(\frac{kv_0}{mg} + 1 \right)$

2.3.5.:
$$v = \sqrt{mg/k} \frac{(\sqrt{mg/k} + v_0) \exp \left(\frac{2\sqrt{kg}}{\sqrt{m}} t \right) - (\sqrt{mg/k} - v_0)}{(\sqrt{mg/k} + v_0) \exp \left(\frac{2\sqrt{kg}}{\sqrt{m}} t \right) + (\sqrt{mg/k} - v_0)}$$

$$v = \sqrt{\frac{mg}{k} - \left(\frac{mg - kv_0^2}{k} \right) \exp \left(-\frac{2k}{m} y \right)}$$

2.3.6.: (1) 弹性碰撞, 动量大小不变, 速率依然为 v ; 但方向变化。

(2) $|\vec{I}| = 1.218mv$, $\angle COX = 52.5^\circ + 30^\circ = 82.5^\circ$

2.3.7.: (1) $T = \frac{a}{b}$ (2) $I = \frac{a^2}{2b}$ (3) $m = \frac{a^2}{2bv_0}$

2.3.8.: (1) $\vec{M} = -mgv_0 t \cos \theta \hat{k}$ (2) $\vec{L} = -\frac{1}{2}mgv_0 t^2 \cos \theta \hat{k}$

2.3.9.: (1) $\vec{L} = mR\sqrt{2gR \sin \theta} \hat{k}$ (2) $\omega = \sqrt{\frac{2g}{R}} \sin \theta$

2.3.10.: (1) $I = 16 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$ (2) $A = 176 \text{ J}$

2.3.11.: $A = \frac{25}{2} + \frac{25}{4}\pi \approx 31.125 \text{ J}$

2.3.12.: (1) $A_a = 84 \text{ J}$ (2) $A_b = 40 \text{ J}$

$$2.3.13.: A = \frac{m\omega^2}{2}(A^2 - B^2)$$

$$2.3.14.: \cos \theta = \frac{2lg - v_0^2}{3gl}$$

$$2.3.15.: (1) x_0 = v_0 \sqrt{\frac{m}{k + \alpha mg}} \quad (2) v_1 = v_0 \sqrt{\frac{k - \alpha mg}{k + \alpha mg}}$$

$$2.3.16.: (1) v_2 = \sqrt{\frac{GM}{6R}} = \sqrt{\frac{gR}{6}}, \quad v_1 = 2v_2 = 2\sqrt{\frac{GM}{6R}} = 2\sqrt{\frac{gR}{6}}$$

$$(2) \rho_1 = \frac{R^2}{GM} \frac{8gR}{3} = \frac{8}{3}R, \quad \rho_2 = \frac{16R^2}{GM} \frac{gR}{6} = \frac{8}{3}R$$

$$2.3.17.: v_A = \sqrt{3G \frac{M}{2R} - \frac{1}{2}v_2^2} = \sqrt{\frac{3}{2}gR - \frac{1}{2}2Rg} = \sqrt{\frac{Rg}{2}}$$

$$\sin \theta = \frac{Rmv_2}{4Rmv_A} = \frac{v_2}{4v_A} = \frac{\sqrt{2Rg}}{4\sqrt{Rg/2}} = \frac{1}{2}$$