Κεφάλαιο 1

1. $|\dot{\mathbf{r}}| = \dfrac{au_0}{2\sqrt{a^2-b^2}}$

4. $\dot{\mathbf{r}} = \dot{\rho}\boldsymbol{\rho}_1 + \rho\dot{\phi}\boldsymbol{\phi}_1 + \dot{z}\mathbf{k}$
$\ddot{\mathbf{r}} = (\ddot{\rho} - \rho\dot{\phi}^2)\boldsymbol{\rho}_1 + (\rho\ddot{\phi} + 2\dot{\rho}\dot{\phi})\boldsymbol{\phi}_1 + \ddot{z}\mathbf{k}$

5. $t = \dfrac{a^2}{2}\sqrt{\dfrac{m}{k}}$

6.(α) $W = \frac{1}{2}k\left(x_1^2 - x_2^2\right)$
(β) $u_2 = \sqrt{u_1^2 + k\left(x_2^2 - x_1^2\right)}$

7. $T = 12.7$ s και $Z = 292$ m

9. (α) $\mathbf{r} = \left(\dfrac{\sqrt{3}}{2}ut - \dfrac{1}{4}gt^2\right)\mathbf{i} + \left(\dfrac{1}{2}ut - \dfrac{\sqrt{3}}{4}gt^2\right)\mathbf{j}$
(β) $t = \dfrac{2u}{\sqrt{3}g}$
(γ) $R = \dfrac{2u^2}{3g}$
(δ) $\theta = \dfrac{\pi}{3}$

12. $\mathbf{v} = v_0 \mathrm{e}^{-\frac{b}{m}t}\cos\alpha\mathbf{j} + \left[\left(v_0\sin\alpha + \dfrac{mg}{b}\right)\mathrm{e}^{-\frac{b}{m}t} - \dfrac{mg}{b}\right]\mathbf{k}$
$\mathbf{r} = \dfrac{mv_0}{b}\left(\cos\alpha\mathbf{j} + \sin\alpha\mathbf{k}\right)\left(1 - \mathrm{e}^{-\frac{b}{m}t}\right) - \dfrac{mg}{b}\left(t + \dfrac{m}{b}\mathrm{e}^{-\frac{b}{m}t} - \dfrac{m}{b}\right)\mathbf{k}$

13. $T_1 = \dfrac{W\cos\theta_2}{\cos(\theta_1 - \theta_2)}, \quad T_2 = \dfrac{W\sin\theta_1}{\cos(\theta_1 - \theta_2)}$

14. (i) (α) $a = 5.5$ ms^{-2} (β) $a = 5$ ms^{-2}
(ii) (α) $a = 5.5$ ms^{-2} (β) $a = 2.6$ ms^{-2}

15. (α) $F = \dfrac{mg\sin\alpha}{\cos\beta}$ (β) $F = \dfrac{mg(\sin\alpha - \mu\cos\alpha)}{\cos\beta}$

17. $a = \dfrac{m_2 g}{m_1 + m_2}, \quad T = \dfrac{m_1 m_2 g}{m_1 + m_2}$

18. (α) $a = \dfrac{m_1\sin\alpha_1 - m_2\sin\lambda_2}{m_1 + m_2}g$
(β) $a = \dfrac{m_1\sin\alpha_1 - m_2\sin\alpha_2 - \mu m_1\cos\alpha_1 - \mu m_2\cos\alpha_2}{m_1 + m_2}g$

20. $h = \dfrac{3}{4}l$

21. $x = \dfrac{a}{4}\cos\sqrt{\dfrac{k}{m}}t, \quad \dot{x} = -\dfrac{a}{4}\sqrt{\dfrac{k}{m}}\sin\sqrt{\dfrac{k}{m}}t, \quad \dot{x}_{\mathrm{MAX}} = \dfrac{a}{4}\sqrt{\dfrac{k}{m}}, \quad T = 2\pi\sqrt{\dfrac{m}{k}}$

22. (α) $x = (1+5t)\mathrm{e}^{-5t}$
(β) $x = \frac{1}{3}\left(4\mathrm{e}^{-\frac{5}{2}t} - \mathrm{e}^{-10t}\right)$

Κεφάλαιο 2

8. $\theta = \frac{\pi}{2}$

Κεφάλαιο 3

1. $x = \frac{1}{2}a\cosh\omega t$
$\dot{x} = \frac{\sqrt{3}}{2}a\omega$

2. $\frac{1}{3}\omega t^3 g\cos\lambda$

3. $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + x\mathbf{k}$, όπου
$x = \omega a\sin\omega t + (v\cos\beta t + a)\cos\omega t$
$y = \omega a\cos\omega t - (v\cos\beta t + a)\sin\omega t$
$z = -\frac{1}{2}gt^2 + v\sin\beta t + h$

Κεφάλαιο 4

4. $u_1 = \dfrac{Jm_2\cos\alpha}{(m_1+m_2+m_3)m_2 + m_1m_3\sin^2\alpha}$

5. $J_1 = \frac{3}{2}m\sqrt{2gh}\cos\alpha, \quad J_4 = \frac{3}{16}m\sqrt{2gh}\cos\alpha$

6. $r_1 = \dfrac{a}{\sqrt{3}\sin\theta - 3\cos\theta + 4}, \quad r_2 = \dfrac{a}{1+\sqrt{3}\sin\theta}$

Κεφάλαιο 5

1. $k_1^2 = \frac{3}{10}a^2, \quad k_2^2 = \frac{1}{20}(3a^2 + 2h^2)$

2. $k_{QR} = \dfrac{h}{\sqrt{6}}, \quad I_{BC} = \dfrac{23}{6}a^2M$

5. $\ddot{\theta} = \dfrac{1}{3}\dfrac{g}{a}, \quad \mu \geq \dfrac{\sqrt{3}}{9}$

7. AC$= \sqrt{7}a$

9. Οταν $t \to +\infty$, $\omega_1 = 0,\ \omega_2 = \frac{4}{5}\Omega,\ \omega_3 = 0$

10. $\omega_1 = \frac{\sqrt{3}}{2}\Omega\text{sech}\left(\frac{t}{2\sqrt{3}}\right),\quad \omega_2 = \frac{\sqrt{3}}{2}\Omega\tanh\left(\frac{t}{2\sqrt{3}}\right),\quad \omega_3 = \frac{1}{2}\Omega\text{sech}\left(\frac{t}{2\sqrt{3}}\right)$

11. $(x - A_1)^2 + (y - A_2)^2 = B_1^2 + B_2^2$

Κεφάλαιο 6

2. $T = Ma^2\dot{\theta}^2 + \frac{1}{2}m\left(\dot{x}^2 + a^2\dot{\theta}^2 + x^2\dot{\theta}^2 + 2a\dot{x}\dot{\theta}\cos\theta + 2ax\dot{\theta}^2\sin\theta\right)$
$V = mgx\sin\theta$
$2Ma\ddot{\theta} + m\left(a^2\ddot{\theta} + b^2\ddot{\theta} + a\ddot{x} - gb\right) = 0,\quad \ddot{x} + a\ddot{\theta} = 0$

4. $T = \frac{1}{2}ma^2\dot{\theta}^2 + \frac{1}{2}ma^2\omega^2\sin^2\theta$