Chapter 15.

1. $k_{合} = k_1 + k_2 = 7580 \times 2 = 15160\ N/m$.

$\therefore T = 2\pi\sqrt{\frac{m}{k_{合}}}$ $f = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{k_{合}}{m}} = 3.7\ s^{-1}(Hz)$.

3. $f_U = 50Hz$ $f_R = 30Hz$.

$\therefore \frac{1}{2\pi}\sqrt{\frac{k_U}{m}} = 50$. $\frac{1}{2\pi}\sqrt{\frac{k_R}{m}} = 30$.

$f_{总} = \frac{1}{2\pi}\sqrt{\frac{k_{总}}{m}}$ $k_{总} = k_U + k_R$.

又有 $(f_U)^2 + (f_R)^2 = (f_{总})^2$ $\therefore f_{总} = \sqrt{2500+900} = 58.3Hz$.

7. (a) $I = \sum m_i r_i^2$

$I_{rod} = \frac{1}{3}mL^2$ $I_{垂直} = \frac{1}{2}mr^2$ $I_{移} = m(r+L)^2$

代入 $I_{合} = I_{rod} + I_{垂直} + I_{平移} = 0.12033\ kg\cdot m^2$.

(b) 以旋转点为 0 点

$\sum m_i r_i = 0.175 \times 0.35 + 0.6 \times 0.5 = 0.3625\ kg\cdot m$.

$\therefore \bar{r}_i = \frac{\sum m_i r_i}{\sum m_i} = \frac{0.3625\ kg\cdot m}{0.75} = 0.48m$

(c). $T = 2\pi\sqrt{\frac{I}{mgl}} = 1.51s$

9. (a) 平衡时 $G\sin\theta = k_1 x$. $\therefore \Delta x = 0.07m$

$\therefore \Delta x' = L_1 + \Delta x = 0.52m$

(b). $F_{合} = -kx + mg\sin\theta$

$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{G}{g\cdot k}} = 0.65s$.

13. (a) 动量守恒.

$m \cdot v = (m+M) \cdot v_{共}$ $\therefore v_{共} = 1.19\ m/s$

(b) 能量守恒 $\frac{1}{2}kx_0^2 = \frac{1}{2}(m+M) \cdot v_{共}^2$

代入: $A = \frac{x_0}{2} = 0.02m$.

24. $r = 0.1m$.

$I = \frac{2}{5}mr^2$. $T = 2\pi\sqrt{\frac{I}{k}}$.

$\tau = k \cdot \alpha$. $k = \frac{\tau}{\alpha}$. 代入 $\therefore T = 5.36s$

36. $f = \mu mg$. $\omega^2 \cdot A = a_{max} = \mu g$

$\omega^2 = \frac{k}{m+m_2}$ $\frac{k}{m+m_2} \cdot A = \mu g$

代入: $\therefore m = 0.13kg$

45.

$I = \frac{1}{12}mL^2$ $\tau = -\frac{L}{2} \cdot (k \cdot x)$.

$\tau = I \cdot \alpha$; $k \cdot \alpha = \tau$. $x = \frac{L}{2} \cdot \theta$

$\therefore -\frac{L^2 k\theta}{4} = I \cdot \alpha = \frac{1}{12}mL^2 \cdot \alpha$. $\therefore \alpha = -\frac{3k\theta}{m}$.

$\omega = -\frac{3k}{m} \cdot \omega$ $\therefore \omega = \sqrt{\frac{3k}{m}}$ $\therefore T = \frac{2\pi}{\omega} = 0.07\ s^{-1}$.

59. (a) $\omega_m = \theta \cdot \omega = \pi \cdot \frac{2\pi}{0.6} = 32.9\ rad \cdot s^{-1}$.

(b) $\theta = \frac{\pi}{2}$ $\omega_m \cdot \sin\theta = \omega_m \cdot \frac{\sqrt{3}}{2} = 28.46\ rad \cdot s^{-1}$.

$= \frac{1}{2}\theta_{max}$

(c) $\frac{4\pi^2}{(0.6)^2} \times \frac{1}{4} \times \pi = 8.99\ rad \cdot s^{-2}$.