

### 第 三 章 机械振动 参考答案

一、 选择题

1-5      A B D D C

6-10      D D B A D

二、 填空题

1.  $6 \times 10^{-2} \cos\left(\frac{\pi}{2}t - \frac{\pi}{2}\right)$

2.  $5 \cos\left(\frac{\pi}{3}t + \frac{\pi}{6}\right)$

3. 4Hz,  $8\pi \times 10^{-2}$ ,  $\frac{\pi}{6}$

4.  $-kx$ ,  $\frac{1}{2}kx^2$

5.  $2k\pi + \frac{2}{5}\pi$ , 0.14m,  $(2k+1)\pi + \frac{2}{5}\pi$ , 0.02

6.  $\frac{5}{\pi}$  Hz

7.  $5 \times 10^{-2} \cos[\pi t + \arctan(-7)]$

8.  $\frac{8}{16\pi^2}$

9.  $\frac{d^2x}{dt^2} + \omega^2 x = 0$

10.  $\frac{1}{10\pi^2}$

三、 简答题

1. 振幅 角频率 初相位

2. 略

四、 计算题

1. (1)  $v = \frac{dx}{dt} = -0.3 \sin\left(5t - \frac{\pi}{2}\right)$      $a = \frac{dv}{dt} = 1.5 \cos\left(5t - \frac{\pi}{2}\right)$

则  $t=\pi$  时,  $x=0$   $v=-0.3\text{m/s}$   $a=0$

$$(2) E_{\max} = \frac{1}{2}mv_{\max}^2 = 2.25 \times 10^{-3} \text{ J}$$

$$(3) E_p = \frac{1}{2}kx^2 = \frac{1}{2}mv^2 = E_k \quad x = \pm \frac{\sqrt{2}}{2} \times 0.06$$

$$2. A_2 = \sqrt{A^2 + A_1^2 - 2AA_1\cos\frac{\pi}{4}} = 14.7 \text{ cm}$$

$$3. (1) \text{ 对 } m_1、m_2 \quad (m_1+m_2)g - kx_1 = 0$$

$$\text{对 } m_1 \quad m_1g - kx_2 = 0$$

$$\text{则 } x_1 = \frac{(m_1+m_2)g}{k} \quad x_2 = \frac{m_1g}{k}$$

$$\text{能量守恒, } \frac{1}{2}kx_1^2 - \frac{1}{2}kx_2^2 = \frac{1}{2}m_1v_{\max}^2 + mg(x_1 - x_2)$$

$$\text{得 } v_{\max}^2 = 10 \text{ m/s}$$

$$(2) \quad \omega = \sqrt{\frac{k}{m}} = \frac{1}{2} \quad T = \frac{2\pi}{\omega} = \frac{2\pi}{\frac{1}{2}} = 4\pi$$

$$4. (1) \text{ 关于 } O_1 \text{ 点合外力矩为 } 0 \quad F\frac{l}{\sqrt{3}} = mg\frac{l}{2}$$

当摆动到任意角度 $\theta$ 时, 细杆合外力矩为

$$M = mg\frac{l}{2}\cos\theta - mgl\sin\theta - \left(k\frac{l}{\sqrt{3}}\cos\theta + F\right)\frac{l}{\sqrt{3}} = J\beta$$

$$\theta \rightarrow 0 \quad \text{则 } \cos\theta = 1, \sin\theta = \theta$$

$$\text{即 } \frac{1}{2}mg - \frac{1}{2}\frac{kl^2}{3} - \frac{1}{2}mgl^2 = J\beta = \frac{1}{\sqrt{3}}ml^2\beta$$

$$\frac{d^2\theta}{dt^2} + \frac{k}{m}\theta = 0 \quad \text{因此做简谐运动}$$

$$(2) \quad \omega = \frac{2\pi}{T} = \sqrt{\frac{k}{m}} \quad T = 2\pi \sqrt{\frac{m}{k}}$$

$$(3) \quad \theta = \theta_0 \cos\left(\sqrt{\frac{k}{m}} t\right)$$