

SHM practice

1) $\Delta x = 0.04 \text{ m}$
 $M_1 = 0.05 \text{ kg}$
 $k = \text{---} \frac{\text{N}}{\text{m}}$
 $M_T = 0.15 \text{ kg}$
 $f = \text{---} \text{ Hz}$

$$F_s = -kx$$

$$k = \frac{F_s}{x}$$

$$= \frac{4.9}{0.04 \text{ m}}$$

$$k = 12.3 \frac{\text{N}}{\text{m}}$$

$$\omega = 2\pi f$$

$$\omega = \sqrt{\frac{k}{m}}$$

$$2\pi f = \sqrt{\frac{k}{m}}$$

$$f = \frac{1}{2\pi} \sqrt{\frac{k}{m_T}}$$

$$= \frac{1}{2\pi} \sqrt{\frac{12.25 \frac{\text{N}}{\text{m}}}{0.15 \text{ kg}}}$$

$f = 1.44 \text{ Hz}$

2) $M = 0.25 \text{ kg}$
 $A = 0.23 \text{ m}$
 $T = 1.5 \text{ s}$
 $f = \text{---} \text{ Hz}$
 $\omega = \text{---} \frac{\text{rad}}{\text{s}}$
 $v_m = \text{---} \frac{\text{m}}{\text{s}}$
 $a_m = \text{---} \frac{\text{m}}{\text{s}^2}$
 $k = \text{---} \frac{\text{N}}{\text{m}}$

$$f = \frac{1}{T}$$

$$= \frac{1}{1.5 \text{ s}}$$

$f = 0.667 \text{ Hz}$

$$\omega = 2\pi f$$

$$= 2\pi(0.667 \text{ Hz})$$

$$a_m = \frac{k}{m} A$$

$$= \omega^2 A$$

$$= (4.19 \frac{\text{rad}}{\text{s}})^2 (0.23 \text{ m})$$

$a_m = 4.04 \frac{\text{m}}{\text{s}^2}$

$\omega = 4.19 \frac{\text{rad}}{\text{s}}$

$$v_m = \sqrt{\frac{k}{m}} A$$

$$\omega = \sqrt{\frac{k}{m}}$$

$$v_m = \omega A$$

$$= 4.19 \frac{\text{rad}}{\text{s}} (0.23 \text{ m})$$

$$\omega^2 = \frac{k}{m}$$

$$k = m \omega^2$$

$$= 0.25 \text{ kg} (4.19 \frac{\text{rad}}{\text{s}})^2$$

$k = 4.39 \frac{\text{N}}{\text{m}}$

$x_1 = 0.05 \text{ m}$ $v = \text{---} \frac{\text{m}}{\text{s}}$
 $x_2 = 0.08 \text{ m}$ $a = \text{---} \frac{\text{m}}{\text{s}^2}$

$v_m = 0.964 \frac{\text{m}}{\text{s}}$

$$a = -\frac{k}{m} x$$

$$= \frac{4.39 \frac{\text{N}}{\text{m}}}{0.25 \text{ kg}} (0.08 \text{ m})$$

or

$a = 1.41 \frac{\text{m}}{\text{s}^2}$

 $a = \omega^2 x$

3)
$$V = \sqrt{\frac{k}{m} (A^2 - x^2)}$$

$$= \sqrt{\frac{4.39 \frac{\text{N}}{\text{m}}}{0.25 \text{ kg}} ((0.23 \text{ m})^2 - (0.05 \text{ m})^2)}$$

$V = 0.941 \frac{\text{m}}{\text{s}}$

4) $T = 2\pi \sqrt{\frac{l}{g}}$

$$T^2 = 4\pi^2 \frac{l}{g}$$

$$l = \frac{gT^2}{4\pi^2}$$

$$l = \frac{1.6 \frac{\text{m}}{\text{s}^2} (2 \text{ s})^2}{4\pi^2}$$

$l = 0.162 \text{ m}$

$$f = \frac{1}{T}$$

$$= \frac{1}{2 \text{ s}}$$

$f = 0.5 \text{ Hz}$

$$\omega = 2\pi f$$

$$= 2\pi(0.5 \text{ Hz})$$

$\omega = 3.14 \frac{\text{rad}}{\text{s}}$

$$\begin{aligned}
 5) \Delta x_1 &= 0.15 \text{ m} \\
 M_1 &= 0.3 \text{ kg} \\
 k &= \frac{N}{m} \\
 A &= 0.1 \text{ m} \\
 \omega &= \frac{\text{rad}}{s} \\
 v_m &= \frac{m}{s} \\
 a_m &= \frac{m}{s^2} \\
 F_m &= N \\
 x_{15} &= m \\
 t_1 &= s \\
 t_2 &= s
 \end{aligned}$$

$$\begin{aligned}
 F_s &= -kx \\
 k &= \frac{F}{x} \\
 &= \frac{11.9}{0.15 \text{ m}} \\
 &= 0.3 \text{ kg} (9.8 \frac{m}{s^2})
 \end{aligned}$$

$$a) \boxed{k = 19.6 \frac{N}{m}}$$

$$\begin{aligned}
 \omega &= \sqrt{\frac{k}{M}} \\
 &= \sqrt{\frac{19.6 \frac{N}{m}}{0.3 \text{ kg}}}
 \end{aligned}$$

$$b) \boxed{\omega = 8.08 \frac{\text{rad}}{s}}$$

$$\begin{aligned}
 v_m &= \omega A \\
 &= (8.08 \frac{\text{rad}}{s}) (0.1 \text{ m})
 \end{aligned}$$

$$c) \boxed{v_m = 0.808 \frac{m}{s}}$$

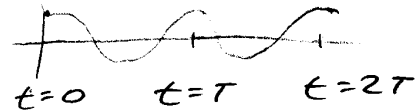
$$\begin{aligned}
 a_m &= \omega^2 A \\
 &= (8.08 \frac{\text{rad}}{s})^2 (0.1 \text{ m})
 \end{aligned}$$

$$d) \boxed{a_m = 6.53 \frac{m}{s^2}}$$

$$\begin{aligned}
 \text{or} \\
 a_m &= \omega v_m
 \end{aligned}$$

$$\begin{aligned}
 x &= A \cos(\omega t) \\
 &= 0.1 \text{ m} \cos(8.08 \frac{\text{rad}}{s} (15 \text{ s}))
 \end{aligned}$$

$$f) \boxed{x_{15} = -0.0246 \text{ m}}$$



$$g) \boxed{t_1 = 0.778 \text{ s}} \\ \boxed{t_2 = 1.56 \text{ s}}$$

$$\begin{aligned}
 F_m &= m a_m \\
 &= 0.3 \text{ kg} (6.53 \frac{m}{s^2})
 \end{aligned}$$

$$e) \boxed{F_m = 1.96 \text{ N}}$$

$$\omega = \frac{2\pi}{T}$$

$$T = \frac{2\pi}{\omega}$$

$$T = \frac{2\pi}{8.08 \frac{\text{rad}}{s}}$$

$$T = 0.778 \text{ s}$$

$$6) x = 0.3 \cos(0.5t)$$

$$x_3 = m$$

$$v_3 = \frac{m}{s}$$

$$a_3 = \frac{m}{s^2}$$

$$t = 3 \text{ s}$$

$$x_3 = 0.3 \cos(0.5(3 \text{ s}))$$

$$a) \boxed{x_3 = 0.0212 \text{ m}}$$

$$v_3 = -0.5(0.3) \sin(0.5(3 \text{ s}))$$

$$b) \boxed{v_3 = -0.150 \frac{m}{s}}$$

$$a_3 = -(0.5)^2 (0.3) \cos(0.5(3 \text{ s}))$$

$$c) \boxed{a_3 = -0.00530 \frac{m}{s^2}}$$

$$\omega = \frac{2\pi}{T}$$

$$T = \frac{2\pi}{\omega}$$

$$= \frac{2\pi}{15.7 \frac{\text{rad}}{s}}$$

$$a) \boxed{T = 0.400 \text{ s}}$$

$$a_m = \omega^2 A$$

$$A = \frac{a_m}{\omega^2}$$

$$= \frac{25.1 \frac{m}{s^2}}{(15.7 \frac{\text{rad}}{s})^2}$$

$$b) \boxed{A = 0.102 \text{ m}}$$

$$\text{or} \\ v_m = \omega A$$

$$A = \frac{v_m}{\omega}$$

$$7) a_m = 25.1 \frac{m}{s^2}$$

$$v_m = 1.6 \frac{m}{s}$$

$$T = s$$

$$A = m$$

$$a_m = \omega v_m$$

$$\omega = \frac{a_m}{v_m}$$

$$= \frac{25.1 \frac{m}{s^2}}{1.6 \frac{m}{s}}$$

$$\omega = 15.7 \frac{\text{rad}}{s}$$

$$8) A = 0.07 \text{ m}$$

$$a_m = 9.8 \frac{\text{m}}{\text{s}^2}$$

$$f = \text{--- Hz}$$

$$a_m = \omega^2 A$$

$$\omega = \sqrt{\frac{a_m}{A}}$$

$$= \sqrt{\frac{9.8 \frac{\text{m}}{\text{s}^2}}{0.07 \text{ m}}}$$

$$\omega = 11.83 \frac{\text{rad}}{\text{s}}$$

$$\omega = 2\pi f$$

$$f = \frac{\omega}{2\pi}$$

$$= \frac{11.83 \frac{\text{rad}}{\text{s}}}{2\pi}$$

$$f = 1.88 \text{ Hz}$$

$$9) M = 0.036 \text{ kg}$$

$$A = 0.13 \text{ m}$$

$$T = 1.2 \text{ s}$$

$$t = 0 \text{ s}$$

$$x = 0.13 \text{ m}$$

$$k = \text{--- } \frac{\text{N}}{\text{m}}$$

$$x = 0.05 \text{ m}$$

$$v = \text{--- } \frac{\text{m}}{\text{s}}$$

$$t = 2 \text{ s}$$

$$F = \text{--- N}$$

$$\omega^2 = \frac{k}{M} \quad \omega = \frac{2\pi}{T}$$

$$k = M\omega^2$$

$$= M \left(\frac{2\pi}{T} \right)^2$$

$$= \frac{M 4\pi^2}{T^2}$$

$$= \frac{0.036 \text{ kg} (4\pi^2)}{(1.2 \text{ s})^2}$$

$$a) k = 0.987 \frac{\text{N}}{\text{m}}$$

$$v = \sqrt{\frac{k}{M} (A^2 - x^2)}$$

$$= \sqrt{\frac{0.987 \frac{\text{N}}{\text{m}}}{0.036 \text{ kg}} \left((0.13 \text{ m})^2 - (0.05 \text{ m})^2 \right)}$$

$$b) v = 0.628 \frac{\text{m}}{\text{s}}$$

$$a = -\omega^2 A \cos(\omega t)$$

$$= -\left(5.24 \frac{\text{rad}}{\text{s}} \right)^2 (0.13 \text{ m}) \cos\left(5.24 \frac{\text{rad}}{\text{s}} (2 \text{ s}) \right)$$

$$a = 1.76 \frac{\text{m}}{\text{s}^2}$$

$$F = ma$$

$$= 0.036 \text{ kg} (1.76 \frac{\text{m}}{\text{s}^2})$$

$$c) F = 0.0634 \text{ N}$$

$$\omega = \frac{2\pi}{T}$$

$$= \frac{2\pi}{1.2 \text{ s}}$$

$$\omega = 5.24 \frac{\text{rad}}{\text{s}}$$