

1) $x(t) = A \sin(\omega_0 t + \delta)$

$$x(t) = x(t+T) = A \sin[\omega_0(t+T) + \delta]$$

→ For this to hold $\omega_0 t + \omega_0 T + \delta = \omega_0 t + \delta + 2n\pi$

$$\therefore \omega_0 T = 2n\pi$$

$$T = \frac{2n\pi}{\omega_0} \text{ set } n=1$$

$$\therefore T = \frac{2\pi}{\omega_0}$$

$$\gamma = \frac{1}{T} = \frac{\omega_0}{2\pi}$$

2) $m = 0.05 \text{ kg}$ $k = 35 \text{ N/m}$ $A = 0.04 \text{ m}$

a. $E = KE + PE$ when $x = A$, $KE = 0$ and

$$E = PE = \frac{1}{2} k A^2$$

$$E = \frac{1}{2} (35 \frac{\text{N}}{\text{m}}) (0.04 \text{ m})^2$$

$$E = \underline{0.028 \text{ J}}$$

b. $v = ?$ at $x = 0.01 \text{ m}$

$$E = \frac{1}{2} m v^2 + \frac{1}{2} k x^2$$

$$v^2 = \frac{2}{m} \left(E - \frac{1}{2} k x^2 \right)$$

$$= \frac{2}{(0.05 \text{ kg})} \left(0.028 \text{ J} - \frac{1}{2} (35 \frac{\text{N}}{\text{m}}) (0.01 \text{ m})^2 \right)$$

$$\underline{v = 1.02 \text{ m/s}}$$

c. $x = 0.03 \text{ m}$ $PE = ?$ $KE = ?$

$$PE = \frac{1}{2} k x^2 = \frac{1}{2} (35 \frac{\text{N}}{\text{m}}) (0.03 \text{ m})^2 = \underline{0.016 \text{ J}}$$

$$KE = E - PE = 0.028 \text{ J} - 0.016 \text{ J} = \underline{0.012 \text{ J}}$$

d. See 2.c

3) $T = 1.5 \text{ s}$ $m = 1500 \text{ kg}$ $k_t = 4k$ $k = ?$

$$F_s = -\frac{kx}{t} = ma$$

$$a = \frac{d^2 A \sin(\omega_0 t + \delta)}{dt^2}$$

$$-k_t A \sin(\omega_0 t + \delta) = \underbrace{a = -\omega_0^2 A \sin(\omega_0 t + \delta)}_{-m\omega_0^2 A \sin(\omega_0 t + \delta)}$$

$$\therefore k_t = m\omega_0^2$$

$$4k = m \frac{4\pi^2}{T^2}$$

$$T = \frac{2\pi}{\omega_0} \text{ from 1)}$$

$$k = \frac{m\pi^2}{T^2} = \frac{(1500 \text{ kg})\pi^2}{(1.5 \text{ s})^2}$$

$$\underline{k = 6.6 \times 10^3 \text{ N/m}}$$

4) $m = 0.81 \text{ kg}$ $T = 0.91 \text{ s}$

$$m_u = ? \quad T_u = 1.16 \text{ s}$$

$$k = ?$$

$$k = m\omega_0^2$$

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

$$= \frac{(0.81 \text{ kg}) 4\pi^2}{(0.91 \text{ s})^2}$$

$$\underline{k = 38.6 \text{ N/m}}$$

$$\therefore k = m_u \omega_u^2$$

$$= m_u \frac{4\pi^2}{T_u^2}$$

$$m_u = \frac{k T_u^2}{4\pi^2} = \underline{1.32 \text{ kg}}$$

5) $M = 1 \text{ kg}$ $A = 0.1 \text{ m}$ $T = 0.5 \text{ s}$ $k = ?$ $E = ?$

$$k = m\omega_0^2 = m \frac{4\pi^2}{T^2} = \frac{(1 \text{ kg}) 4\pi^2}{(0.5 \text{ s})^2} = \underline{158 \text{ N/m}}$$

$$E = \frac{1}{2} k A^2 = \frac{1}{2} (158 \frac{\text{N}}{\text{m}}) (0.1 \text{ m})^2 = \underline{0.79 \text{ J}}$$