

## Chapter # 8:

# Wave Motion & Sound

## Numericals:

1) Data:

$$m = 0.1 \text{ kg}$$

$$\lambda = 20 \text{ cm} = 20 \times 10^{-2} \text{ m}$$

$$\lambda = 0.2 \text{ m}$$

$$F = 5 \text{ N}$$

$$F = k\lambda$$

$$k = \frac{F}{\lambda}$$

$$k = \frac{5}{0.2} = 25 \text{ Nm}^{-1}$$

$$T = 2\pi \sqrt{\frac{m}{k}} = 2\pi \sqrt{\frac{0.1}{25}}$$

$$T = 0.39 \text{ sec}$$

$$f = \frac{1}{T} = \frac{1}{0.39}$$

$$f = 2.51 \text{ Hz}$$

2).

Data:

$$T = 0.5 \text{ s}$$

$$x = ?$$

$$F = kx$$

$$\therefore F = W = mg$$

$$mg = kx$$

$$x = \frac{m}{k} g$$

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

S.B.S

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

$$\frac{m}{k} = \frac{T^2}{4\pi^2} = \frac{(0.5)^2}{4\pi^2} = 0.00633$$

$$x = \frac{m}{k} g$$

$$x = (0.00633) (9.8)$$

$$x = 0.06212 \text{ m}$$

$$x = 6.212 \text{ cm}$$

Answer

3) Data :

$$m = 0.025 \text{ kg}$$

$$x = 0.1 \text{ m}$$

$$k = 0.4 \text{ Nm}^{-1}$$

$$v = 0.4 \text{ ms}^{-1}$$

$$T.E = ?$$

$$x_0 = ?$$

$$T.E = P.E + K.E$$

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

$$= \frac{1}{2} (0.4) (0.1)^2 + \frac{1}{2} (0.025) (0.4)^2$$

$$T.E = 0.002 + 0.002$$

$$= 0.004$$

$$T.E = 4 \times 10^{-3} \text{ J}$$

$$T.E = \frac{1}{2} k x_0^2$$

$$\frac{2(T.E)}{k} = x_0^2$$

$$\Rightarrow \sqrt{x_0^2} = \sqrt{\frac{2(T.E)}{k}}$$

$$x_0 = \sqrt{\frac{2(0.004)}{0.4}}$$

$$x_0 = 0.141 \text{ m}$$

Answer.

4) Find length of second pendulum.

Data :

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

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

S.B.S

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

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

$$\Rightarrow l = \frac{(2)^2 (9.8)}{4(3.14)^2}$$

$$= 0.992 \text{ m}$$

$$l = 1 \text{ m}$$

Answer

5) Data:

4 vibration in 8 sec

$$T = \frac{8}{4} = 2 \text{ sec}$$

$T = ?$  on moon.

$$l = ?$$

$$g_m = \frac{1}{6} g_e = 1.634 \text{ ms}^{-2}$$

$$T_m = 2\pi \sqrt{\frac{l}{g}}$$

$$T_E = 2\pi \sqrt{\frac{l}{g}}$$

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

$$l = \frac{T_E^2 g}{4\pi^2} = \frac{(2)^2 9.8}{4 \times \pi^2} = 0.993 = 1 \text{ m}$$

$$T_m = 2\pi \sqrt{\frac{l}{g}} = 2 \times 3.14 \times \sqrt{\frac{1}{1.634}}$$

$$T_m = 4.91 \text{ sec}$$

6) Data :

$$F = 20 \text{ N}$$

$$m = 4 \text{ kg}$$

$$\lambda = 1 \text{ cm} = 1 \times 10^{-2} \text{ m} = 0.01 \text{ m}$$

$$k = ?$$

$$T = ?$$

$$F = kx$$

$$k = F/x = \frac{20}{0.01} = 2000 \text{ Nm}^{-1}$$

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

$$= 2 \times 3.14 \times \sqrt{\frac{4}{2000}}$$

$$T = 0.28 \text{ s} \quad \text{Answer}$$

6)

Data :

$$m = 2 \text{ kg}$$

$$x = 0.04 \text{ m}$$

$$k = 200 \text{ Nm}^{-1}$$

$$T = ?$$

$$f = ?$$

$$v_{\text{max}} = ? \quad a_{\text{max}} = ?$$

$$T = 2\pi \sqrt{\frac{m}{k}} = 2 \times 3.14 \times \sqrt{2/200}$$

$$T = 0.628 \text{ sec}$$

$$f = \frac{1}{T} = \frac{1}{0.628}$$

$$f = 1.59 \text{ Hz}$$

$$v_{\max} = \omega_0 \sqrt{k/m}$$

$\omega_0 = \text{find yourself}$

$$a_{\max} = -\frac{k}{m} x_0$$

$x_0 = \text{find yourself}$

7) Data:

$$T = 0.4 \text{ sec}$$

$$x = 4 \text{ cm} = 4 \times 10^{-2} = 0.04 \text{ m}$$



$$a \propto -x$$

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

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

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

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

$$\frac{k}{m} = \frac{4\pi^2}{T^2} = \frac{4k (3.14)^2}{(0.4)^2}$$

$$= 246.49 \text{ N/m}^1 \cdot \text{m}^1$$

$$= 246.49 \text{ N}$$

$$a = -(246.49)(0.04)$$

$$a = -9.85 \text{ m/s}^{-2}$$

8) Data:

$$g_m = 0.167 g_e = 0.167 (9.8)$$

$$g_m = 1.633$$

$$T = 2s$$

$$l = ?$$

$$T = 2\pi \sqrt{\frac{l}{g_m}}$$

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

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

$$\Rightarrow l = \frac{(2)^2 (1.633)}{4(3.14)^2}$$

$$l = 0.165 \text{ m}$$

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