

$$1 \quad F = -kx$$

$$F_e = kx$$

$$k = 1.75 \text{ kN/m} = 1750 \text{ N/m}$$

$$x = 80 \text{ cm} = 0.8 \text{ m}$$

$$F = kx$$

$$= 1750 \times 0.8$$

$$= 1400 \text{ N}$$

$$= 1.4 \text{ kN}$$

2.

$$F = kx$$

$$k = ?$$

$$F = 1.5 \text{ N}$$

$$x = 30 \text{ } \mu\text{m} = 0.00003 \text{ m}$$

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

$$= \frac{1.5 \text{ N}}{0.00003 \text{ m}}$$

$$= 50,000 \text{ N/m}$$

$$= 50,000 \text{ N/m}$$

$$= 50 \text{ kN/m}$$

$$3 \quad k = 0.125 \text{ MN/m} = 125000 \text{ N/m}$$

$$e = x = 0.08 \text{ m}$$

$$F = ke = 125000 \text{ N/m} \times 0.08 \text{ m}$$

$$= 10000 \text{ N}$$

$$F = ma$$

$$m = 1 \text{ tonne} = 1000 \text{ kg}$$

$$a = \frac{F}{m}$$

$$= \frac{10000}{1000}$$

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

4 Spring Constant $k = 0.25 \text{ kN/m}$

$$l_{\text{rod}} = 400 \text{ g} = 0.4 \text{ kg} = 4 \text{ N}$$

$$v_0 = 20 \text{ m/s} \quad A?$$

$$v_t = \omega A \sin \omega t$$

$$v = \omega A \Rightarrow A = \frac{v}{\omega} \quad \text{but } \omega = \sqrt{\frac{k}{m}}$$

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

$$= 20 \times \sqrt{\frac{0.4}{250}} = 0.8 \text{ m}$$

5 $\lambda = \frac{v}{f}$

$$f = \frac{12}{2} = 6 \text{ Hz}$$

$$v = 31.2 \text{ m/s}$$

$$\lambda = \frac{31.2 \text{ m/s}}{6 \text{ Hz}}$$

$$= 5.2 \text{ m}$$

6. Linear intensity $= 8.0 \times 10^{-4} \text{ kg/m}$

$$f = 400 \text{ Hz}$$

$$\lambda = 60 \text{ cm} = 0.6 \text{ m}$$

$$\text{Tension } (T_s) = ?$$

$$v = \sqrt{\frac{F}{\mu}}$$

$$v^2 = \frac{F}{\mu}$$

$$F = v^2 \mu \quad \text{but } v = \lambda \cdot f$$

$$F = (\lambda \cdot f)^2 \mu$$

$$= (400 \times 0.6)^2 \times 8.0 \times 10^{-4}$$

$$F = 46.08 \text{ N}$$

7 Wave $y = 4.2 \text{ m} \sin(1.2 \text{ rad/m} x - 9.6 \text{ rad/s} t)$

velocity in (m/s)

$$y(x, t) = A \sin(kx - \omega t)$$

$$4.2 \text{ m} \sin(1.2 \text{ rad/m} x - 9.6 \text{ rad/s} t)$$

Magnitude of speed

$$|v| = \frac{\omega}{k}$$

$$= \frac{9.6}{1.2}$$

$$= 8 \text{ m/s}$$

8 Sound intensity in $\mu\text{W/m}^2$

$$d = 1.86 \text{ m}$$

Source 4 mW

$$P = 4 \text{ mW} = 4000 \mu\text{W}$$

$$I = P/A = I = \frac{P}{4\pi d^2}$$

$$A = 4\pi d^2 = \frac{4000 \mu}{4\pi \cdot 1.86^2}$$

$$= 92.017 \mu\text{W/m}^2$$

9

$$20 \mu\text{W/m}^2 \text{ to } 20 \text{ mW/m}^2$$

$$\frac{2000 \mu\text{W/m}^2}{= 20 \mu\text{W/m}^2}$$

$$1980 \mu\text{W/m}^2$$

$$10 \log_{10} \frac{1.98 \text{ W/m}^2}{10^{-2} \text{ W/m}^2}$$

$$= 122.97 \text{ dB}$$

10 Input piston $r = 2\text{cm} = 0.02\text{m}$

output piston $r = 0.4\text{m}$

$$\text{Mass} = 1.2 \text{ tonnes} = 1200 \text{ kg} \\ 12000 \text{ N}$$

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$F_1 = F_2 \times \frac{A_1}{A_2}$$

$$= 12000 \times \frac{(0.02^2 \pi)}{(0.4^2 \pi)}$$

$$= 30 \text{ N}$$

11 $\Delta L = 790 \text{ mm}$

$$\Delta T = 30^\circ\text{C} \quad -9^\circ\text{C to } 21^\circ\text{C}$$

$$\alpha \text{ coefficient of } L.E = 12 \times 10^{-6} / ^\circ\text{C}$$

$$\Delta L = \alpha L_0 \Delta T$$

$$L_0 = \frac{\Delta L}{\alpha \Delta T}$$

$$= \frac{0.09}{12 \times 10^{-6} \times 30^\circ\text{C}}$$

$$= 250 \text{ m}$$

12 Copper rod $r = 1.5 \text{ cm} = 0.015 \text{ m}$

Length = 0.8 m

Temp = 415°C

Rom $T = 20^\circ\text{C}$

Thermal conductivity of copper = $390 \text{ J/s m}^\circ\text{C}$

$$Q/t = \frac{KA(T_2 - T_1)}{d}$$

$$= 390 (\pi \times 0.015^2 + \pi \times 0.03 \times 0.8) (415 - 20)$$

$$= 112311.723.99$$

$$= 11.723 \text{ kW}$$

13 Absorber at 760 W/m^2

Perfect radiator $e = 1$

$Q = \frac{P}{A}$ From Boltzmann Law

$$T = \left[\frac{P/A}{e\sigma} \right]^{1/4}$$

$$= \left[\frac{760 \text{ W/m}^2}{1.00 \times 5.67 \times 10^{-8}} \right]^{1/4}$$

$$= 340.26 \text{ K}$$

14 0.3 m^3 of helium pressure $1.1 \times 10^5 \text{ Pa}$

Temp = 310 K

mass (in kg) of helium

$$R = 8.314 \text{ J/mol K}$$

$$m = \frac{n \times MW}{PV/RT \times MW}$$

molecular mass of He = 4

$$\frac{1.1 \times 10^5 \times 0.300 \times 4}{8.314 \times 310}$$

$$= 51.25 \text{ kg He.}$$