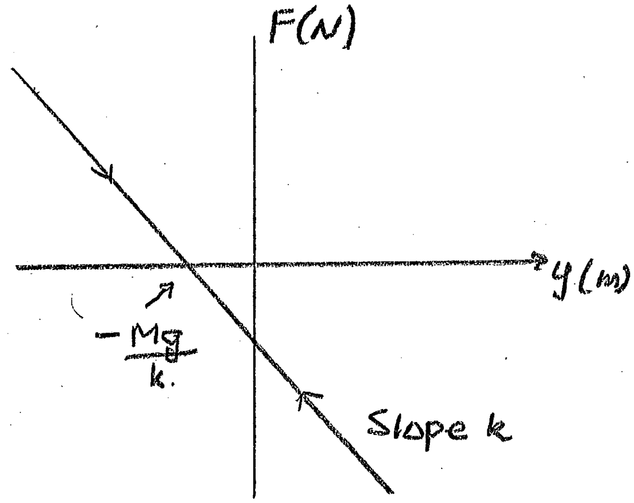
Answers – Week 2

2-1 Reduce length by a factor of 6.

2-3 FREQUENCY DOES NOT CHANGE.

Equilibrium position is $y = -\frac{Mg}{k}$



2-5 $P = \frac{1}{2}A^2\omega^2\frac{T}{V}, V = \sqrt{\frac{T}{\mu}}$

(i) P increases 4 times.
(ii) P reduces by factor of 4.
(iii) P increases by factor of $\sqrt{3}$.

2-7 $y = y_i + y_r = 2\,A_i\,\text{Sin}\,kx\,\text{Cos}\,\omega t$

$= 2\,A_i\,\text{Sin}\frac{2\pi x}{\lambda}\,\text{Cos}\,\omega t$

At nodes $y = 0$, $\text{Sin}\frac{2\pi x}{\lambda} = 0$, $\frac{2\pi x}{\lambda} = n\pi$

$x = \frac{n\lambda}{2}$, $n = 0, 1, 2$

At antinodes $y = 2\,A_i\,\text{Sin}\frac{2\pi x}{\lambda} = 1$, $\frac{2\pi x}{\lambda} = \left(n + \frac{1}{2}\right)\pi$

So $x = (2n+1)\frac{\lambda}{4}$, $n = 0, 1, 2$

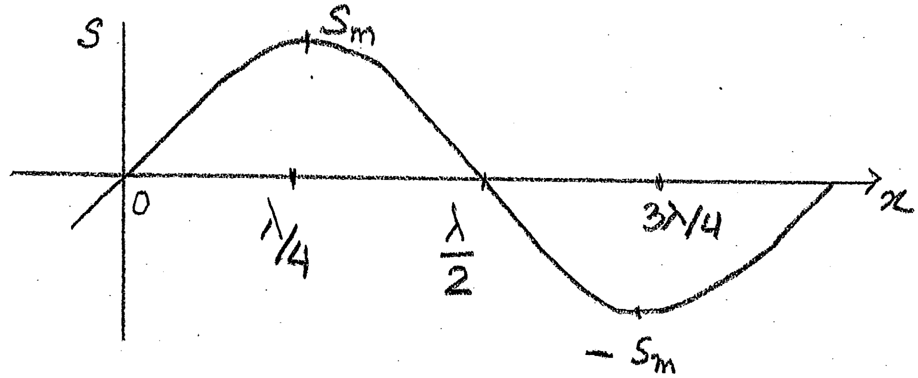
2-9 In the experiment, frequency is fixed

(i) $f = \frac{n}{2L}\sqrt{\frac{T}{\mu}}$, so when n is smallest, T must be largest

(ii) Reduce T and hence Mass by a factor of 9.

2-11 $S = S_m\,\text{Sin}\,(kx - \omega t)$

Consider wave at t = 0



Near x = 0, (i) Displacements are positive for x > 0 and increase with x and (ii) Displacements are negative at x < 0 and become more negative as x becomes more negative: GAS IS EXPANDING – PRESUURE WILL BE REDUCED TO A MINIMUM.

NEAR $x = \frac{\lambda}{4}$ DISPLACEMENTS ARE LARGE (Max) BUT ALL NEARLY SAME.CHANGE OF VOLUME IS ZERO SO CHANGE OF PRESUURE IS ZERO!

2-13 Since displacement is a function of position, volume must change, hence pressure much change. To proceed further we must know the relationship between these changes, Sound has frequencies higher than 20 Hz, there is no possibility of heat exchange with the surroundings so it is an Adiabatic Thermodynamic Process and the P-V equation is PV^{γ} = Constant, where $\gamma = \frac{C_p}{C_V}$

C_p = specific heat at constant pressure
C_V = specific heat at constant volume

2-15 $V_S = \sqrt{\frac{\gamma k T}{m}}$ $\qquad C_{\gamma m S} = \sqrt{\frac{3k_B T}{m}}$

$$\gamma_{He} = \frac{5}{3}$$

$$\frac{V_s}{C_{\gamma m s}} = \sqrt{\frac{5}{9}} = 0.75$$