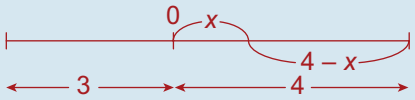
$F_r = F_l \Rightarrow 48 - 8d$

$= 12d - 12$

$\Rightarrow d = 3$

Answer: 3 metres from left hand wall.

(ii)



$F_r = k(l - l_0)$

$= 8(4 - x - 1)$

$= 24 - 8x$

$F_l = k(l - l_0)$

$= 12(3 + x - 1)$

$= 24 + 12x$

$F = F_r - F_l$

$= 24 - 8x - 24 - 12x$

$= -20x$

$F = ma$

$\Rightarrow -20x = 5a$

$\Rightarrow a = -4x$

It will perform SHM with $\omega = 2$.

(iii) When it is released its displacement, x, from 0 is $\frac{1}{2}$ m.

Therefore $A = \frac{1}{2}$.

Periodic time $= \frac{2\pi}{\omega} = \frac{2\pi}{2} = \pi$ s

Maximum velocity $= \omega A$

$= 2\left(\frac{1}{2}\right)$

$= 1$ m/s

(iv) Firstly, find x when $v = \frac{\sqrt{3}}{2}$:

$v^2 = \omega^2(A^2 - x^2)$

$\Rightarrow \frac{3}{4} = 4\left(\frac{1}{2} - x^2\right)$

$\Rightarrow x = \frac{1}{4}$

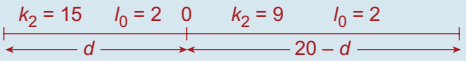
When $x = \frac{1}{4}$

$a = \omega^2 x = -(4)\left(\frac{1}{4}\right) = -1$ m/s^2

The acceleration is of magnitude 1 m/s^2.

$F = ma \Rightarrow F = (5)(1) = 5$ N

Q. 5. (i)



$F_r = k(l - l_0)$

$= 9(20 - d - 2)$

$= 162 - 9d$

$F_l = k(l - l_0)$

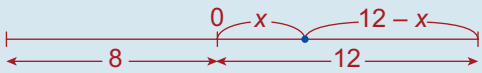
$= 15(d - 2)$

$= 15d - 30$

$F_r = F_l$

$\Rightarrow 162 - 9d = 15d - 30$

$\Rightarrow d = 8$



$F_r = k(l - l_0)$

$= 9(12 - x - 2)$

$= 90 - 9x$

$F_l = k(l - l_0)$

$= 15(8 + x - 2)$

$= 90 + 15x$

$F = F_r - F_l$

$= 90 - 9x - 90 - 15x$

$= -24x$

$F = ma$

$\Rightarrow -24x = \frac{1}{6}a$

$\Rightarrow a = -144x$

It will perform SHM with $\omega = 12$

(ii) When it was released its displacement, x, from 0 was 1 m.

Therefore $A = 1$.

Maximum acceleration $= \omega^2 A$

$= 144(1)$

$= 144$ m/s^2

(iii) $\frac{3}{5}$ (Max. acceleration) $= \frac{3}{5}(144)$

$= \frac{432}{5}$ m/s^2

When $a = \frac{432}{5}$, what is x?, $a = -\omega^2 x$

$\Rightarrow \frac{432}{5} = -144x$

$\Rightarrow x = \frac{-3}{5}$