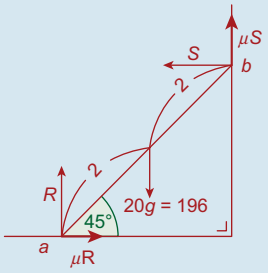
Q. 9.



① $R + \mu S = 196$

② $\mu R = S$

③ **Taking moments about *a*:**

$196(2 \cos 45°) = S(4 \sin 45°) + \mu S(4 \cos 45°)$

But $\cos 45° = \sin 45° = \frac{1}{\sqrt{2}}$

$\therefore 196(2) = S(4) + \mu S(4)$

$\Rightarrow S + \mu S = 98$

$\Rightarrow S(1 + \mu) = 98$

$\Rightarrow S = \frac{98}{1 + \mu}$

Now $\mu R = S$

$\Rightarrow R = \frac{1}{\mu}S = \frac{1}{\mu}\left(\frac{98}{1 + \mu}\right) = \frac{98}{\mu(1 + \mu)}$

Putting these into equation ①, we get

$\frac{98}{\mu(1 + \mu)} + \mu\left(\frac{98}{1 + \mu}\right) = 196.$

… Multiply by $\mu(1 + \mu)$

$\Rightarrow 98 + 98\mu^2 = 196\mu(1 + \mu).$

… Divide by 98.

$\Rightarrow 1 + \mu^2 = 2\mu(1 + \mu)$

$\Rightarrow 1 + \mu^2 = 2\mu + 2\mu^2$

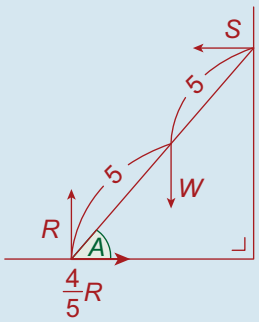
$\Rightarrow \mu^2 + 2\mu - 1 = 0$

$\Rightarrow \mu = \frac{-2 \pm \sqrt{4 + 4}}{2} = \frac{-2 \pm 2\sqrt{2}}{2}$

$= -1 \pm \sqrt{2}$

Since $\mu > 0$, $\mu = \sqrt{2} - 1$ **Q.E.D.**

Q. 10. (i)



① $R = W$

② $\frac{4}{5}R = S$

③ **Taking moments about the foot of the ladder:**

$W(5 \cos A) = S(10 \sin A)$

$\Rightarrow W \cos A = 2S \sin A$

But $S = \frac{4}{5}R = \frac{4}{5}W.$

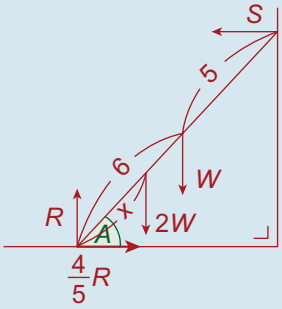
$\therefore W \cos A = 2\left(\frac{4}{5}W\right) \sin A$

$\Rightarrow \cos A = \frac{8}{5} \sin A$

$\Rightarrow 1 = \frac{8}{5} \tan A$

$\Rightarrow \tan A = \frac{5}{8}$

(ii)



Since $\tan A = \frac{3}{4}$, $\cos A = \frac{4}{5}$, $\sin A = \frac{3}{5}$

① $R = 2W + W = 3W$

② $\frac{4}{5}R = S$

$\Rightarrow S = \frac{4}{5}(3W) = \frac{12}{5}W$

③ $2W(x \cos A) + W(5 \cos A)$

$= S(10 \sin A)$

$\Rightarrow 2W\left(\frac{4}{5}x\right) + W(4) = S(6)$

$\Rightarrow \frac{8}{5}xW + 4W = 6S$

But $S = \frac{12}{5}W$

$\therefore \frac{8}{5}xW + 4W = 6\left(\frac{12}{5}W\right)$

$\Rightarrow 8x + 20 = 72$

$\Rightarrow x = 6.5$ m

(iii)