From the diagram of forces on the ring C we can see that

$\mu R = T \cos \alpha$ … Equation ①

and $R = T \sin \alpha + W$

… but $W = T \sin \alpha$

$\Rightarrow \quad R = 2T \sin \alpha$ … Equation ②

Dividing Equation ① by Equation ② we get:

$\mu = \dfrac{1}{2 \tan \alpha}$

$\Rightarrow 2\mu \tan \alpha = 1$

$\Rightarrow \tan \alpha = \dfrac{1}{2\mu}$ … (i)

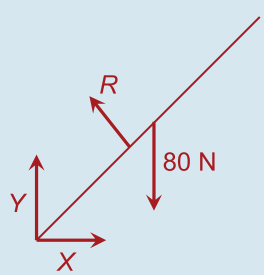
(ii) $W = T \sin \alpha$

$\Rightarrow T = W/\sin \alpha$ … $\tan \alpha = \dfrac{1}{2\mu}$

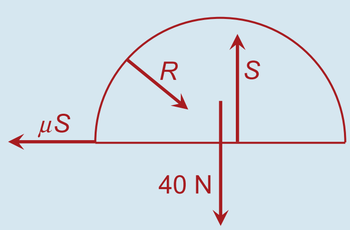
$\Rightarrow \sin \alpha = \dfrac{1}{\sqrt{1 + 4\mu^2}}$

$\Rightarrow T = W\sqrt{1 + 4\mu^2}$

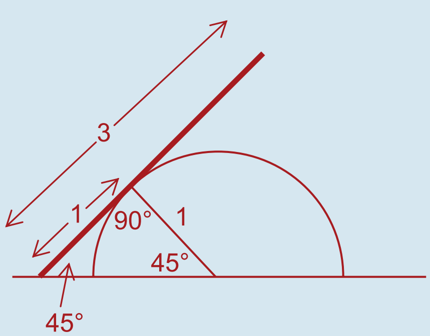
Q. 12. (i) **Rod**



Hemisphere



Lengths



(ii) Taking moments around the hinge we get:

$80\left(\dfrac{1.5}{\sqrt{2}}\right) = R(1)$

$R = \dfrac{120}{\sqrt{2}} = 60\sqrt{2}$ N

(iii) $S = \dfrac{R}{\sqrt{2}} + 40$

$\mu S = \dfrac{R}{\sqrt{2}}$

$\Rightarrow \mu\left(\dfrac{R}{\sqrt{2}} + 40\right) = \dfrac{R}{\sqrt{2}}$

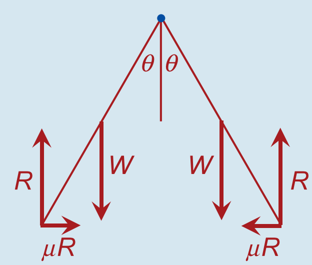
… but $R = 60\sqrt{2}$

$\Rightarrow \mu(60 + 40) = 60$

$\Rightarrow 100\mu = 60$

$\Rightarrow \mu = 0.6$

Q. 13. Assume ladders are on the point of slipping. We will then be at the smallest value of μ that will prevent slipping from occurring. Here is the force diagram for the system:



Note: Because both ladders have the same weight, both reaction forces are the same and slipping occurs simultaneously at A and C.

$2R = 2W$

$\Rightarrow R = W$

Now, we examine the forces on the ladder $[AB]$ in isolation: