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Mathematics

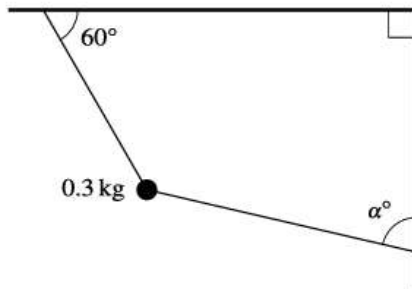
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Paper 4 Mechanics

October/November 2022

Question No (3)

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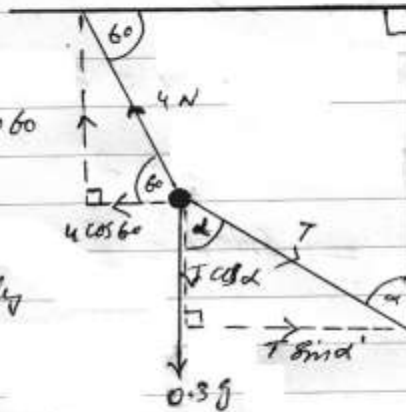


A particle of mass 0.3 kg is held at rest by two light inextensible strings. One string is attached at an angle of 60° to a horizontal ceiling. The other string is attached at an angle α° to a vertical wall (see diagram). The tension in the string attached to the ceiling is 4 N.

Find the tension in the string which is attached to the wall and find the value of α .

Solution:

Resolve the
forces 4N and T
into its rectangular
components.



Resolve the
forces horizontally

Left hand forces =
Right hand forces

$$4 \cos 60 = T \sin \alpha$$

$$T \sin \alpha = 4 \left(\frac{1}{2} \right)$$

$$T \sin \alpha = 2 \rightarrow \textcircled{1}$$

Resolve the forces vertically

upward forces = downward forces

$$4 \sin 60 = 0.3g + T \cos \alpha$$

$$3.4641 = 0.3 \times 10 + T \cos \alpha$$

$$T \cos \alpha = 3.4641 - 3$$

$$T \cos \alpha = 0.4641 \rightarrow \textcircled{2}$$

squaring and adding $\textcircled{1}$ and $\textcircled{2}$

$$T^2 \sin^2 \alpha + T^2 \cos^2 \alpha = (2)^2 + (0.4641)^2$$

$$T^2 (\sin^2 \alpha + \cos^2 \alpha) = 4.2154$$

$$T^2 = 4.2156$$

$$\therefore \sin^2 \alpha + \cos^2 \alpha = 1$$

$$T = 2.053$$

$$T = 2.05 \text{ N}$$

substitute $T = 2.053$ in equation (1)

$$(2.053) \sin \alpha = 2$$

$$\Rightarrow \sin \alpha = \frac{2}{2.053}$$

$$\sin \alpha = 0.9742$$

$$\alpha = \sin^{-1}(0.9742)$$

$$\alpha = 76.9^\circ$$