Leave blank

7.

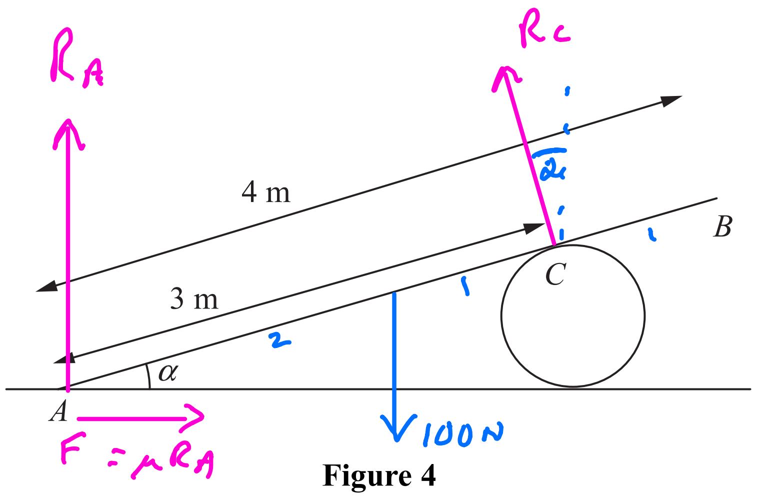

Figure 4

A uniform plank *AB*, of weight 100 N and length 4 m, rests in equilibrium with the end *A* on rough horizontal ground. The plank rests on a smooth cylindrical drum. The drum is fixed to the ground and cannot move. The point of contact between the plank and the drum is *C*, where $AC = 3$ m, as shown in Figure 4. The plank is resting in a vertical plane which is perpendicular to the axis of the drum, at an angle α to the horizontal, where $\sin\alpha = \frac{1}{3}$. The coefficient of friction between the plank and the ground is μ. Modelling the plank as a rod, find the least possible value of μ.

(10)

$\sin\alpha = \frac{1}{3}$, $\cos\alpha = \frac{\sqrt{8}}{3}$, $\tan\alpha = \frac{1}{\sqrt{8}}$

↕ $R_A + R_c\cos\alpha = 100$

$R_A + \frac{\sqrt{8}}{3}R_c = 100$ (1)

↔ $\mu R_A = R_c\sin\alpha$

$\mu R_A = \frac{1}{3}R_c$ (2)

Mom about A

$100 \times 2\cos\alpha = R_c \times 3$

$\frac{200\sqrt{8}}{3} = 3R_c$

$\frac{200\sqrt{8}}{9} = R_c$ (3)

N 3 5 4 0 8 A 0 2 2 2 8

Sub for R_C in (2)

$$\mu R_A = \frac{200\sqrt{8}}{27} \qquad (4)$$

Sub for R_C in (1)

$$R_A + \frac{\sqrt{8}}{3} \times \frac{200\sqrt{8}}{9} = 100$$

$$R_A + \frac{1600}{27} = 100$$

$$R_A = 100 - \frac{1600}{27} = \frac{1100}{27}$$

Sub for R_A in (4)

$$\mu \times \frac{1100}{27} = \frac{200\sqrt{8}}{27}$$

$$\mu = \frac{200\sqrt{8}}{27} \times \frac{27}{1100}$$

$$\mu = \frac{200\sqrt{8}}{1100} = \frac{2\sqrt{8}}{11} = 0.514$$

$$\mu \geqslant 0.514$$
