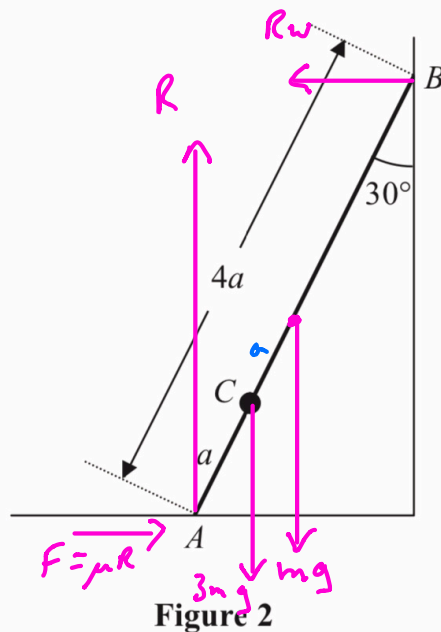


5.



Resolve \updownarrow

$$R = 3mg + mg$$

$$R = 4mg$$

A ladder AB , of mass m and length $4a$, has one end A resting on rough horizontal ground. The other end B rests against a smooth vertical wall. A load of mass $3m$ is fixed on the ladder at the point C , where $AC = a$. The ladder is modelled as a uniform rod in a vertical plane perpendicular to the wall and the load is modelled as a particle. The ladder rests in limiting equilibrium making an angle of 30° with the wall, as shown in Figure 2.

Find the coefficient of friction between the ladder and the ground.

(10)

Moments about B

Clockwise Moment = Anti-clockwise Moment

$$R \times 4a \sin 30^\circ = mg \times 2a \sin 30^\circ + 3mg \times 3a \sin 30^\circ + \mu R \times 4a \cos 30^\circ$$

$$8mga = mga + \frac{9}{2}mga + \mu 16mga \frac{\sqrt{3}}{2}$$

$$\frac{5mga}{2} = \mu \times 8mga \sqrt{3}$$

$$\frac{5mga}{16\sqrt{3}mga} = \mu$$

$$\mu = \frac{5}{16\sqrt{3}} = 0.180$$