Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

4 Forces

Exercise G, Question 1

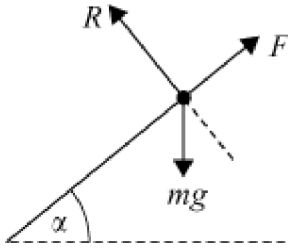
Question:

In the following situations a particle of mass m kg is placed on a rough plane inclined at an angle α to the horizontal. Determine whether the particle will slide.

(a) $\alpha = 20°$, $\mu = 0.1$

(b) $\alpha = 30°$, $\mu = 0.75$

(c) $\alpha = 50°$, $\mu = 0.9$



Solution:

(a) Resolving along plane (for equilibrium)

$F = 9.8 \times m \times \cos 70°$

$F = 3.3518 \times m$ N (5 s.f.)

Resolving perpendicular to plane

$R = 9.8 \times m \times \sin 70°$

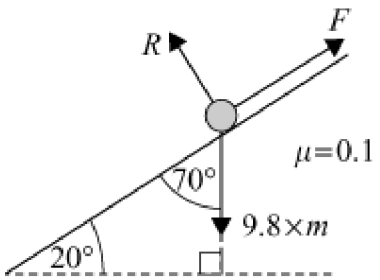
Maximum available friction

$F_{\max} = 0.1 \times R$

$F_{\max} = 0.1 \times 9.8 \times m \sin 70°$

$F_{\max} = 0.92090m$

which is not enough to hold the particle at rest (see the first equation), $\therefore$ it slides.



(b) Resolving perpendicular to plane

$R = 9.8 \times m \times \sin 60° = 8.4870 \times m$

Maximum available friction

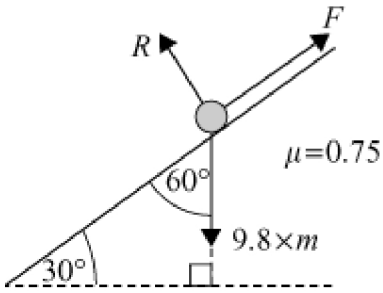
$F_{\max} = 0.75 \times R = 0.75 \times 9.8 \times m \times \sin 60°$

$F_{\max} = 6.3653m$

Resolving along plane (if in equilibrium)

$F = 9.8 \times m \times \cos 60°$

$F = 4.90m$ which is less than the available friction i.e. particle stays in equilibrium.



(c) Resolving perpendicular to plane

$R = 9.8 \times m \times \sin 40°$

$R = 6.2993m$

$\therefore$ Maximum available friction

$F_{\max} = 0.9 \times R = 0.9 \times 6.2993m$

$F_{\max} = 5.6694m$

Resolving along plane (if in equilibrium)

$F = 9.8 \times m \times \cos 40°$

$F = 7.5072m$ which is greater than the available friction

$\therefore$ particle slides