Solutionbank M1

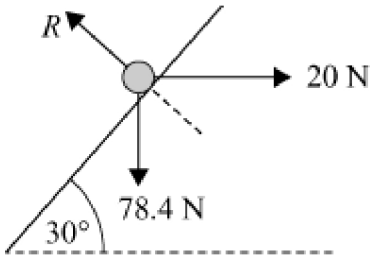
Heinemann Modular Maths for Edexcel AS and A-level

4 Forces

Exercise G, Question 7

Question:

A particle of mass 8 kg is at rest on a rough plane inclined at an angle of 30° to the horizontal. A horizontal force of 20 N acts on the particle as shown. Find the magnitude of the friction force and the normal reaction on the particle. What is the least value of μ?



Solution:

Along plane

$$F + 20\ \cos\ 30^\circ = 78.4\ \cos\ 60^\circ$$
$$\therefore F = 78.4\ \cos\ 60^\circ - 20\ \cos\ 30^\circ$$
$$F = 21.9\ \text{N (3 s.f.)}$$

Perpendicular to plane

$$R = 78.4\ \sin\ 60^\circ + 20\ \sin\ 30^\circ$$
$$R = 77.9\ \text{N (3 s.f.)}$$

Limiting equilibrium

$$F \leq \mu \times R$$
$$78.4\ \cos\ 60^\circ - 20\ \cos\ 30^\circ \leq \mu\,(\,78.4\ \sin\ 60^\circ + 20\ \sin\ 30^\circ\,)$$
$$\frac{78.4\ \cos\ 60^\circ - 20\ \cos\ 30^\circ}{78.4\ \sin\ 60^\circ + 20\ \sin\ 30^\circ} \leq \mu$$
$$\mu \geq 0.28087..$$

i.e. least value of μ is 0.281 (3 s.f.)