Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

5 Newton's laws of motion

Exercise B, Question 12

Question:

A particle of mass 20 kg is pulled across a rough horizontal plane by a light inextensible string, inclined at 30° to the horizontal. If the tension in the string is 50 N and the acceleration produced is 0.5 m s^{-2} find the frictional force on the particle and the coefficient of friction.

Solution:

Newton's 2nd Law, →

$$\begin{aligned} 50\cos 30° - F &= 20 \times 0.5 \\ \therefore 50\cos 30° - 20 \times 0.5 &= F \\ \therefore F &= 33.301.. \\ F &= 33.3 \text{ N (3 s.f.)} \end{aligned}$$

Newton's 2nd Law, ↑

$$\begin{aligned} R + 50\sin 30° - 196 &= 20 \times 0 \\ \therefore R = 196 - 50\sin 30° &= 171 \text{ N} \end{aligned}$$

Limiting friction,

$$\begin{aligned} F &= \mu R \\ 33.301.. &= \mu \times 171 \\ \therefore \mu &= \frac{33.301}{171} \\ \mu &= 0.19474.. \\ \therefore \mu &= 0.195 \text{ (3 s.f.)} \end{aligned}$$