

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

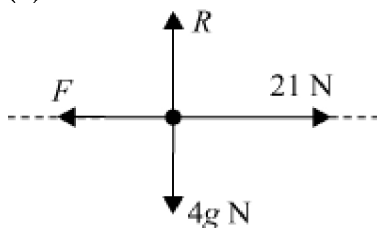
4 Forces

Exercise F, Question 2

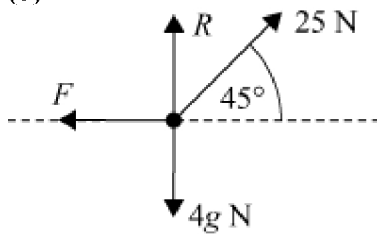
Question:

In the following situations a particle of mass 4 kg is placed on a rough horizontal plane. If $\mu = \frac{5}{7}$ determine whether motion will occur.

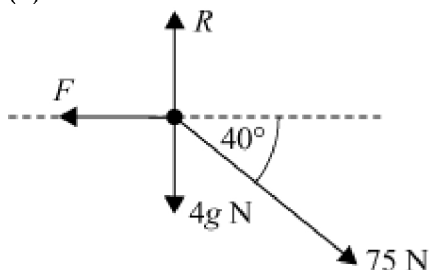
(a)



(b)



(c)



Hint:

The maximum available friction force $F_{\text{MAX}} = \mu \times R$

Solution:

$$\begin{aligned} \text{Resolving vertically } R &= 4g \\ R &= 4 \times 9.8 \\ &= 39.2 \end{aligned}$$

$$\begin{aligned} \text{(a) Maximum available friction force} &= \frac{5}{7} \times 39.2 \\ &= 28 \text{ N} \end{aligned}$$

This is sufficient to resist the horizontal force of 21 N i.e. motion won't occur.

$$\begin{aligned} \text{Resolving vertically } R + 25 \sin 45^\circ &= 4 \times 9.8 \\ \therefore R &= 4 \times 9.8 - 25 \times \sin 45^\circ \\ R &= 21.562\dots \end{aligned}$$

$$\begin{aligned} \text{(b) } \therefore \text{Maximum available friction force} &= \frac{5}{7} \times 21.562\dots \\ &= 15.401\dots \text{ N} \\ \text{but Applied horizontal force} &= 25 \cos 45^\circ \\ &= 17.677\dots \text{ N} \end{aligned}$$

which is sufficient to overcome the maximum frictional force
 \therefore motion will occur: it will slide.

$$\begin{aligned} \text{Resolving vertically } R &= 4 \times 9.8 + 75 \sin 40^\circ \\ R &= 87.409\dots \\ \text{(c) } \therefore \text{Maximum available friction force} &= \frac{5}{7} \times 87.449 \\ &= 62.435\dots \text{ N} \\ \text{but Applied horizontal force} &= 75 \times \cos 40^\circ \\ &= 57.453\dots \text{ N} \end{aligned}$$

which isn't sufficient to overcome the frictional force
 \therefore motion won't occur.