

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

4 Forces

Exercise F, Question 5

Question:

Horizontal forces, each of magnitude 100 N act in the direction of the bearings 050° , 170° , and 260° . Find the magnitude of the resultant of these forces. If these forces act on a particle, of mass 10 kg, which is in equilibrium on a rough horizontal plane, find the magnitude of frictional force, which acts on the particle. Find also the least value of the coefficient of friction, giving your answer correct to two significant figures.

Solution:

In the horizontal plane, the resultant force

$$R_1 = 100 \sin 50^\circ \mathbf{i} + 100 \cos 50^\circ \mathbf{j} - 100 \cos 10^\circ \mathbf{i} - 100 \sin 10^\circ \mathbf{j} + 100 \sin 10^\circ \mathbf{i} - 100 \cos 10^\circ \mathbf{j}$$

$$\text{i.e. } R_1 = (100 \sin 50^\circ - 100 \cos 10^\circ + 100 \sin 10^\circ) \mathbf{i} + (100 \cos 50^\circ - 100 \sin 10^\circ - 100 \cos 10^\circ) \mathbf{j}$$

$$\text{i.e. } R_1 = -4.5115\mathbf{i} - 51.566\mathbf{j}$$

\therefore since the particle is in equilibrium

$$F = -R_1$$

$$\text{i.e. } F = 4.5115\mathbf{i} + 51.566\mathbf{j}$$

$$\therefore |F| = \sqrt{4.5115^2 + 51.566^2}$$

$$|F| = 51.763\dots$$

$$\text{i.e. } |F| = 51.8 \text{ N (3 s.f.)}$$

Resolving vertically $R = 98 \text{ N}$

\therefore for equilibrium

$$F \leq \mu R$$

$$51.763\dots \leq \mu \times 98$$

$$\frac{51.763}{98} \leq \mu$$

$$\mu \geq 0.52820\dots$$

i.e. the least value of μ is 0.528 (3 s.f.)

