

# Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

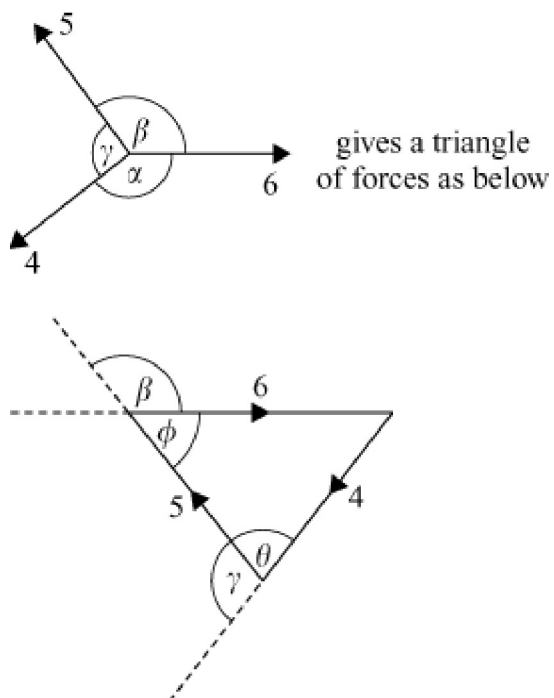
## 4 Forces

### Exercise E, Question 15

#### Question:

Three forces act upon a particle, which is in equilibrium. If the magnitudes of the forces are 4 N, 5 N, and 6 N, find the angles between the forces.

#### Solution:



cosine rule

$$6^2 = 5^2 + 4^2 - 2 \times 5 \times 4 \times \cos \theta$$

$$\therefore 2 \times 5 \times 4 \times \cos \theta = 5^2 + 4^2 - 6^2$$

$$\therefore \cos \theta = \frac{(5^2 + 4^2 - 6^2)}{(2 \times 5 \times 4)}$$

$$\therefore \theta = 82.819...^\circ$$

i.e. angle between the 4 N and 5 N forces is

$$\begin{aligned}\gamma &= 180^\circ - \theta \\ \gamma &= 180 - 82.819\dots^\circ \\ \text{i.e. } \gamma &= 97.180\dots^\circ \\ \gamma &= 97.2^\circ \text{ (3 s.f.)}\end{aligned}$$

$$\text{then sine rule } \frac{4}{\sin \phi} = \frac{6}{\sin \theta}$$

$$\frac{\sin \phi}{4} = \frac{\sin \theta}{6}$$

$$\sin \phi = 4 \times \frac{\sin \theta}{6}$$

$$\phi = 41.409\dots^\circ$$

$\therefore$  the angle between the 5 N and 6 N forces is

$$\beta = 180^\circ - \phi$$

$$\beta = 180^\circ - 41.409\dots^\circ$$

$$\beta = 138.59\dots^\circ$$

$$\beta = 139^\circ \text{ (3 s.f.)}$$

$$\alpha = 360^\circ - \gamma - \beta$$

$$\alpha = 360^\circ - 97.180\dots^\circ - 138.59\dots^\circ$$

$$\alpha = 124.22\dots^\circ$$

$$\alpha = 124^\circ \text{ (3 s.f.)}$$

The angles are  $124^\circ$ ,  $97.2^\circ$ ,  $139^\circ$  (all 3 s.f.)