

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

4 Forces

Exercise B, Question 2

Question:

Forces of magnitude F_1 and F_2 act on a particle. The resultant of the forces has magnitude R . Find the angle between the two forces acting on the particle in the following cases:

(a) $F_1 = 60 \text{ N}$, $F_2 = 80 \text{ N}$, $R = 100 \text{ N}$,

(b) $F_1 = 11 \text{ N}$, $F_2 = 17 \text{ N}$, $R = 20 \text{ N}$,

(c) $F_1 = 7 \text{ N}$, $F_2 = 10 \text{ N}$, $R = 5 \text{ N}$,

(d) $F_1 = 8 \text{ N}$, $F_2 = 7 \text{ N}$, $R = 3 \text{ N}$.

Solution:

(a) cosine rule

$$100^2 = 60^2 + 80^2 - 2 \times 60 \times 80 \cos \beta$$

$$\therefore 2 \times 60 \times 80 \cos \beta = 60^2 + 80^2 - 100^2$$

$$9600 \cos \beta = 0$$

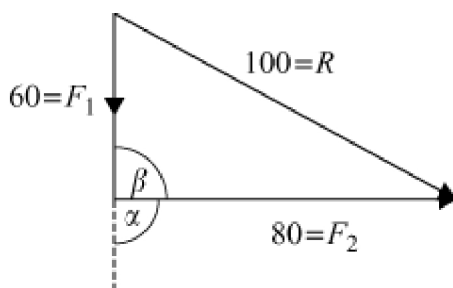
$$\cos \beta = 0$$

$$\text{i.e. } \beta = 90^\circ$$

$$\therefore \alpha = 180^\circ - \beta$$

$$= 90^\circ$$

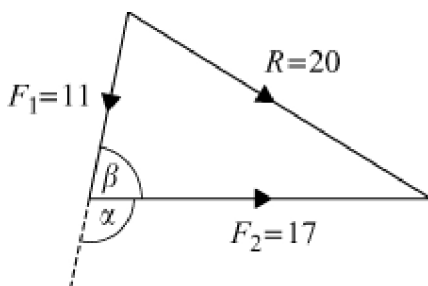
\therefore angle between F_1 and F_2 is 90° .



(b) cosine rule

$$\begin{aligned}
 20^2 &= 11^2 + 17^2 - 2 \times 11 \times 17 \cos \beta \\
 \therefore 2 \times 11 \times 17 \cos \beta &= 11^2 + 17^2 - 20^2 \\
 374 \cos \beta &= 10 \\
 \cos \beta &= \frac{10}{374} \\
 \beta &= 88.467\dots^\circ \\
 \therefore \alpha &= 180^\circ - \beta \\
 &= 180^\circ - 88.467\dots^\circ \\
 &= 91.532\dots^\circ
 \end{aligned}$$

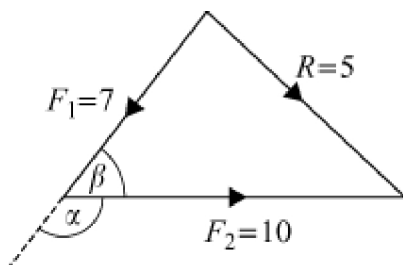
\therefore angle between F_1 and F_2 is 91.5° (3 s.f.)



(c) cosine rule

$$\begin{aligned}
 5^2 &= 7^2 + 10^2 - 2 \times 7 \times 10 \times \cos \beta \\
 2 \times 7 \times 10 \cos \beta &= 7^2 + 10^2 - 5^2 \\
 140 \times \cos \beta &= 124 \\
 \cos \beta &= \frac{124}{140} \\
 \text{i.e. } \beta &= 27.660\dots^\circ \\
 \therefore \alpha &= 180 - \beta \\
 &= 180 - 27.660\dots^\circ \\
 &= 152.33\dots^\circ
 \end{aligned}$$

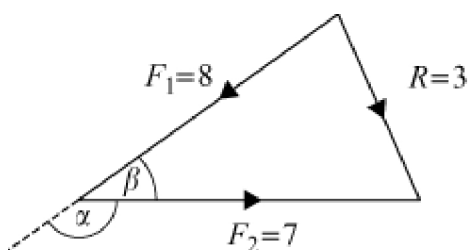
\therefore angle between F_1 and F_2 is 152° (3 s.f.)



(d) cosine rule

$$\begin{aligned}
 3^2 &= 8^2 + 7^2 - 2 \times 8 \times 7 \times \cos \beta \\
 \therefore 2 \times 8 \times 7 \times \cos \beta &= 8^2 + 7^2 - 3^2 \\
 112 \times \cos \beta &= 104 \\
 \cos \beta &= \frac{104}{112} \\
 \text{i.e. } \beta &= 21.786\dots^\circ \\
 \therefore \alpha &= 180^\circ - \beta \\
 &= 180^\circ - 21.786\dots^\circ \\
 &= 158.21\dots^\circ
 \end{aligned}$$

\therefore angle between F_1 and F_2 is 158° (3 s.f.)



© Harcourt Education Ltd 2005