

Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

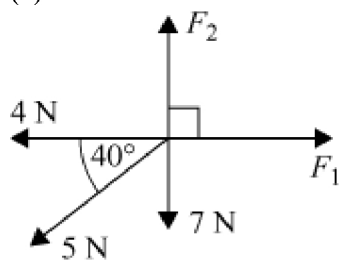
4 Forces

Exercise E, Question 3

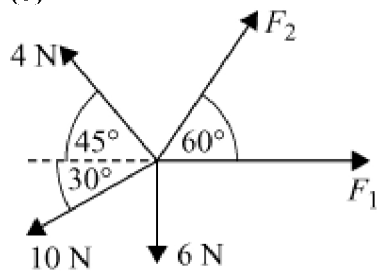
Question:

Each of the following sets of forces is in equilibrium. Find F_1 and F_2 .

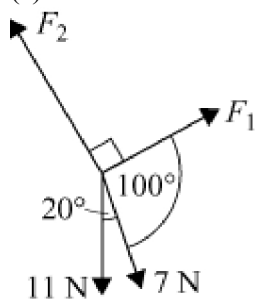
(a)



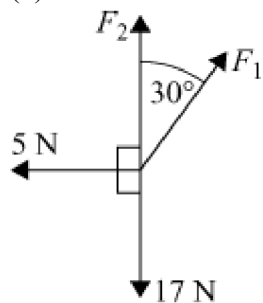
(b)



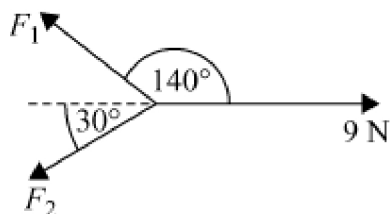
(c)



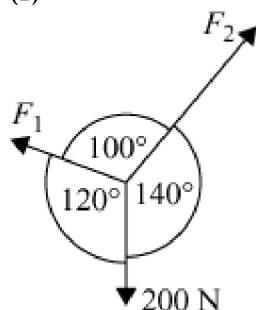
(d)



(e)



(f)

**Solution:**

$$\text{Resolving } \rightarrow F_1 = 4 + 5 \cos 40^\circ$$

$$F_1 = 7.8302\dots$$

$$\text{i.e. } F_1 = 7.83 \text{ N (3 s.f.)}$$

$$(a) \text{ Resolving } \uparrow F_2 = 7 + 5 \sin 40^\circ$$

$$F_2 = 10.213\dots$$

$$F_2 = 10.2 \text{ N (3 s.f.)}$$

$$\text{Resolving } \uparrow F_2 \sin 60^\circ + 4 \sin 45^\circ = 6 + 10 \sin 30^\circ$$

$$\text{i.e. } F_2 = \frac{(6 + 10 \sin 30^\circ - 4 \sin 45^\circ)}{\sin 60^\circ}$$

$$\therefore F_2 = 9.4357\dots$$

$$(b) F_2 = 9.44 \text{ N (3 s.f.)}$$

$$\text{Resolving } \rightarrow F_1 + F_2 \cos 60^\circ = 4 \cos 45^\circ + 10 \cos 30^\circ$$

$$\therefore F_1 = 4 \cos 45^\circ + 10 \cos 30^\circ - 9.4357 \times \cos 60^\circ$$

$$F_1 = 6.7708\dots$$

$$F_1 = 6.77 \text{ N (3 s.f.)}$$

(c) Resolving in F_1 direction

$$F_1 = 7 \sin 10^\circ + 11 \sin 30^\circ$$

$$F_1 = 6.7155\dots$$

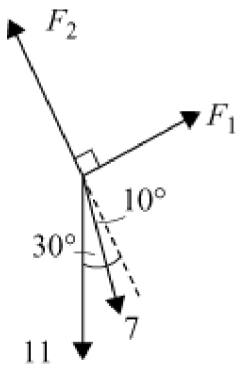
$$F_1 = 6.72 \text{ N (3 s.f.)}$$

Resolving in F_2 direction

$$F_2 = 7 \cos 10^\circ + 11 \cos 30^\circ$$

$$F_2 = 16.419\dots$$

$$F_2 = 16.4 \text{ N (3 s.f.)}$$



$$\text{Resolving } \rightarrow F_1 \sin 30^\circ = 5$$

$$\therefore F_1 = \frac{5}{\sin 30^\circ}$$

$$F_1 = 10 \text{ N}$$

$$(d) \text{ Resolving } \uparrow F_2 + F_1 \cos 30^\circ = 17$$

$$\therefore F_2 = 17 - 10 \times \cos 30^\circ$$

$$F_2 = 8.3397\dots$$

$$F_2 = 8.34 \text{ N (3 s.f.)}$$

(e) Resolving perpendicular to F_1

$$F_2 \sin 70^\circ = 9 \sin 40^\circ$$

$$\therefore F_2 = \frac{9 \sin 40^\circ}{\sin 70^\circ}$$

$$F_2 = 6.1563\dots$$

$$F_2 = 6.16 \text{ N (3 s.f.)}$$

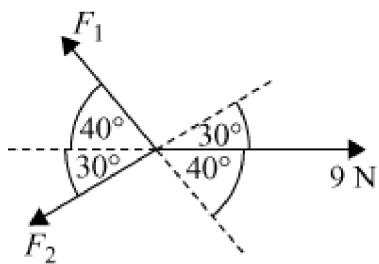
Resolving perpendicular to F_2

$$F_1 \sin 70^\circ = 9 \sin 30^\circ$$

$$F_1 = \frac{9 \sin 30^\circ}{\sin 70^\circ}$$

$$F_1 = 4.7887\dots$$

$$F_1 = 4.79 \text{ N (3 s.f.)}$$



(f) Resolving perpendicular to F_2

$$F_1 \sin 80^\circ = 200 \sin 40^\circ$$

$$F_1 = \frac{200 \sin 40^\circ}{\sin 80^\circ}$$

$$F_1 = 130.54\dots$$

$$F_1 = 131 \text{ N (3 s.f.)}$$

Resolving perpendicular to F_1

$$F_2 \sin 80^\circ = 200 \sin 60^\circ$$

$$F_2 = \frac{200 \sin 60^\circ}{\sin 80^\circ}$$

$$F_2 = 175.87\dots$$

$$F_2 = 176 \text{ N (3 s.f.)}$$

