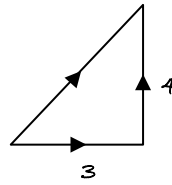


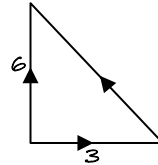
Section 1: Resolving forces

Solutions to Exercise level 1

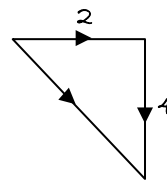
1. (i) Magnitude of resultant $= \sqrt{3^2 + 4^2} = 5 \text{ N}$
 $\tan \theta = \frac{4}{3} \Rightarrow \theta = 53.1^\circ$



(ii) Magnitude of resultant $= \sqrt{3^2 + 6^2} = 6.71 \text{ N}$
 $\tan \theta = \frac{6}{3} = 2 \Rightarrow \theta = 63.4^\circ$



(iii) Magnitude of resultant $= \sqrt{2^2 + 4^2} = 4.47 \text{ N}$
 $\tan \theta = \frac{4}{2} = 2 \Rightarrow \theta = 63.4^\circ$



2. (i) $(8 \cos 50^\circ)\underline{i} + (8 \sin 50^\circ)\underline{j} = 5.14\underline{i} + 6.13\underline{j} \text{ N or } \begin{pmatrix} 5.14 \\ 6.13 \end{pmatrix} \text{ N}$

(ii) $-(5 \cos 30^\circ)\underline{i} + (5 \sin 30^\circ)\underline{j} = -4.33\underline{i} + 2.5\underline{j} \text{ N or } \begin{pmatrix} -4.33 \\ 2.5 \end{pmatrix} \text{ N}$

(iii) $(6 \cos 60^\circ)\underline{i} - (6 \sin 60^\circ)\underline{j} = 3\underline{i} - 5.20\underline{j} \text{ N or } \begin{pmatrix} 3 \\ -5.20 \end{pmatrix} \text{ N}$

3. (i) 10N force: $(10 \cos 40^\circ)\underline{i} + (10 \sin 40^\circ)\underline{j} = 7.66\underline{i} + 6.43\underline{j}$
 12N force: $-(12 \cos 20^\circ)\underline{i} + (12 \sin 20^\circ)\underline{j} = -11.3\underline{i} + 4.10\underline{j}$
 6N force: $(6 \cos 60^\circ)\underline{i} - (6 \sin 60^\circ)\underline{j} = 3\underline{i} - 5.20\underline{j}$

(ii) Resultant $= (10 \cos 40^\circ - 12 \cos 20^\circ + 6 \cos 60^\circ)\underline{i}$
 $+ (10 \sin 40^\circ + 12 \sin 20^\circ - 6 \sin 60^\circ)\underline{j}$
 $= -0.616\underline{i} + 5.34\underline{j} \text{ N}$

4. (i) (a) Not in equilibrium

(b) $25\underline{i} + 30\underline{j} \text{ N}$

(c) $\sqrt{25^2 + 30^2} = \sqrt{1525} = 39.1 \text{ N (3 s.f.)}$

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(ii) (a) In equilibrium since $20 \sin 45^\circ = 10\sqrt{2}$ and $20 \cos 45^\circ = 10\sqrt{2}$.

(b) $0\mathbf{i} + 0\mathbf{j}$

(c) 0 N

(iii) (a) Not in equilibrium

(b) $0\mathbf{i} + 9\mathbf{j}$

(c) 9 N

(iv) (a) In equilibrium since $50 \sin 30^\circ = 25$ and $50 \cos 30^\circ = 25\sqrt{3}$.

(b) $0\mathbf{i} + 0\mathbf{j}$

(c) 0 N

5. Total force in the horizontal direction = $5 + 15 \cos 60^\circ - 10 \cos 45^\circ$
 $= 5.429$ (4 s.f.)

Total force in the vertical direction = $15 \sin 60^\circ + 10 \sin 45^\circ - 20$
 $= 0.06145$ (4 s.f.)

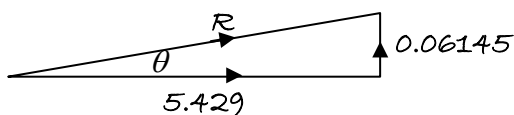
$$R^2 = 5.429^2 + 0.06145^2$$

$$R = 5.43$$
 (2 d.p.)

$$\tan \theta = \frac{0.06145}{5.429}$$

$$\theta = 0.65^\circ$$
 (2 d.p.)

The resultant force is 5.43 N at an angle of 0.65° to the \mathbf{i} direction.



6. (i) Resolving vertically: $P \cos 30^\circ - 10 = 0$

$$\frac{1}{2}\sqrt{3}P = 10$$

$$P = \frac{20}{\sqrt{3}}$$

Resolving horizontally: $X - P \sin 30 = 0$

$$X = \frac{1}{2}P = \frac{10}{\sqrt{3}}$$

(ii) Resolving horizontally: $6 + 8 \cos \theta - 10 = 0$

$$8 \cos \theta = 4$$

$$\cos \theta = \frac{1}{2}$$

$$\theta = 60^\circ$$

Resolving vertically: $8 \sin \theta - W = 0$

$$W = 8 \sin 60^\circ = 4\sqrt{3}$$