

## Combining Forces

### Starter

1. **(Review of last lesson)**  
A force of 12 N acts on a particle of mass 60 kg causing the velocity of the particle to increase from 3 m/s to 7 m/s. Find the distance that the particle travels during this period.
2. **(Review of last lesson)** A particle of mass 10 kg is acted on by a force of  $(8\mathbf{i} - 2\mathbf{j})$  N.
  - (a) Find the acceleration of the particle in vector form.
  - (b) Find the magnitude of the acceleration.
  - (c) Assuming that the particle is initially at rest, find the speed of the particle after 6 seconds.

### Notes

The **resultant force** on an object is the single force that has the same effect as all the forces acting on the object combined.

**Forces in the same or opposite direction** — add or subtract the forces depending on direction.

**E.g. 1** An object, being pulled by a 12 N force, experiences a frictional force of 5 N in the opposite direction. What is the resultant force?

**Forces in terms of vectors** — add the vectors (the direction of the force is included in the vector).

**E.g. 2** Two forces, given by the vectors  $(3\mathbf{i} - \mathbf{j})$  N and  $(-2\mathbf{i} + 4\mathbf{j})$  N, act on an object. Calculate the resultant force.

**Forces at right angles** — use Pythagoras to find the resultant force and trigonometry to find the angle at which it acts.

**N.B.** The angle is measured **anti-clockwise** from the positive  $x$ -axis.  
Always draw a diagram to help you decide which quadrant the angle is in.

**E.g. 3** A force of 6 N acting west and 10 N acting north acts on a body. Find

- (a) the magnitude of the resultant force and
- (b) the direction of the resultant force.

**Hint:** draw a diagram with vectors nose to tail.

**Multiple forces acting at a point** — resolve the forces in the  $\mathbf{i}$  and  $\mathbf{j}$  direction and then use Pythagoras and trigonometry as above, if the question requires it.

**E.g. 4** Find the resultant of the two force  $(8\mathbf{i} + 5\mathbf{j})$  N and  $(3\mathbf{i} - 2\mathbf{j})$  N:

- (a) in component form and
- (b) giving the magnitude and direction of the force.

**Video:** [Force diagrams](#)

[Solutions to Starter and E.g.s](#)

**Exercise**

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**Summary**

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