# The First Constant-Acceleration Formulae

Specification: AQA 7357: P1, Q1, Q3 · Edexcel 9MA0: 6.1, 7.1, 7.3

INDEPENDENT

## You do

### A · Using v = u + at

The letter you do not need here is s.

**1** A particle moves in a straight line with constant acceleration $2.5$ m s$^{-2}$. At $t = 0$ its velocity is $4$ m s$^{-1}$. Find its velocity when $t = 8$.

**2** A van moving at $18$ m s$^{-1}$ brakes and comes to rest with constant deceleration in $12$ s. Modelling the van as a particle, find its deceleration.

**3** A ball rolls down a slope with constant acceleration $1.2$ m s$^{-2}$. After $5$ s its velocity is $9$ m s$^{-1}$. Find its velocity at the start.

**4** A cyclist accelerates uniformly from $2$ m s$^{-1}$ to $8$ m s$^{-1}$ at $0.75$ m s$^{-2}$. How long does this take?

### B · Using s = ½(u + v)t, and choosing the formula

The missing letter picks the formula. Change to m and s first.

**5** A car accelerates uniformly from $6$ m s$^{-1}$ to $20$ m s$^{-1}$ in $9$ s. Find the distance it travels.

**6** A particle moves from A to B with constant acceleration, taking $6$ s. The distance AB is $45$ m and its velocity at B is $11$ m s$^{-1}$.
(a) Find its velocity at A.
(b) Find its acceleration.

**7** A lorry travelling at $72$ km h$^{-1}$ brakes with constant deceleration and stops in $8$ s.
(a) Find its deceleration.
(b) Find its braking distance.

**8** A particle moves from P to Q with constant acceleration $0.4$ m s$^{-2}$. Its velocity at P is $5$ m s$^{-1}$ and it takes $15$ s.
(a) Find its velocity at Q.
(b) Find the distance PQ.

**9** A train passes a signal at $54$ km h$^{-1}$. It then accelerates uniformly at $0.25$ m s$^{-2}$ for $2$ minutes.
(a) Find its speed at the end, in km h$^{-1}$.
(b) Find the distance it travels, in km.

### C · Signs and turning round

No calculator. Positive direction: + ; against it: −.

**10** The positive direction is from A to B. For each car, write down $u$, $v$ and $a$, with signs.
(a) A car moving towards B speeds up from $4$ m s$^{-1}$ to $10$ m s$^{-1}$ in $3$ s.
(b) A car moving towards B slows down from $10$ m s$^{-1}$ to $4$ m s$^{-1}$ in $3$ s.
(c) A car moving towards A speeds up from $4$ m s$^{-1}$ to $10$ m s$^{-1}$ in $3$ s.

**11** A particle passes O moving in the positive direction at $6$ m s$^{-1}$. Its acceleration is a constant $-2$ m s$^{-2}$.
(a) Find its velocity when $t = 5$. What does the sign tell you?
(b) Find its displacement from O when $t = 5$.
(c) Find the distance it travels in the 5 seconds.

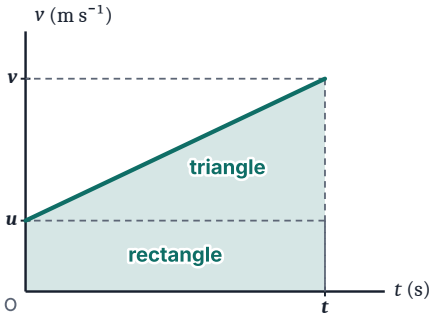
**12** True or false? Explain each answer.
(a) A particle moving in the positive direction decelerates at $3$ m s$^{-2}$, so $a = -3$.
(b) If $v$ is negative, the particle is slowing down.
(c) $s = \frac{1}{2}(u + v)t$ always gives the distance travelled.

**D · Derive and show that** Quote the graph fact you use at each step.

**13** A particle accelerates uniformly from $u$ to $v$ in $t$ seconds. The area under its velocity–time graph is split into a rectangle and a triangle.

(a) Use the gradient to show that $v - u = at$.

(b) Use the rectangle and the triangle to show that $s = \frac{1}{2}(u + v)t$.




**14** A car accelerates uniformly from $u$ m s$^{-1}$ to $3u$ m s$^{-1}$ in $T$ seconds. It travels $d$ metres.

(a) Show that $d = 2uT$.

(b) Find its acceleration in terms of $u$ and $T$.

**15** A particle starts from rest and accelerates uniformly at $1.6$ m s$^{-2}$ for $15$ s. It then decelerates uniformly to rest in $10$ s.

(a) Find its greatest speed.

(b) Find the total distance it travels.

(c) Find its deceleration.

**E · Exam-style question** Show your method: marks are for working.

**16** A particle P moves along a straight line with constant acceleration. At time $t = 0$ it passes a point A, moving towards a point B with velocity $14$ m s$^{-1}$. At $t = 4$ it passes B, still moving in the same direction, with velocity $6$ m s$^{-1}$.

(a) Find the acceleration of P. [2 marks]

(b) Find the distance AB. [2 marks]

(c) Find the time at which P is instantaneously at rest. [2 marks]

(d) Find the velocity of P when $t = 10$, and state the direction in which it is moving. [2 marks]