Section 3: The constant acceleration formulae

Section test

1. A particle, initially at rest at the origin, accelerates at 4 ms^{-2} for 7 seconds. What is the distance travelled by the particle during these 7 seconds?

2. A particle has an initial velocity of 6 ms^{-1}, and accelerates at 2 ms^{-2} for 5 seconds. What is its final velocity?

3. The initial velocity of a particle is 7 ms^{-1}. While accelerating at a constant rate, it travels 21 m in 3 seconds. Find its acceleration.

4. The initial velocity of a particle is 6 ms^{-1} and it accelerates at a constant rate for 5 seconds, during which time it travels 10 metres. What is its final velocity?

5. A particle, initially 15 m from the origin and travelling at –2 ms^{-1}, accelerates at a constant rate and ends up –20 m from the origin and travelling at –5 ms^{-1}. What is its acceleration?

6. A train is timed between successive posts A, B and C, each 2000 m apart. It takes 100 seconds to travel from A to B and 150 seconds to travel from B to C. The acceleration throughout the journey is uniform.

   (i) What is the acceleration?
   (ii) Find the velocity of the train at B.

7. A particle starts from rest and moves in a straight line with constant acceleration. In a certain 4 seconds of its motion it travels 12 m and in the next 5 seconds it travels 30 m.

   (i) What is the acceleration of the particle?
   (ii) What is the velocity of the particle at the start of the timing?
   (iii) Find the distance it had travelled before timing started.

Edexcel AS Maths Kinematics 3 Section test solutions

Solutions to section test

1. $u = 0$, $a = 4$, $t = 7$, $s = ?$

$s = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2} \times 4 \times 7^2$

$= 98$

The distance travelled by the particle is 98 m.

2. $u = 6$, $a = 2$, $t = 5$, $v = ?$

$v = u + at$

$= 6 + 2 \times 5$

$= 16$

The final velocity of the particle is 16 ms^{-1}.

3. $u = 7$, $s = 21$, $t = 3$, $a = ?$

$s = ut + \frac{1}{2}at^2$

$21 = 7 \times 3 + \frac{1}{2}a \times 3^2$

$21 = 21 + \frac{9}{2}a$

$a = 0$

The acceleration of the particle is 0 ms^{-2}.

4. $u = 6$, $t = 5$, $s = 10$, $a = ?$

$s = \frac{1}{2}(u + v)t$

$10 = \frac{1}{2} \times 5(6 + v)$

$4 = 6 + v$

$v = -2$

The velocity of the particle is -2 ms^{-1}.

5. Displacement = final position – initial position = -20 – 15 = -35

$u = -2$, $v = -5$, $s = -35$, $a = ?$

$v^2 = u^2 + 2as$

$(-5)^2 = (-2)^2 + 2a \times -35$

$25 = 4 - 70a$

$21 = -70a$

$a = -0.3$

The acceleration of the particle is -0.3 ms^{-2}.

6. (i) Let the velocity at B be w

For the journey from A to B:

$v = w$ $\quad s = vt - \frac{1}{2}at^2$

$t = 100$ $\quad 2000 = 100w - \frac{1}{2}a \times 100^2$

$s = 2000$ $\quad 20 = w - 50a$ (1)

$a = ?$

For the journey from B to C:

$u = w$ $\quad s = ut + \frac{1}{2}at^2$

$t = 150$ $\quad 2000 = 150w + \frac{1}{2}a \times 150^2$

$s = 2000$ $\quad 40 = 3w + 225a$ (2)

$a = ?$

(1) × 3: $60 = 3w - 150a$

(2): $40 = 3w + 225a$

Subtracting: $20 = -375a$

$a = -\frac{4}{75}$

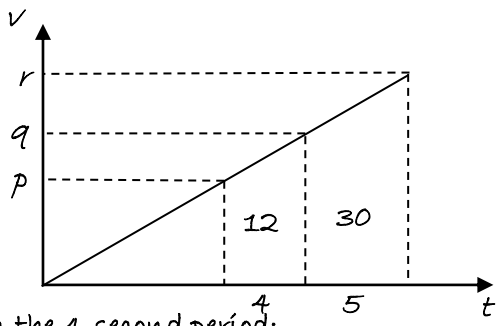
The acceleration is $-\frac{4}{75}$ ms^{-1}.

(ii) From above: $20 = w - 50a$

$w = 20 + 50a = 20 + 50 \times -\frac{4}{75} = \frac{52}{3}$

The velocity of the train at B is $\frac{52}{3}$ ms^{-1}.

7.



(i) In the 4-second period:

$s = vt - \frac{1}{2}at^2$

$12 = 4q - \frac{1}{2}a \times 4^2$

$3 = q - 2a$ (1)

In the 5-second period:

$s = ut + \frac{1}{2}at^2$

$30 = 5q + \frac{1}{2}a \times 5^2$

$6 = q + 2.5a$ (2)

(2) – (1) gives $3 = 4.5a$

$a = \frac{2}{3}$

The acceleration is $\frac{2}{3}$ ms^{-2}.

(ii) In the 4-second period:

$$s = ut + \frac{1}{2}at^2$$

$$12 = 4p + \frac{1}{2} \times \frac{2}{3} \times 4^2$$

$$3 = p + \frac{4}{3}$$

$$p = \frac{5}{3}$$

The velocity at the start of the timing is $\frac{5}{3}$ ms^{-1}.

(iii) For the period before timing starts:

$u = 0$	$v^2 = u^2 + 2as$
$v = \frac{5}{3}$	$\left(\frac{5}{3}\right)^2 = 0 + 2 \times \frac{2}{3}s$
$a = \frac{2}{3}$	$\frac{25}{9} = \frac{4}{3}s$
$s = ?$	$s = \frac{25}{12}$

The distance travelled is $\frac{25}{12}$ m.