Constant Acceleration Formulae

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1 A car moves along a straight horizontal road passing through points A, B and C.

At $t = 0$, the car passes point A with a velocity of 6 ms^{-1} then accelerates uniformly at 1.5 ms^{-2} for 8 seconds before reaching point B. The car then maintains a constant velocity until it reaches point C.

(a) Find the velocity of the car when $t = 8$ **(2)**

(b) Find the distance between points A and B. **(2)**

The distance between points B and C is 135 m.

(c) Find the time taken for the car to travel from point A to point C. **(2)**

(Total for Question 1 is 6 marks)

2 A cyclist travels along a straight horizontal road between points C and D.

In the model of the motion, the cyclist starts from rest at point C when $t = 0$, then moves with a constant acceleration of 1.2 ms^{-2}. When $t = 9$, the cyclist arrives at point D.

(a) Find the velocity of the cyclist when they reach point D. **(2)**

(b) Find the distance between points C and D. **(2)**

(c) Find the time taken to reach the midpoint of C and D. **(3)**

(Total for Question 2 is 7 marks)

3 A train travels along a straight horizontal track with uniform acceleration for 30 seconds.

When $t = 4$, the velocity of the train is 18 ms^{-1}
When $t = 24$, the velocity of the train is 34 ms^{-1}

(a) Find the acceleration of the train. **(2)**

(b) Find the velocity of the train when $t = 0$ **(2)**

(c) Find the distance travelled by the train in the 30 second journey. **(3)**

(Total for Question 3 is 7 marks)

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4 A cyclist travels along a straight horizontal road.

In the model of the motion, the cyclist is travelling at 9 ms^{-1} when they apply the brakes, causing them to decelerate uniformly. The cyclist comes to rest after travelling 27 m with the brakes applied.

(a) Find the acceleration of the cyclist whilst they are braking. **(2)**

(b) Find the time taken to come to rest whilst they are braking. **(2)**

(Total for Question 4 is 4 marks)

5 A bus travels along a straight horizontal road.

In the model of the motion, the bus accelerates uniformly from a velocity of 8.5 ms^{-1} to a velocity of 16.5 ms^{-1}, in 5 seconds. The bus then maintains a constant velocity of 16.5 ms^{-1} for a further 15 seconds.

(a) Find the acceleration of the bus during the first 5 seconds. **(2)**

(b) Find the total distance travelled by the bus during the 20 second period. **(4)**

(Total for Question 5 is 6 marks)

6 A runner travels along a straight horizontal track.

In the model of the motion, the runner starts from rest when $t = 0$ before travelling with constant acceleration 1.6 ms^{-2}, until they reach a velocity of 6.4 ms^{-1}

The runner then maintains a constant velocity of 6.4 ms^{-1} until they have travelled a total distance of 500 m.

Show that it takes the runner more than 80 seconds to travel the distance of 500 m.

(Total for Question 6 is 4 marks)

7 A motorcycle travels along a straight horizontal road between points A and B.

In the model of the motion, the motorcycle travels with constant acceleration between points A and B, passing point A with velocity 18 ms^{-1} and point B with velocity 32 ms^{-1}

Given that the distance between A and B is 125 m, find

(a) the acceleration of the motorcycle **(2)**

(b) the time taken for the motorcycle to travel between points A and B. **(2)**

(Total for Question 7 is 4 marks)

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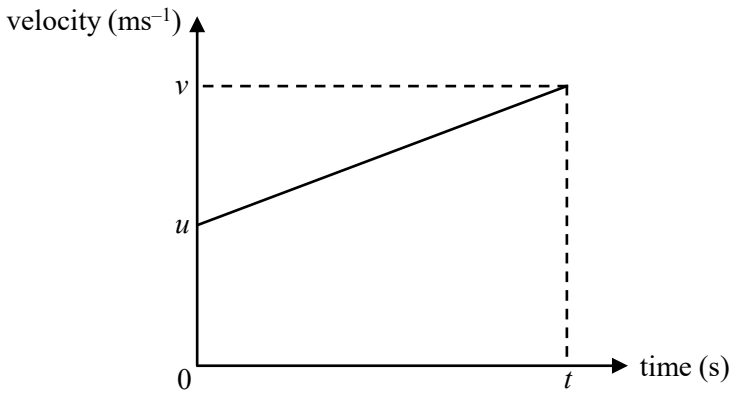


Figure 1

Figure 1 shows the velocity-time graph for the motion of the object travelling in a straight line for t seconds.

It has initial velocity u ms^{-1}, final velocity v ms^{-1}, and uniform acceleration a ms^{-2}

(a) Use the graph to show that $v = u + at$ **(3)**

(b) Use the graph to show that $s = \frac{1}{2}(u + v)t$ **(1)**

(Total for Question 8 is 4 marks)

9 An object travels in a straight line with constant acceleration a ms^{-2} for t seconds.

It has initial velocity u ms^{-1} and final velocity v ms^{-1}

Given that $v = u + at$ and $s = \frac{1}{2}(u + v)t$ show that

(a) $s = ut + \frac{1}{2}at^2$ **(3)**

(b) $s = vt - \frac{1}{2}at^2$ **(3)**

(c) $v^2 = u^2 + 2as$ **(3)**

(Total for Question 9 is 9 marks)

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10 A train travels along a straight horizontal track.

In the model of the motion, when $t = 0$ the train travels with uniform acceleration 0.3 ms^{-2} for T seconds, from an initial velocity of 15 ms^{-1} to a velocity of V ms^{-1}.

At time $t = T$ the train has travelled a total distance of 255 m.

Find the values of V and T.

(Total for Question 10 is 4 marks)

11 A car travels along a straight horizontal road.

In the model of the motion,

- the car travels with constant acceleration
- when $t = 2$, the car has velocity 10 ms^{-1}
- when $t = 8$, the car has travelled a total distance of 104 m

Find the velocity of the car when $t = 9$

(Total for Question 11 is 6 marks)

12 A cyclist travels along a straight horizontal road between points A and B.

In the model of the motion, at $t = 0$ the cyclist passes point A, travelling at 12 ms^{-1} and then accelerates uniformly at 0.5 ms^{-2} for T seconds, reaching a velocity of V ms^{-1} when they pass point B.

The distance between A and B is D metres

In the final 2 seconds of the journey the cyclist travels a distance of 34 metres.

Find the values of V, T and D.

(Total for Question 12 is 6 marks)

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