Displacement–Time Graphs

Specification: AQA 7357: P1, Q1, Q2 · Edexcel 9MA0: 6.1, 7.1, 7.2

INDEPENDENT

You do

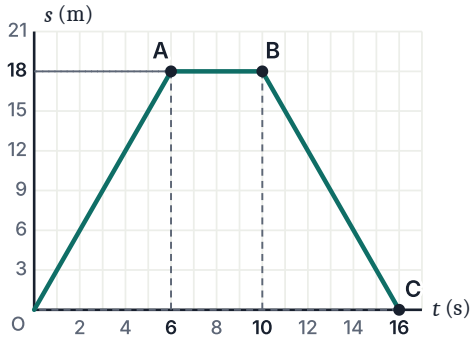
A · Velocity from a gradient

Gradient = change in displacement ÷ change in time.

1 A displacement–time graph is a straight line from $(0, 0)$ to $(8, 36)$, with s in metres and t in seconds. Find the velocity.

2 A displacement–time graph is a straight line from $(0, 50)$ to $(10, 20)$ (s in m, t in s). Find the velocity and the speed.

3 The graph shows the displacement of a robot from its charger. Find its velocity on each stage OA, AB and BC.



4 A displacement–time graph is a straight line from $(0, 0)$ to $(2.5, 4)$, with s in km and t in minutes. Find the velocity in m s^{-1}.

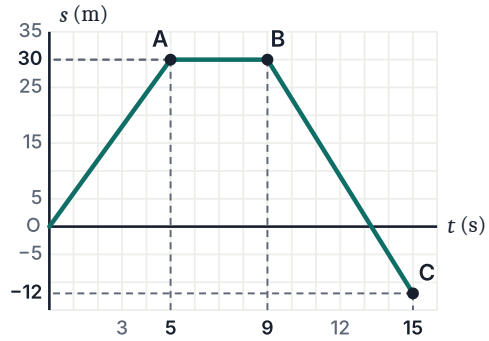
5 The displacement of a particle is given by $s = 7 - 2t$ (s in m, t in s). Find its velocity and describe its motion.

B · Average velocity and average speed

Displacement for velocity, distance for speed.

6 A jogger runs 400 m along a straight path in 160 s, then walks back to the start in 240 s.
(a) Find her average velocity.
(b) Find her average speed.

7 The graph shows the displacement of a scooter from a lamp post.
(a) Find the total distance travelled.
(b) Find the average velocity.
(c) Find the average speed.

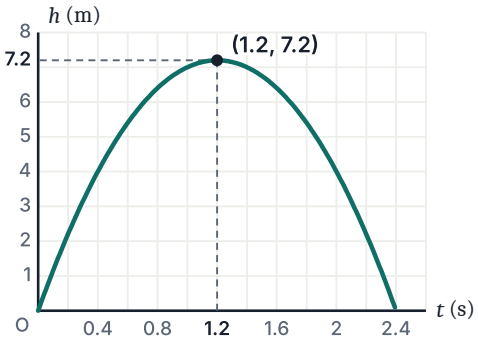


8 A bus travels 12 km in 15 minutes, stops for 5 minutes, then travels a further 8 km in 10 minutes, all in the same direction. Find its average speed in km h^{-1} and in m s^{-1}.

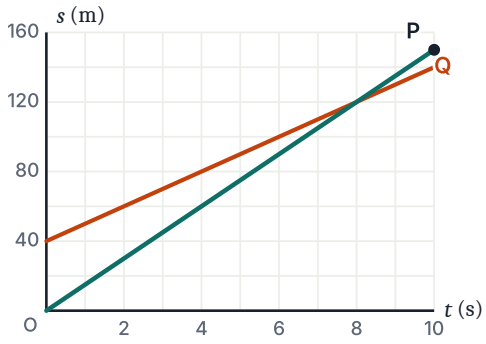
9 (a) Convert 72 km h^{-1} into m s^{-1}.
(b) Convert 12.5 m s^{-1} into km h^{-1}.

C · Reasoning No calculator. Explain in words.

10 A ball is thrown straight up. The graph shows its height h metres after t seconds.
(a) Write down the greatest height and when it happens.
(b) Write down the velocity at that moment.
(c) Describe the motion before and after this moment.



11 The graph shows the displacements of two cars, P and Q, on a straight road.
(a) Which car is faster? Explain.
(b) When and where are they level?



12 True or false? Explain each answer.
(a) If an object's average velocity is zero, it has not moved.
(b) An object's average speed is never less than the size of its average velocity.

D · Unknowns and "show that" Set up an equation in the unknown.

13 A car travels a distance d metres along a straight road at 20 m s^{-1} and returns along the same road at 30 m s^{-1}. Show that its average speed for the whole trip is 24 m s^{-1}.

14 A runner runs 300 m in a straight line at 6 m s^{-1}, rests for T seconds, then runs back to the start at 5 m s^{-1}. Her average speed for the whole journey is 4 m s^{-1}. Find T.

15 A robot moves along a straight line. Its displacement–time graph is two straight lines: from $(0, 0)$ to $(a, 24)$, then from $(a, 24)$ to $(18, 0)$ (s in m, t in s). It takes twice as long to come back as to go out. Find a and the velocity on each stage.

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

16 The graph shows a cyclist's displacement s km from home after t minutes on a straight road.
(a) Find her velocity on OA, in km h^{-1}. [2 marks]
(b) Find her velocity on BC, in m s^{-1}. [3 marks]
(c) Find her average speed for the whole journey, in km h^{-1}. [2 marks]
(d) Where is she at the end? How does the graph show this? [1 mark]

