

Rates of Change Graphs

GCSE Maths · Written to the shared content for AQA, Edexcel and OCR

Name _____ Class _____ Date _____

1. Worked example

A distance–time graph rises steadily from 0 km to 12 km in the first 30 minutes. Find the speed in km/h.

Step 1 · Convert the time to hours

$$30 \text{ minutes} = 0.5 \text{ hours}$$

Step 2 · Gradient = distance ÷ time

$$12 \div 0.5 = 24$$

Answer: 24 km/h

Check: In a full hour at this speed she would cover 24 km ✓

2. Now try one with the steps

The graph is then horizontal from 30 to 45 minutes. What does this show?

Step 1 · Distance does not change

Answer:

3. Practice

Show your working. The marks tell you how much is expected.

- 1.** A distance–time graph rises steadily by 40 km in 2 hours. Find the speed in km/h. [1]

- 2.** What does a horizontal section of a distance–time graph show? [1]

- 3.** On a distance–time graph, one section is steeper than another. What does that tell you? [1]

- 4.** Ellie cycles 9 km in 45 minutes. Find her speed in km/h. [2]

5. The return part of a distance–time graph falls from 60 km to 0 km in 1.5 hours. Find the speed on the way back, in km/h. [2]
6. A trip is 30 km in 40 minutes, a 20-minute stop, then 20 km in 30 minutes. Find the average speed for the whole trip, in km/h, to 1 decimal place. [3]
7. A straight conversion graph goes through (0, 0) and (£10, €11.50). How many euros per pound is that? [1]
8. Using the rate from question 7, convert £40 into euros. [1]
9. The depth of water in a tank rises steadily from 20 cm to 80 cm in 15 minutes. Find the rate of change in cm per minute. [2]
10. A velocity–time graph rises steadily from 0 to 18 m/s in 6 s. Find the acceleration in m/s^2 . [1]
11. A velocity–time graph falls steadily from 24 m/s to 0 in 8 s. Find the deceleration in m/s^2 . [1]
12. A graph of cost (£) against units of electricity is a straight line through the origin with gradient 0.25. What is the cost per unit? [1]
13. A distance–time graph is a straight line through the origin with equation $d = 5t$ (d in metres, t in seconds). What is the speed, in m/s? [1]

14. A curved distance–time graph has a tangent at $t = 4$ that passes through $(2, 0)$ and $(6, 20)$, with t in seconds and d in metres. Estimate the speed at $t = 4$, in m/s. [2]

15. On a curved distance–time graph, explain the difference between the average speed from $t = 0$ to $t = 6$ and the speed at $t = 4$. [2]

4. Before you hand it in

9 km in 45 minutes $\rightarrow 9 \div 45 = 0.2$ km/h

Convert the time to hours first: 45 minutes = 0.75 h, so $9 \div 0.75 = 12$ km/h.

Average speed = $(24 + 0 + 24) \div 3$

Average speed = total distance $\div$ total time, including stops. The stages last different lengths of time.

A line sloping down means the object is slowing down

On a DISTANCE–time graph, sloping down means travelling back towards the start. Slowing down shows line getting less steep.

Acceleration of 15 m/s over 5 s written as 3 m/s

Acceleration is metres per second, per second: m/s^2 .