Position–time graphs

A position–time graph shows the journey of an object traveling in a straight line. The slope (gradient) of the line reveals how fast it's moving and when it speeds up, slows down, or stands still.
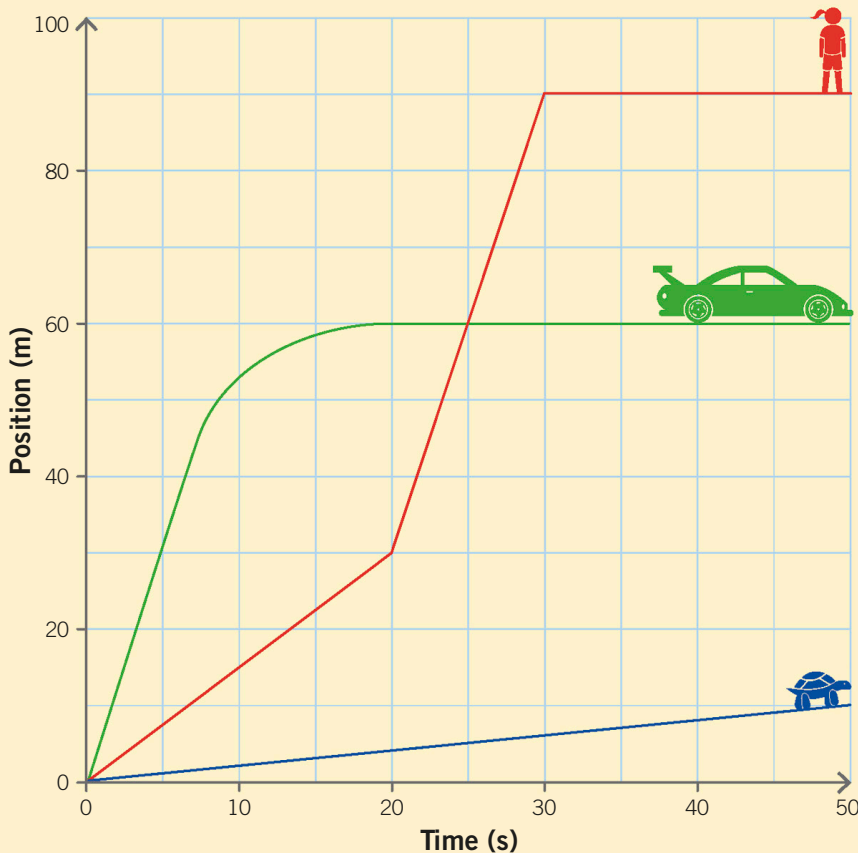
Understanding position–time graphs
Each of the lines on this position–time graph shows a different journey. The steeper the line, the faster an object is moving. A curved line has a changing gradient, which means an object is changing speed. A flat horizontal line means an object is stationary.

Key facts

✓ **A position–time graph shows how far and how fast an object has traveled at different times in its journey.**

✓ **The gradient shows the speed of an object—the steeper the gradient, the faster the speed.**

✓ **You can use a position–time graph to calculate an object's speed at any point in the journey.**

This person starts walking at a constant speed, but after 20 seconds, she suddenly speeds up—she must be running. After 10 seconds of running, she comes to a stop and the line remains horizontal.

At first, the car travels quickly at a constant speed, but then it gradually slows. When it reaches a position of 60 m, its distance traveled stops changing, so the car must have stopped.
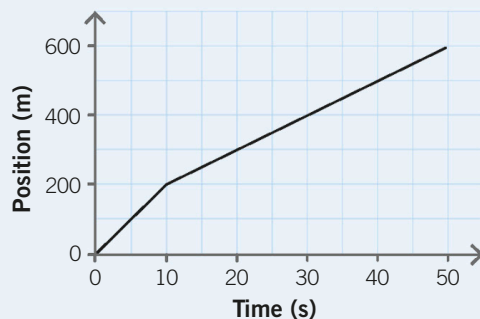
The low gradient of the tortoise's line shows that it walks slowly. The line is perfectly straight, which means that its speed is not changing.

📑 Calculating speed from a gradient
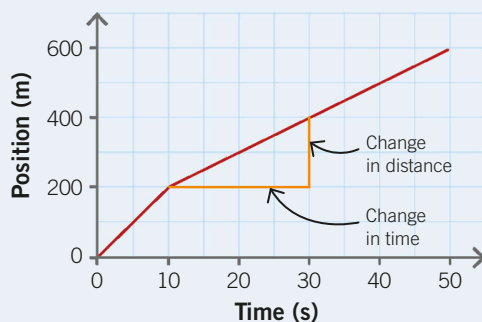
Question

This graph shows the position–time journey for a car. At what speed was the car traveling during the last 40 seconds of the journey?

Answer

1. To find the speed, you need to calculate the gradient of the straight line. Draw a right-angled triangle under any part of the line. The triangle's vertical side is the change in distance. The horizontal side is the change in time.
2. Work out both values.
   Change in distance = 400 m – 200 m = 200 m
   Change in time = 30 s – 10 s = 20 s
3. Divide the change in distance by the change in time to find the speed.

$$\text{speed} = \frac{\text{change in distance}}{\text{change in time}}$$

$$= \frac{200 \text{ m}}{20 \text{ s}}$$

$$= 10 \text{ m/s}$$

📑 Drawing a tangent

Sometimes you might have to work out the gradient on a curved part of the line. This is easy—you do it by drawing a line called a tangent. A tangent is a straight line that touches the curve without crossing it, matching the slope at the point in question. After drawing a tangent, complete a right-angled triangle as described above and use it to work out the change in distance divided by the change in time.