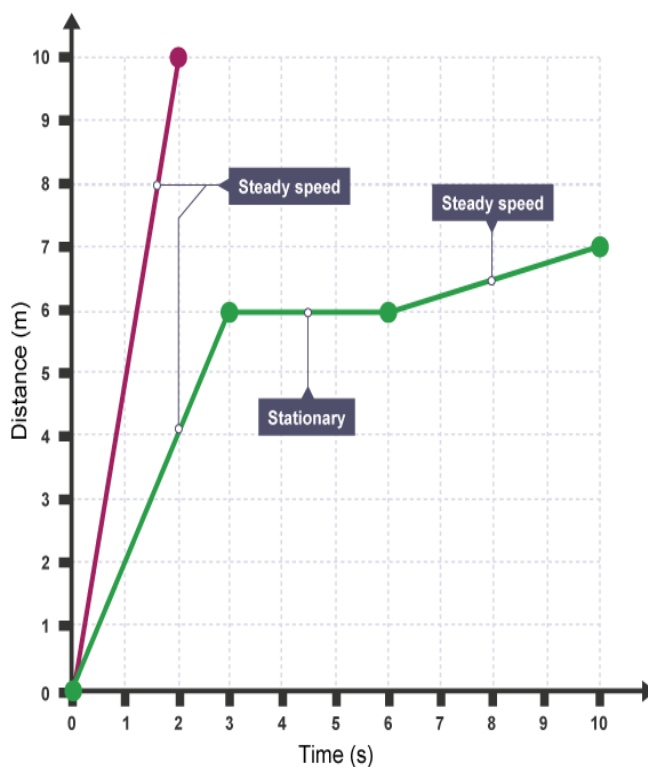# KS3 Science Independent Learning Booklets

Speed

If you have internet at home, you can use bitesize to help you with some of the activities.

Try your hardest to work through the booklets

<u>**Speed**</u>

The speed of an object tells you how fast or slow it is moving. You can find the average speed of an object if you know:

- the distance travelled
- the time taken to travel that distance

You can calculate average speed using this equation:

average speed = distance ÷ time

Example 1

Question

Calculate the average speed of a runner who runs 100 m in 10 s.

average speed = 100 ÷ 10 = 10 m/s

Notice that the unit for speed in science is metres per second, m/s. It is not, for example, mph, kph or m per s.

If you are given the distance travelled in km, multiply it by 1000 to get the distance in m. For example, 3.5 km is 3500 m (3.5 × 1000).
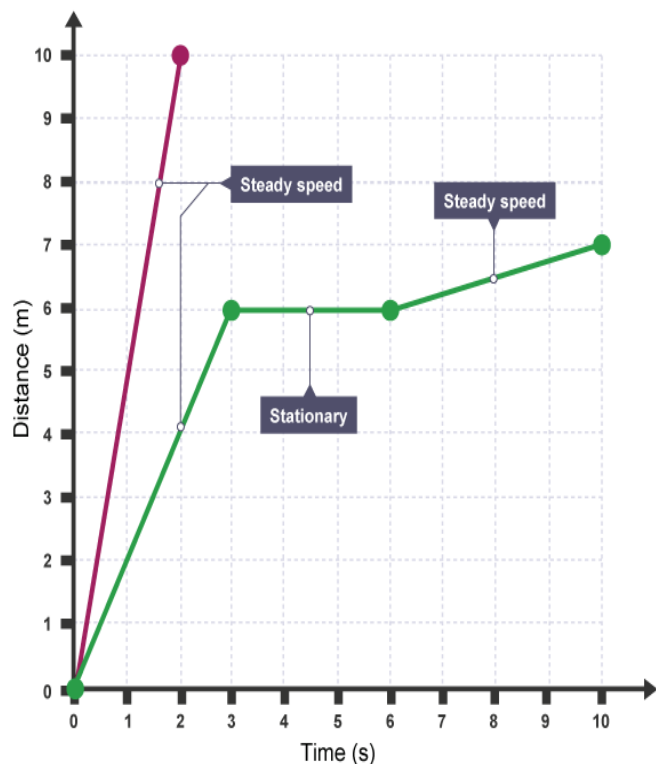
Distance-time graphs

A distance-time graph is a useful way to represent the motion of an object. It shows how the distance moved from a starting point changes over time.

In a distance-time graph:

- distance travelled is plotted on the vertical (y) axis
- time taken is plotted on the horizontal axis

The gradient of the line is equal to the speed. This means that the line is:

- horizontal for a stationary object (because the distance stays the same)
- a straight diagonal for an object moving at a constant speed
- The steeper the line, the greater the gradient and the greater the speed.

(x)

Calculating the speed of rection:

Find the distance travelled between the two time points given.

Work out the time taken between the two time points.

Use the equation: Speed = distance ÷ time

Example 1

Question

> From the distance-time graph above, calculate the speed represented by the green line between 6 s and 10 s.

distance travelled = 7 – 6 = 1 m

time taken = 10 – 6 = 4 s

speed = 1 ÷ 4 = 0.25 m/s

Relative motion

If you have travelled in a car on the motorway, you may have noticed that other cars passing by appear to move slowly past you, even though you know the actual speeds of the two cars are very high. This is because of their relative motion to each other.

The table summarises the different situations and how you can calculate the relative speed of two objects:

Situation	Relative speed
Objects moving in the same direction towards, or away from, each other	Fastest speed – slowest speed
Objects moving in opposite directions towards, or away from, each other	Add the two speeds together

Example 1

Question

> Two cars are travelling in the same direction on a road. The blue car is travelling at 25 m/s in front of the red car, which is travelling at 30 m/s. What is their relative speed?
>
> relative speed = 30 – 25 = 5 m/s
>
> The red car is catching up with the blue car.

Example 2:

> Two cars are travelling on a road in opposite directions. The blue car is travelling at 25 m/s and the red car is travelling at 30 m/s. What is their relative speed?
>
> relative speed = 30 + 25 = 55 m/s

<u>Activities:</u>

1. What is the definition of speed?
2. What is the equation for speed? Give the standard units of each variable.
3. Two objects are travelling at different speeds, which will travel the furthest in one second – the faster or the slower object?
4. Complete the answers in the table to the right.
5. Using the table, if the distance travelled gets bigger whilst the time take stays the same, what happens to the speed?

CALCULATING SPEED

6. In 3s, an object moves 15m. Calculate its speed.
7. An object moves 250m in 15s. Calculate its speed.
8. It takes an object 10s to move 0.5m. Calculate its speed.
9. An object moves 3500m in 120s. Calculate its speed.
10. In 0.1s, an object moves 0.01m. Calculate its speed.
11. It takes an object 0.3s to move 1m. Calculate its speed.
12. An object moves 0.3m in 6s. Calculate its speed.

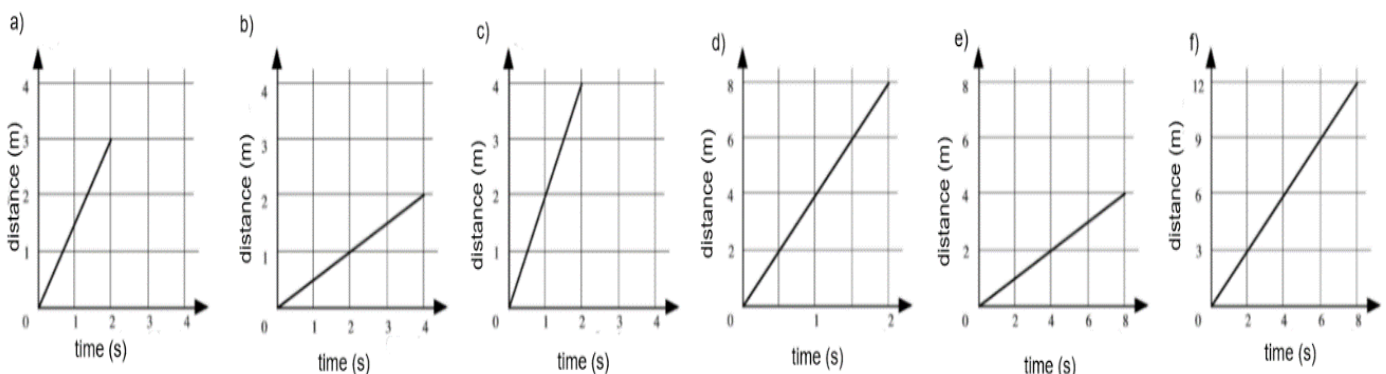| Distance (m)	Time (s)	Speed (m/s)
2	2	(a)
4	2	(b)
6	2	(c)
8	2	(d)
10	2	(e)
10	5	(f)
10	10	(g)
12	10	(h)

HARDER SPEED QUESTIONS

13. My classroom is 12m wide. I walk half of the width of my classroom in 4s. Calculate my speed.
14. On the school running track, I start at the 50m mark. I run to the 100m mark in 8s. Calculate my speed.
15. A car travels 250m in 10s before slowing down and travelling another 200m in 15s. Calculate the overall average speed.
16. Usain Bolt travels 100m in 9.58s. Calculate his average speed.
17. Why is Usain Bolt's speed in Q14 only an average? What is his speed like at different parts of his run?
18. I leave my house at 7.15am and travel 1800m to school, arriving at 7.19am. Calculate my average speed (remember to convert minutes to seconds, 1min=60s).

DISTANCE-TIME GRAPHS

1. What goes on the x-axis of a distance-time graph?
2. What goes on the y-axis of a distance-time graph?
3. What does the gradient of the line on a distance-time graph tell us?
4. If the line on a distance-time graph is horizontal, what does that tell us about the motion of the object?
5. Find the speeds of the following using the gradient of the lines:

   e.g. 1(a) The object travels 3m in 2s.

   Speed = Distance ÷ Time

   Distance = 3m   Time = 2s

   Speed = 3 ÷ 2 = 0.67m/s

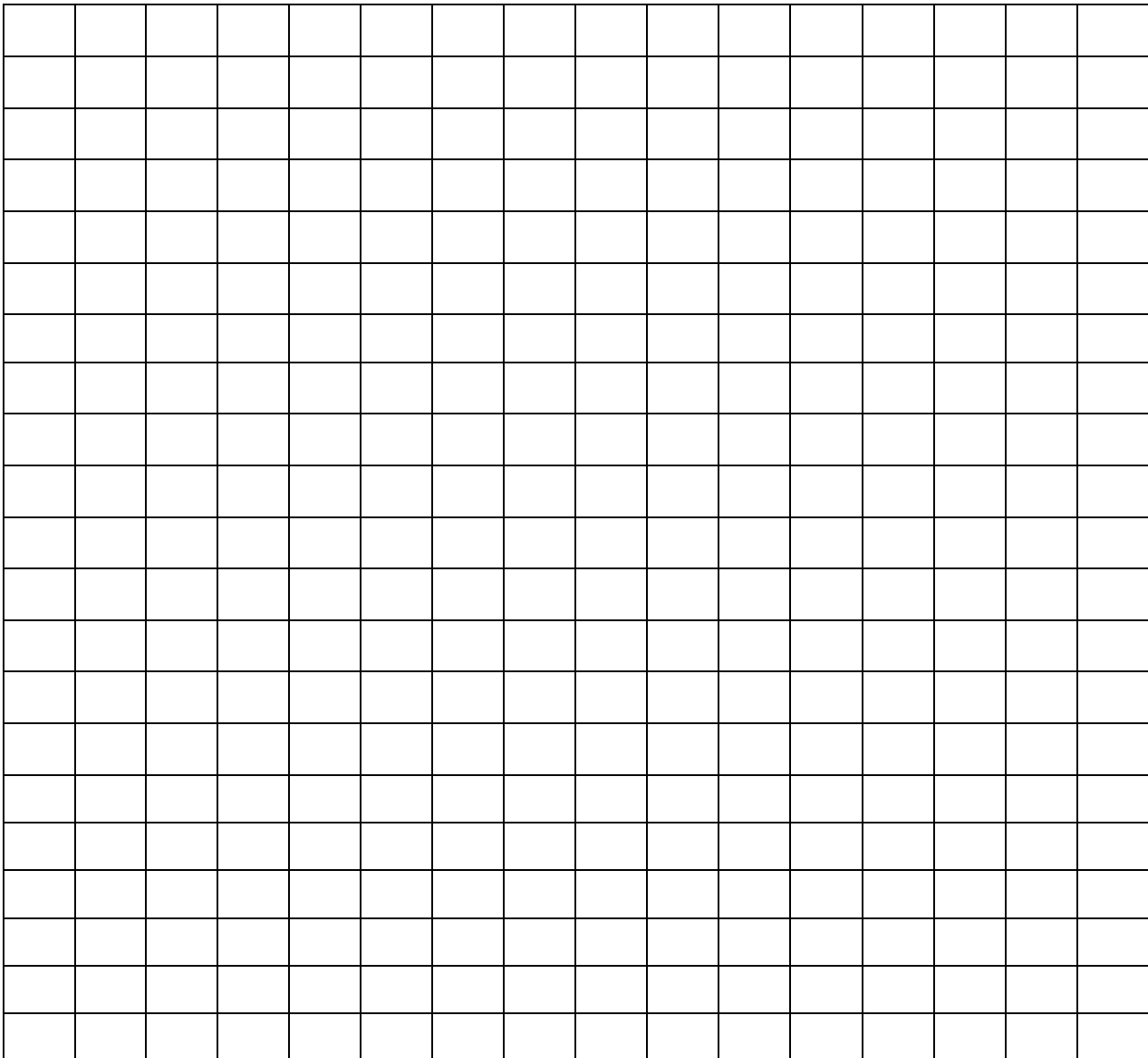| Question	Answer
Two cars pass each other head on, one is doing 50 mph one is doing 30 mph, what is their relative speed?	
A car (with a speed of 20m/s) overtakes a cyclist (the cyclist is moving at 11 m/s) what is their relative speed?	
Two trains pass each other head on with a relative speed of 100 mph, one train is moving at 70 mph, what is the speed of the other train?	
If a runner at 7 m/s overtakes a walker moving at 2 m/s what is the relative speed?	
Two observers are watching a runner. Observer A is stationary, Observer B is moving towards the runner. Do they agree on the speed of the runner?	

Relative motion

1.Produce 10 speed calculation questions of your own.

2.(challenge) Draw a distance time graph using the table below:

Distance (m)	Time (s)
2	2
4	2
6	2
8	2
10	2
10	5
10	10
12	10

3.Create a wordsearch using ten key words from this topic.

Section A: For each question work out the speed, distance or time travelled. (L7)

1. A man walking takes 2 hours to walk 10 miles. How fast did he walk?

    _____mph

2. A policeman took 2 hours to travel 100 miles. What speed was he travelling at?

    _____mph

3. A girl ran 105 metres in 15 seconds. What was her speed?

    _____m/s

4. What distance would a car travel after 4 hours travelling at 60mph?

    _____miles

5. Find the distance travelled by a train travelling at 140 km/h for 6 hours.

    _____km

6. If a person runs at 5 m/s, how long will it take that person to run 300 metres?

    _____secs

7. A horse travels at 12 km/hour. How long will it take to travel 18km?

    _____hours

8. A cyclist took 1.5 hours to travel 24 km. What speed was the cyclist travelling at?

    _____km/h

9. How far would an athlete run travelling at 8 m/s for one minute?

    _____metres

10. Find the distance travelled by a horse running at 20 km/h for 30 minutes.

    _____km

Section B: For each question work out the speed, distance or time travelled. (L7)

1. A car travels 50 miles in 1 hour and 15 minutes. Work out its average speed

    _____mph

2. A car travels at 60mph for 2 hours and 40 minutes. How far has it travelled?

    _____miles

3. A car travels at 72 mph for 2 hour and 20 minutes. How far has it travelled?

    _____miles

4. At a health club Tanya uses a treadmill for a quarter of an hour and walks a distance of 1.3 miles. At what speed, in miles per hour has she set the treadmill?

    _____mph

5. The distance from the bus terminals to Amy's house is 3.5 kilometres. The journey takes 8 minutes.. Calculate the average speed of the bus in kilometres per hour.   _____km/h

Extension:

Section C: Using the skills learnt today, can you now attempt the GCSE questions? (L8)

1.

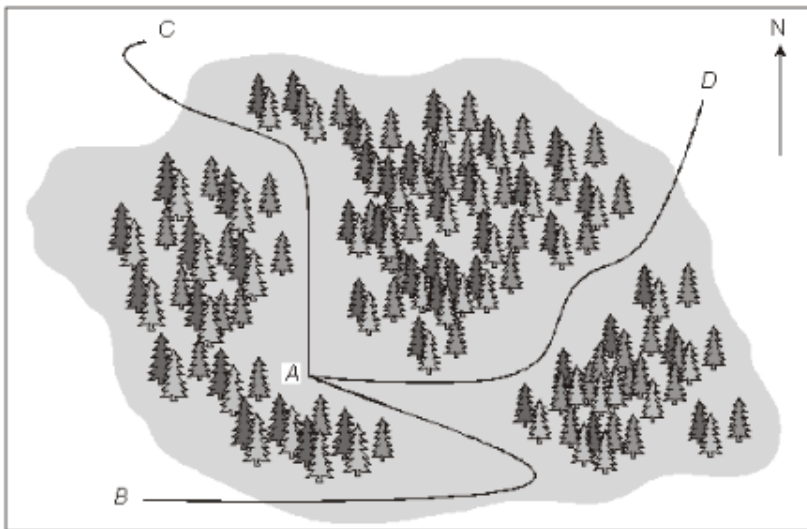Harry drives 182 miles.
His average speed is 35 miles per hour.

How long does the journey take?
Give your answer in hours and minutes.

....

....

....

....

....

Answer .... hours .... minutes

(Total 4 marks)

2. The diagram shows a map of three paths *AB, AC* and *AD* through a wood.

(a) A rambler wants to walk towards her house from point *A*.
Her house is to the north-west of the wood.

Which path should she take?

Answer ....

(1)

(b) A warden wants to know the length of the path from *D* to *A*.
He walks along the path.
It takes him 40 minutes.
He knows that he walks at 3 miles an hour.

How long is the path?

....

....

Answer .... miles

(2)