glossary

Calculations involving average speed

SKILLS

Example 1
Calculate Tom's average speed when he runs from the starting block to the finishing line (page 153).

Solution

$$s_{av} = \frac{d}{t} = \frac{100}{12} = 8.3 \text{ m/s} \qquad \left| \quad d = 100 \text{ m}, \quad t = 12 \text{ s}, \quad s_{av} = ? \text{ m/s} \right.$$

Answer: Tom's average speed is 8.3 m/s.

Example 2
Calculate the average speed of a cyclist who rides a total distance of 5 kilometres in 15 minutes.

Solution

$$s_{av} = \frac{d}{t} = \frac{5}{0.25} = 20 \text{ km/h} \qquad \left| \quad d = 5 \text{ km}, \quad t = 15 \text{ min} = \frac{15}{60} \text{ hours} = 0.25 \text{ hours}, \quad s_{av} = ? \text{ km/h} \right.$$

Answer: The average speed of the cyclist was 20 km/h.

Example 3
How long will it take a motorcyclist to travel 300 km if her average speed on the trip is 75 km/h?

Solution
In this case we transpose the formula to make *t* the subject.

$$s_{av} = \frac{d}{t}$$
$$\text{So, } t \times s_{av} = d$$
$$\text{Hence } t = \frac{d}{s_{av}} = \frac{300}{75} = 4 \text{ h} \qquad \left| \quad d = 300 \text{ km}, \quad s_{av} = 75 \text{ km/h}, \quad t = ? \text{ hours} \right.$$

Answer: The motorcyclist will take 4 hours.

Note

- The layout shown in these examples helps you substitute the correct figures in the correct units into the formula. If you do make a mistake it is easier to spot. Also it shows your calculations clearly, which is an important skill.
- With this layout, the units are only stated at the end of the calculation. Unit conversions are performed on the side.
- Round off the answer to the same number of significant figures as the data (page 135).

Converting speed units

Example 4
Express 72 km/h in m/s.

Solution
We can still use the speed formula for this calculation.

This speed means that a distance of 72 km is travelled in 1 hour.

Hence the speed is given by:

$$s_{av} = \frac{d}{t} = \frac{72\,000}{3600} = 20 \text{ m/s} \qquad \left| \quad d = 72 \text{ km} = 72 \times 1000 \text{ m} = 72\,000 \text{ m}, \quad t = 1 \text{ h} = 3600 \text{ s}, \quad s_{av} = ? \text{ m/s} \right.$$

Note
There is also a simple unit conversion formula that you can use. Example 4 illustrates how it came about. This is summarised in the simple flow chart shown in Figure 7.10. This flow chart also shows how to convert speed in km/h to the unit of speed in the British Imperial system of measurement used in both Great Britain and the USA – miles per hour.

Work the Web

Visit **www.scienceedge.com.au** and link to **animal speeds**. How are animal speeds measured and what are the difficulties associated with this? Name the record-holding species for speed.

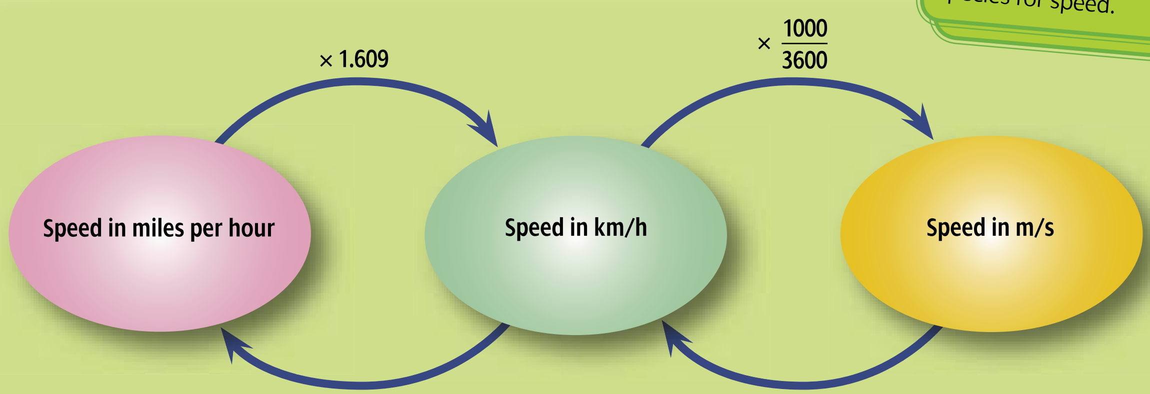

Figure 7.10 A flow chart for converting speed units

Questions 7.2

1 A tram travelled along a straight track from a particular stop back to its depot. This 5 km journey took 12 minutes. What was its average speed? (Give your answer in km/h.)

2 If an object travels at 7 m/s for 3 minutes, how far will it go?

3 Calculate how long it will take to drive 30 km along a highway at an average speed of 90 km/h. Give your answer in minutes.

4 If you drive 60 km along a freeway at an average speed of 100 km/h, then another 10 km along another road at an average speed of 60 km/h, how long will you take to complete your trip?

5 Convert the following speeds:

a 50 km/h to m/s

b 3 m/s to km/h

c 110 km/h to m/s

d 20 m/s to km/h

e 60 km/h to miles per hour (mph)

6 Copy Table 7.1 into your book and use unit conversions to fill in the missing values.

Table 7.1 The speeds of some of the world's fastest creatures

Living thing	Speed in m/s	Speed in km/h
Fastest land animal (cheetah)		100
Fastest fish (sailfish)		110
Fastest bird (swift)	97.9	

Puzzle

7 Figure 7.12 shows a map of a section of a certain highway. Car A left town P at 9.00 am and travelled west at a constant speed of 90 km/h. Car B left town Q at 9.30 am and travelled east at a constant speed. It passed car A at 10.00 am.

a If town Q is the reference point, what was the displacement of car A when the two cars passed each other?

b At what speed must car B have been travelling? Show all calculations.

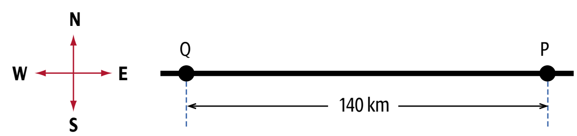

Figure 7.12

Figure 7.11 A tram travelling along a straight track