KEY SKILL 1

TAKE A LOOK BACK AT BOOK 1, PP. 3, 16

The metric units of length used most often are:

The *kilometre* (km) — roughly equal to three laps of a sports oval.

The *metre* (m) — about the length of an adult's 'stretched pace'.

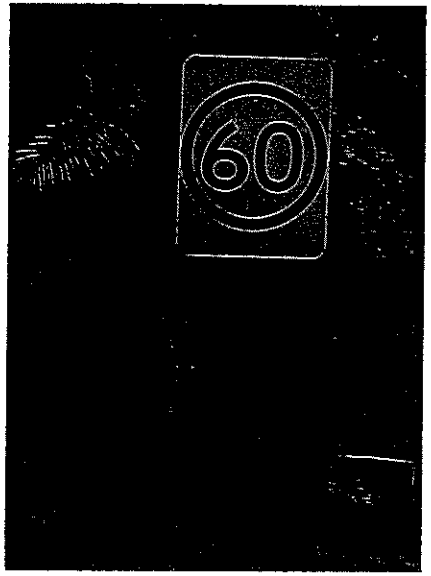
The *centimetre* (cm) — roughly equal to the width of a little finger.

The *millimetre* (mm) — the approximate thickness of a metal ruler.

You would measure the distance between two capital cities in kilometres, the length of a driveway in metres, the distance around your waist in centimetres, and the thickness of a pencil in millimetres.

Speed is a description that relates to the change in distance over a period of time.

Speed is defined as $\frac{\text{change in distance}}{\text{change in time}}$.



WORKED EXAMPLE

Bill walks quickly, covering 4.5 km in 0.75 hours.
a What is his speed in km/h?
b What is his speed in m/s?

THINK	WRITE
a Speed = $\frac{\text{change in distance}}{\text{change in time}}$	Speed = $\frac{4.5}{0.75}$
Write with units.	6 km/h
b Convert km to m.	4.5 km × 1000 = 4500 m
Convert hours to seconds.	0.75 × 60 = 45 mins = 45 × 60 = 2700 s
Speed = $\frac{\text{change in distance}}{\text{change in time}}$	Speed = $\frac{4500}{2700}$
Write with units.	1.67 m/s

QUESTIONS

1 Convert the following units.

a 2.4 m = 2.4 × 100 = 240 cm

b 6 km = 6 × _____ = _____ m

c 460 mm = _____ = _____ cm

d 12 000 cm = _____ = _____ m

2 Compare and put in order the following measurements from smallest to largest.

210 cm, 6 m, 0.8 km and 6100 mm.

3 Calculate the average speed in km/h for the following.

a A car travelling 400 km in 5 h

b A marathon runner taking 3 h to run 42 km

c An aeroplane travelling a distance of 875 km in 3.5 h

4 Calculate the average speed in m/s (rounded to 1 decimal place) for the following.

a A cyclist travels 50 km in 5 hours.

b A horse gallops 3 km in 5 min.

c A walker covers 10 km in 1 h 15 min.

5 The sound in air travels approximately 340 metres per second.

a If you were standing 150 metres away from the starter of a running race, how long after the start of the race would you hear the starter's pistol? (Round answers to 2 decimal places.)

b A thunderclap is heard 6 seconds after the lightning flash. How far away is the storm?

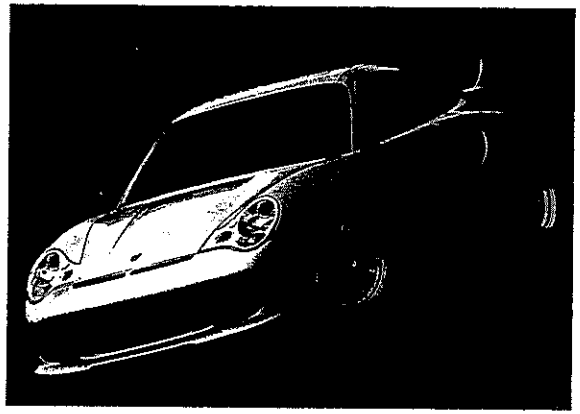
c How long does it take for sound to travel 1 km? (Round to 1 decimal place.)

INVESTIGATION 1

Many drivers drive in a false belief that if the car in front suddenly started braking, they would be able to react and brake, stopping a safe distance apart. The total stopping distance of a vehicle is made up of four components:

- human perception time
- human reaction time
- vehicle reaction time
- vehicle braking capability.

The human perception time is how long the driver takes to see the hazard, and how long the brain takes to realise it is a hazard requiring an immediate reaction. This perception time can be as long as one-quarter to one-half of a second.



Type of car	Stopping distance (m) at 90 km/h	Stopping distance (m) at 120 km/h
Audi A4	43.5	80.7
Mazda MX-5	45.6	76.8
Mercedes C36	36	63
Saab 9000 Aero	36.6	66.3
Toyota Camry V6	43.5	82.2
Porsche 911 Carrera 4	37.8	66.9

Source: www.sdt.com.au/safedrive-directory-STOPPINGDISTANCE.htm.

To work out the difference between the stopping distance of a car travelling at 90 km/h and 120 km/h, subtract the larger value from the smaller value.

QUESTIONS

1 From the table on stopping distances above, rank the cars from shortest to longest stopping distance for the two speeds.

	Stopping distance at 90 km/h	Stopping distance at 120 km/h
1		
2		
3		
4		
5		
6		

2 Find the differences between the two stopping distances of the cars from the stopping distance table on the previous page. Give your answers in metres and centimetres.

Car	Difference in m	Difference in cm
Audi A4		
Mazda MX-5		
Mercedes C36		

Reaction times

3 In the moments between seeing an obstacle in the path of your vehicle and applying the brakes, you continue to drive at a constant speed. If a car is travelling at 60 km/h:

a how many metres would it travel in one hour? (*Hint:* × 1000)

b how many metres would it travel in one minute? (*Hint:* ÷ 60)

c how many metres (rounded to 1 decimal place) would it travel in one second? (*Hint:* ÷ 60)

d how many metres would it travel in half a second? (*Hint:* ÷ 2)

4 Complete the table of distance travelled before you start braking.

Speed	Distance in metres travelled in 1 h	Distance in metres travelled in 1 min	Distance in metres travelled in 1 s	Distance in metres travelled in 0.5 s
10 km/h				
40 km/h				
90 km/h				
100 km/h				

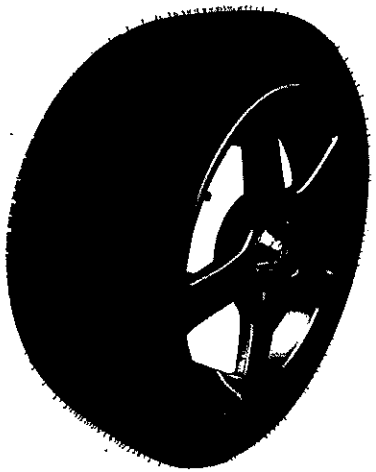
5 If you are travelling at 90 km/h and it takes half a second to react, what is the total stopping distance from when you first see the obstacle?

Car	Stopping distance (m)	Reaction distance (m)	Total distance (m)
Saab 9000 Aero	36.6		
Toyota Camry V6	43.5		
Porsche 911 Carrera 4	37.8		

KEY SKILL 6

TAKE A LOOK BACK AT BOOK 1, PP. 6, 16

For a car to be allowed on the road, the car must be considered to be roadworthy. To test if a car is roadworthy, a check is done by a mechanic to test that the car can be driven safely. A large focus within the roadworthy check is the tyres. Tyres are the only parts of the car touching the ground. They must provide grip so that the car handles and brakes safely.



Stopping distances

For an average-size car with good tyres, the minimum controlled stopping distance in metres can be found by using the formula:

$$D = \frac{0.35s}{f}$$

where: s is the speed of the car in kilometres per hour

f is the coefficient of friction of the road surface.

The higher the coefficient of friction, the better the grip and the shorter the stopping distance. The value of friction will vary depending on the state of the tyres and the condition of the road. If the speed of the car is high, this will increase the stopping distance.

WORKED EXAMPLE

What is the stopping distance of a car travelling at 60 kilometres per hour on dry asphalt, which has a coefficient of friction of 0.8?

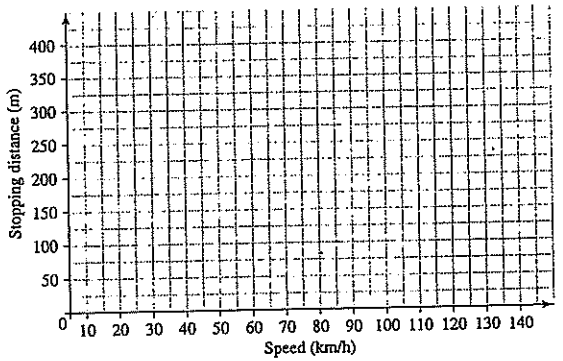
THINK	WRITE
Speed, $s = 60$ km/h Coefficient of friction, $f = 0.8$	$D = \frac{0.35s}{f}$ $= \frac{0.35 \times 60}{0.8}$
Calculate.	$= 26.25$ m

QUESTIONS

1 Complete the table of stopping distances.

Icy road ($f = 0.1$)		Wet road ($f = 0.4$)		Dry road ($f = 0.8$)	
Speed (km/h)	Stopping distance (m)	Speed (km/h)	Stopping distance (m)	Speed (km/h)	Stopping distance (m)
10	$= \frac{0.35 \times 10}{0.1}$	10		10	
20		20		20	
40		40		40	
80		80		80	
100		100		100	

2 Complete the graph of stopping distances for each of the three types of road conditions.



3 Use your graph in Question 2 to complete the following table, then check your answers using the formula.

Speed (km/h)	Stopping distance on a dry road (m)	Stopping distance on a wet road (m)	Stopping distance on an icy road (m)
15			
35			
65			
85			

INVESTIGATION 5

Reducing drink driving is a prominent public safety campaign in all Australian states and territories. The police conduct regular random breath tests (RBTs) to screen for drivers abusing alcohol and drugs. Now, standard police cars can also act as Booze Buses and conduct random breath tests.

In 2006, Victoria Police breath tested 1.37 million drivers and riders from Booze Bus operations. Over 5500 drivers and riders were caught with an illegal blood alcohol concentration (BAC) over this period. Of the 34 drivers and motorcyclists killed in 2006 in Victoria with a BAC of 0.05 or over:

- 91% were males
- 47% were between 21 and 29 years of age, 29% were aged between 30 and 39 years, 18% were aged over 40, and the remaining 6% were 20 years of age or younger
- 79% were involved in single-vehicle crashes
- 62% of fatalities occurred on country roads
- 82% died in crashes that occurred between the hours of 6 pm and 6 am.

QUESTIONS

1 What percentage of fatalities occurred on city roads in 2006?

2 If 82% of deaths occurred in accidents between the hours of 6 pm and 6 am,

a what is the decimal equivalent?

b what percentage of accidents occurred at other times?

c what times did the other accidents in **b** occur between?

3 What percentage of drivers were caught with an illegal BAC in 2006?

In 2007, more than one in four drivers and motorcyclists killed in Victoria tested at or over 0.05. Approximately 80% of those killed were male, and the majority killed were aged 21 to 39 years.

4 Express the ratio of drivers and motorcyclists killed in 2007 as a fraction, a percentage and a decimal.

5 In 2007, 80% of the drivers killed were male. There were 40 people killed on the roads that year — how many males does this percentage represent?

6 Below are statistics on what daytime road accidents have occurred. Find the percentage of crashes on each day. (*Hint:* First find the total number of accidents and round to 1 decimal place.)

Day of the week	Number of accidents	Percentage
Mon.	117	
Tues.	138	
Wed.	138	
Thurs.	117	
Fri.	166	
Sat.	186	
Sun.	154	
Total		100%

7 Use the Crash Database weblink in your eBookPLUS to find more information on crash statistics over the last five years, and write a short report.

NVESTIGATION 3

ı recent years there has been an effort to inform people about how much alcohol they drink and how lcohol affects what they do after drinking. Alcohol is involved in 50% of deaths for drivers aged between 1 and 25 years. Blood alcohol concentration (BAC) is a measure of how much alcohol is in your blood. It is ıeasured in grams of alcohol per 100 millilitres of blood.

o have a BAC of 0.00 you must have no alcohol in your bloodstream. The legal BAC limit is 0.05, but any alcohol ı your bloodstream will have an effect on your ability to drive safely, and is potentially a risk to public safety.

lcohol affects people differently and the formulas for estimating BAC are:

$$BAC_{male} = \frac{(10N - 7.5H)}{6.8M} \quad \text{and} \quad BAC_{female} = \frac{(10N - 7.5H)}{5.5M}$$

vhere N is the number of standard drinks consumed, H is the number of hours of drinking and M is the ɔerson's mass in kilograms.

QUESTIONS

1 Investigate the effect each of the following has on a BAC reading.

a Body size

b Body fat

c Gender

d Food

e Fitness

When authorities say a driver must stay under 0.05, that actually means that the driver must have a limit of five hundredths of alcohol in their blood stream. Anything greater than 0.05 will cause a driver to lose their licence if they are caught drink-driving.

2 A BAC of just 0.05 means the risk of having a crash is doubled compared with a driver with zero BAC. What is the place value of the 5 in the above statistic?

Because people come in all different shapes and sizes, there isn't an exact rule for working out the BAC level of a particular person. A general rule of thumb is that for every 1 mL of alcohol consumed, the blood alcohol content will by raised by 0.0015%.

The following formula can be used to approximate the number of hours you need to wait before driving if you've been drinking alcohol.

$$\text{Number of hours} = \frac{BAC}{0.015}$$

3 Complete the table by estimating the number of hours you need to wait before driving. (Round answers to 2 decimal places.)

BAC reading	Approximate number of hours to wait before driving
0.1	
0.2	
0.3	
0.4	
0.5	

4 How long (to the nearest whole number of hours) would it take for a person with a reading of 0.25 to have their BAC reduced to zero?

5 Create a pamphlet that informs people about the risk associated with drink driving. You should include facts that are from the Transit Accident Commission (TAC). Use the TAC weblink in your eBookPLUS.

What is a standard drink?

A standard drink is any drink that contains approximately 10 grams of alcohol. Ethanol is the chemical name of pure alcohol. Use the label on the bottle, can or cask to find out how many standard drinks there are inside the container. There are five main types of alcoholic beverages: spirits, champagne, wines, regular beer and light beer.

1 standard drink = 10 grams of ethanol = 12.5 mL of ethanol

The main reason for using standard drinks is so that you can keep track of how much alcohol you have consumed. *It takes roughly one hour for your body to break down one standard drink.*

Here is a formula that you can use to calculate the number of standard drinks in each beverage:

Standard drinks = drink volume (L) × % alcohol × 0.789 (kg/L) (specific gravity of ethanol)

Most glasses are not a standard size, so it is extremely difficult to know the volume.

6 Complete the table, converting the different drinks to standard drinks.

	Type of drink	Name of drink size	Volume of drink size	Percentage of alcohol by volume	Standard drinks to 1 decimal place
a	Beer	Pot	285 mL	4.9%	1.1 standard drink
b	Beer	Stubby/can	375 mL	4.9%	
c	Spirit	Shot/nip	30 mL	40%	
d	Premixed spirit	Can/bottle	375 mL	5%	
e	Port/Sherry	Glass	60 mL	18%	
f	Wine	Glass	170 mL	11.5%	
g	Champagne	Flute	180 mL	12%	