10.1 Overview
Why learn this?
Measurement is important in many aspects of everyday life. If you do not have an understanding of metric measurement — length, area and volume — many professions and jobs will be closed to you. Imagine a designer, dressmaker, architect or builder who did not understand measurement. Their job would be impossible!

What do you know?
1 THINK List what you know about measurement. Use a ‘thinking tool’ such as a concept map to show your list.
2 PAIR Share what you know with a partner and then with a small group.
3 SHARE As a class, create a ‘thinking tool’ such as a large concept map that shows your class’s knowledge of measurement.

Learning sequence
10.1 Overview
10.2 Perimeter
10.3 Circumference
10.4 Area of rectangles, triangles, parallelograms, rhombuses and kites
10.5 Area of a circle
10.6 Area of trapeziums
10.7 Volume of prisms and other solids
10.8 Time
10.9 24-hour clock and time zones
10.10 Review
10.2 Perimeter

Units of length

- Metric units of length include millimetres (mm), centimetres (cm), metres (m) and kilometres (km).
- To convert between the units of length, we use the following conversion chart:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>kilometres (km)</td>
<td>$\div 1000$</td>
</tr>
<tr>
<td>metres (m)</td>
<td>$\times 1000$</td>
</tr>
<tr>
<td>centimetres (cm)</td>
<td>$\div 100$</td>
</tr>
<tr>
<td>millimetres (mm)</td>
<td>$\times 1000$</td>
</tr>
</tbody>
</table>

- When converting from a larger unit to a smaller unit, multiply by the conversion factor; when converting from a smaller unit to a larger unit, divide by the conversion factor.

**WORKED EXAMPLE 1**

Complete the following metric length conversions.

a. $1.027 \text{ m} = \underline{\quad} \text{cm}$
b. $0.0034 \text{ km} = \underline{\quad} \text{m}$
c. $76500 \text{ m} = \underline{\quad} \text{km}$
d. $3.069 \text{ m} = \underline{\quad} \text{mm}$

**THINK**

a. Look at the conversion table. To convert metres to centimetres, we need to multiply by 100. So, move the decimal point two places to the right.

b. To convert kilometres to metres, we need to multiply by 1000. So, move the decimal point three places to the right.

c. To convert metres to kilometres, divide by 1000. This can be done by moving the decimal point three places to the left.

d. Look at the conversion table. To convert metres to millimetres, we need to multiply by 100 and then by 10. This is the same as multiplying by 1000, so move the decimal point three places to the right.

**WRITE**

a. $1.027 \times 100 = 102.7 \text{ cm}$
b. $0.0034 \times 1000 = 3.4 \text{ m}$
c. $76500 \div 1000 = 76.5 \text{ km}$
d. $3.069 \times 100 \times 10 = 3069 \text{ mm}$

The perimeter

- The perimeter of a shape is the total distance around the shape.
- To find the perimeter of a shape:
  - identify the length of each side
  - ensure that all measurements are in the same units
  - add all side lengths together and include units with your answer.
Find the perimeter of each of the shapes below.

**a** A kite

```
15 mm  21 mm
```

**b** A trapezium

```
15 mm  18 mm
```

**c** An irregular shape

```
15 mm  11 mm
```

**THINK**

**a** 1 Make sure that all the measurements are in the same units and add them together.

2 Write the answer in words, including the units.

**b** 1 Notice that the measurements are not all in the same metric units. Convert to the smaller unit (in this case convert 7.3 cm to mm).

2 Add the measurements.

3 Write the answer in words, including the units.

**c** 1 Make sure that given measurements are in the same units.

2 Determine the lengths of the unknown sides and label them on the diagram.

3 Add the measurements.

4 Write the answer in words, including the units.

**WRITE/WRITE**

**a**

\[ P = 21 \times 2 + 15 \times 2 \]

\[ = 72 \]

The perimeter of the kite shown is 72 mm.

**b**

\[ 7.3 \text{ cm} = 73 \text{ mm} \]

\[ P = 45 + 17 + 28 + 73 \]

\[ = 163 \]

The perimeter of the trapezium shown is 163 mm.

**c**

\[ P = 45 + 18 + 15 + 11 + 15 + (40 - (18 + 11)) + (45 - (15 + 15)) + 40 \]

\[ = 45 + 18 + 15 + 11 + 15 + 11 + 15 + 15 + 40 \]

\[ = 170 \text{ mm} \]

The perimeter of the irregular shape shown is 170 mm.

**Finding the perimeter of a square and a rectangle**

- The perimeter \((P)\) of a rectangle is given by the formula \(P = 2(l + w)\), where \(l\) is the length and \(w\) is the width of the rectangle.
The perimeter ($P$) of a square is given by the formula $P = 4l$, where $l$ is the side length of the square.

**WORKED EXAMPLE 3**

Find the perimeter of a rectangular block of land that is 20.5 m long and 9.8 m wide.

**THINK**

1. Draw a diagram of the block of land and write in the measurements.

2. Write the formula for the perimeter of a rectangle.

3. Substitute the values of $l$ and $w$ into the formula, and calculate.

4. Write the worded answer with the correct units.

**WRITE/DRAW**

<table>
<thead>
<tr>
<th>$l$</th>
<th>20.5 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>$w$</td>
<td>9.8 m</td>
</tr>
</tbody>
</table>

$P = 2(l + w)$

$P = 2 \times (20.5 + 9.8)$

$P = 2 \times 30.3$

$P = 60.6$ m

The perimeter of the block of land is 60.6 m.

**WORKED EXAMPLE 4**

A rectangular billboard advertising country Victoria has a perimeter of 16 m. Calculate its width if the length is 4.5 m.

**THINK**

1. Draw a diagram of the rectangular billboard and write in the measurements.

2. Write the formula for the perimeter of a rectangle.

3. Substitute the values of $P$ and $l$ into the formula, and solve the equation:
   (a) subtract 9 from both sides
   (b) divide both sides by 2
   (c) simplify if appropriate.

4. Write the worded answer with the correct units.

**WRITE/DRAW**


$P = 16$ m

$P = 2(l + w)$

$16 = 2 \times 4.5 + 2w$

$16 = 9 + 2w$

$16 - 9 = 9 - 9 + 2w$

$7 = 2w$

$7 = \frac{2w}{2}$

$\frac{7}{2} = \frac{2w}{2}$

$3.5 = w$

$w = 3.5$

The width of the rectangular billboard is 3.5 m.
Exercise 10.2 Perimeter

**INDIVIDUAL PATHWAYS**

**PRACTISE**
Questions: 1, 2, 3, 7, 8, 14, 17

**CONSOLIDATE**
Questions: 1a, c, e, i, k, m, 2a, c, d, f, g, h, i, j, 3, 5, 8, 14, 16–18

**MASTER**
Questions: 1b, d, f, h, j, l, n, 2b, d, f, h, i, k, l, 4, 6, 7, 9–19

**REFLECTION**
What is the best way to remember the units conversion chart?

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**FLUENCY**

1. **WE1** Fill in the gaps for each of the following.
   a. 20 mm = _______ cm
   b. 13 mm = _______ cm
   c. 130 mm = _______ cm
   d. 1.5 cm = _______ mm
   e. 0.03 cm = _______ mm
   f. 2.8 km = _______ m
   g. 0.034 m = _______ cm
   h. 2400 mm = _______ cm = _______ m
   i. 1375 mm = _______ cm = _______ m
   j. 2.7 m = _______ cm = _______ mm
   k. 0.08 m = _______ mm
   l. 6.071 km = _______ m
   m. 670 cm = _______ m
   n. 0.0051 km = _______ m

2. **WE2** Find the perimeter of the shapes below.
   a. 
   b. 
   c. 
   d. 
   e. 
   f. 
   g. 
   h. 
   i. 

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**DIGITAL DOC**
Skillsheet
Multiplying and dividing by powers of 10
doc-6956
Skillsheet
Converting units of length
doc-6957
3 Chipboard sheets are sold in three sizes. Convert each of the measurements below into centimetres and then into metres:
   a) 1800 mm × 900 mm  
   b) 2400 mm × 900 mm  
   c) 2700 mm × 1200 mm.
4 A particular type of chain is sold for $2.25 per metre. What is the cost of 2.4 m of this chain?
5 Fabric is sold for $7.95 per metre. How much will 4.8 m of this fabric cost?
6 The standard marathon distance is 42.2 km. If a marathon race starts and finishes with one lap of a stadium which is 400 m in length, what distance is run on the road outside the stadium?
7 Maria needs 3 pieces of timber of lengths 2100 mm, 65 cm and 4250 mm to construct a clothes rack.
   a) What is the total length of timber required, in metres?
   b) How much will the timber cost at $3.80 per metre?
8 Find the perimeter of a basketball court, which is 28 m long and 15 m wide.
9 A woven rectangular rug is 175 cm wide and 315 cm long. Find the perimeter of the rug.
10 A line is drawn to form a border 2 cm from each edge of a piece of A4 paper. If the paper is 30 cm long and 21 cm wide, what is the length of the border line?
11 A rectangular paddock 144 m long and 111 m wide requires a new single-strand wire fence.
   a) What length of fencing wire is required to complete the fence?
   b) How much will it cost to rewire the fence if the wire cost $1.47 per metre.
12 A computer desk needs to have table edging.
   If the edging cost $1.89 per metre, find the cost of the table edging required for the desk.

13 Calculate the unknown side lengths in each of the given shapes.

   a) Perimeter = 30 cm  
   b) Perimeter = 176 cm  
   c) Perimeter = 23.4 m
14 The rectangular billboard has a perimeter of 25 m. Calculate its width if the length is 7 m.

15 The ticket at right has a perimeter of 42 cm.
   a Calculate the unknown side length.
   b Olivia wishes to decorate the ticket by placing a gold line along the slanted sides. How long is the line on each ticket?
   c A bottle of gold ink will supply enough ink to draw 20 m of line. How many bottles of ink should be purchased if 200 tickets are to be decorated?

REASONING
16 A square and an equilateral triangle have the same perimeter. The side of the triangle is 3 cm longer than the side of the square. How long is the side of the square? Show your working.

PROBLEM SOLVING
17 As a warm-up activity for PE class, you are required to run laps of the basketball court. The dimensions of a full-size basketball court are shown.
   a How far will you run if you run three full laps of the court?
   b How far will you run if you run three laps of half the court?
18 a A pool fence is to be placed around a rectangular pool that is 6 m by 8 m. If the fence is to be 1 m away from the edge of the pool and also rectangular in shape, what length of fencing is required? (Include the width of the gate in the length of the fence.)
   b Write a rule that relates the length of the fence to the length and width of any rectangular pool.
19 A present is to be wrapped using a box, as shown at right.
   a If the dimensions of the box are 30 cm long by 25 cm wide by 18 cm high, what is the total length of ribbon that would be needed if the bow used 35 cm of ribbon? (Assume no overlap at the start or finish of the ribbon.)
   b Write a rule that will allow you to calculate the amount of ribbon required for any rectangular box.

10.3 Circumference
• The circumference \( C \) is another term for the perimeter of a circle.
• The diameter \( D \) of a circle is the name given to the straight-line distance across a circle though its centre.
• The straight-line distance from the centre of the circle to the circumferences is called the radius.
• There is a relationship between the diameter and the circumference of a circle.
• The ratio \( \frac{C}{D} \) is approximately 3. When this ratio is calculated exactly, it is called \( \pi \) or \( \pi \).
• The symbol \( \pi \) represents the ratio of the circumference of a circle to its diameter. It is an infinite, non-recurring and non-terminating decimal that begins as 3.141 592 653 5 . . .
• The circumference of a circle is given by the formula \( C = \pi D \).
• A diameter of a circle is twice as long as its radius, that is, \( D = 2r \). Therefore, the other way to write the formula for the circumference is \( C = 2\pi r \), where \( r \) is the radius of a circle.

**WORKED EXAMPLE 5**

Find the circumference of each of the following circles, giving answers

**i** in terms of \( \pi \) and

**ii** correct to 2 decimal places.

**a**

\[ a \]

\[ 24 \text{ cm} \]

**THINK**

**a i** 1 Write the formula for the circumference of a circle.

*Note: Since the diameter of the circle is given, use the formula that relates the circumference to the diameter.*

2 Substitute the value \( D = 24 \) into the formula.

3 Write the answer and include the correct units.

**WRITE**

**a i** \( C = \pi D \)

\[ = \pi \times 24 \]

\[ = 24\pi \text{ cm} \]

**b**

\[ b \]

\[ 5 \text{ m} \]

**b i** 1 Write the formula for the circumference of a circle.

*Note: Since the radius of the circle is given, use the formula that relates the circumference to the radius.*

2 Substitute the value \( r = 5 \) into the formula.

3 Write the answer and include the correct units.

**WRITE**

**b i** \( C = 2\pi r \)

\[ = 2 \times \pi \times 5 \]

\[ = 10\pi \text{ m} \]
**Think**

1. Identify the parts that constitute the perimeter of the given shape.

2. Write the formula for the circumference of a circle.
   
   *Note:* If the circle were complete, the straight-line segment shown would be its diameter. So the formula that relates the circumference to the diameter is used.

3. Substitute the values \( D = 12 \) and \( \pi = 3.14 \ldots \) into the formula.

4. To find the perimeter of the given shape, halve the value of the circumference and add the length of the straight section.

5. Evaluate and include the correct units.

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**Exercise 10.3 Circumference**

**INDIVIDUAL PATHWAYS**

**PRACTISE**

Questions: 1–6, 8, 11, 12, 16, 18

**CONSOLIDATE**

Questions: 1a, c, e, 2a, c, e, 3a, c, e, 4b, d, 5, 6, 8, 11, 12, 15, 16, 18–20

**MASTER**

Questions: 1a, d, 2a, b, f, 3c, e, f, 4b, c, d, f, 5–7, 9, 11c, 12a, 13–17, 19–21

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**Fluency**

1. **WESa** Find the circumference of each of these circles, giving answers
   
   i. in terms of \( \pi \)
   
   ii. correct to 2 decimal places.

   - a
     
     ![Circle a](image)
     
     2 cm
   
   - b
     
     ![Circle b](image)
     
     10 cm
   
   - c
     
     ![Circle c](image)
     
     7 mm
2. Find the circumference of each of the following circles, giving answers
   i. in terms of \( \pi \)
   ii. correct to 2 decimal places.

\[ a \] 4 m
\[ b \] 17 mm
\[ c \] 8 cm
\[ d \] 1.43 km
\[ e \] 0.4 m
\[ f \] 10.6 m

3. Choose the appropriate formula and find the circumference of these circles.

\[ a \] 77 km
\[ b \] 6 m
\[ c \] 48 mm
\[ d \] 1.07 m
\[ e \] 31 mm
\[ f \] 400 m

4. Find the perimeter of each of the shapes below. (Remember to add the lengths of
the straight sections.) Give your answers to 2 decimal places.

\[ a \] 10 cm
\[ b \] 16 mm
\[ c \] 24 m
5. **MC** The circumference of a circle with a radius of 12 cm is:
   - A $\pi \times 12\,\text{cm}$
   - B $2 \times \pi \times 12\,\text{cm}$
   - C $2 \times \pi \times 24\,\text{cm}$
   - D $\pi \times 6\,\text{cm}$
   - E $\pi \times 18\,\text{cm}$

6. **MC** The circumference of a circle with a diameter of 55 m is:
   - A $2 \times \pi \times 55\,\text{m}$
   - B $\pi \times \frac{55}{2}\,\text{m}$
   - C $\pi \times 55\,\text{m}$
   - D $\pi \times 110 \times 2\,\text{m}$
   - E $2 \times \pi \times 110\,\text{m}$

**UNDERSTANDING**

7. In a Physics experiment, students spin a metal weight around on the end of a nylon thread. How far does the metal weight travel if it completes 10 revolutions on the end of a 0.88 m thread? Give your answer to 2 decimal places.

8. A scooter tyre has a diameter of 32 cm. What is the circumference of the tyre? Give your answer to 2 decimal places.

9. Find the circumference of the seaweed around the outside of this sushi roll, correct to 2 decimal places.

10. Find the circumference of the Ferris wheel shown below, correct to 2 decimal places.
11 Calculate the diameter of a circle (correct to 2 decimal places where appropriate) with a circumference of:
   a 18.84 m
   b 64.81 cm
   c 74.62 mm.

12 Calculate the radius of a circle (correct to 2 decimal places where appropriate) with a circumference of:
   a 12.62 cm
   b 47.35 m
   c 157 mm.

13 Calculate the radius of a tyre with a circumference of 135.56 cm. Give your answer to 2 decimal places.

14 Calculate the total length of metal pipe needed to assemble the wading pool frame shown at right. Give your answer in metres to 2 decimal places.

15 Nathan runs around the inside lane of a circular track that has a radius of 29 m. Rachel runs in the outer lane, which is 2.5 m further from the centre of the track. How much longer is the distance Rachel runs each lap? Give your answer to 2 decimal places.

REASONING

16 In Around the world in eighty days by Jules Verne, Phileas Fogg boasts that he can travel around the world in 80 days or fewer. This was in the 1800s, so he couldn’t take a plane. What average speed is needed to go around the Earth at the equator in 80 days? Assume you travel for 12 hours each day and that the radius of the Earth is approximately 6390 km. Give your answer in km/h to 2 decimal places.

17 Liesel’s bicycle covers 19 m in 10 revolutions of her bicycle wheel while Jared’s bicycle covers 20 m in 8 revolutions of his bicycle wheel. What is the difference between the radii of the two bicycle wheels? Give your answer in cm to 2 decimal places.

PROBLEM SOLVING

18 A shop sells circular trampolines of four different sizes. Safety nets that go around the trampoline are optional and can be purchased separately. The entrance to the trampoline is via a zip in the net.

   The table below shows the diameters of all available trampolines and their net lengths. Which safety net matches which trampoline?

<table>
<thead>
<tr>
<th>Diameter of trampoline</th>
<th>Length of safety net</th>
</tr>
</thead>
<tbody>
<tr>
<td>a 1.75 m</td>
<td>i 6.03 m</td>
</tr>
<tr>
<td>b 1.92 m</td>
<td>ii 9.86 m</td>
</tr>
<tr>
<td>c 2.46 m</td>
<td>iii 5.50 m</td>
</tr>
<tr>
<td>d 3.14 m</td>
<td>iv 7.73 m</td>
</tr>
</tbody>
</table>
19 Calculate the perimeter of each of the following shapes. Give your answers correct to 2 decimal places.

a

b

c

d

20 To cover a total distance of 1.5 km, a student needs to run around a circular track three times. Calculate the radius of the track correct to the nearest metre.

21 a A sector is a section of a circle contained between two radii (like a pizza slice). Investigate how to find the perimeter of this sector.

b A segment is a section of a circle contained between a chord and an arc, as shown in this diagram. Investigate how to get the perimeter of the segment shown.

CHALLENGE 10.1

The two small circles in the diagram have a diameter that is equal to the radius of the medium-sized circle. The diameter of the medium-sized circle is equal to the radius of the large circle. If the large circle has a radius of 8 cm, determine the area of the shaded section.

10.4 Area of rectangles, triangles, parallelograms, rhombuses and kites

Area

• The area of a shape is the amount of flat surface enclosed by the shape.
• Area is measured in square units, such as square millimetres (mm²), square centimetres (cm²), square metres (m²) and square kilometres (km²)
• Area units can be converted using the chart below.

<table>
<thead>
<tr>
<th>Area Units</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>square millimetres (mm²)</td>
<td>× 100²</td>
</tr>
<tr>
<td>square centimetres (cm²)</td>
<td>× 10²</td>
</tr>
<tr>
<td>square metres (m²)</td>
<td>× 10²</td>
</tr>
<tr>
<td>square kilometres (km²)</td>
<td>× 100²</td>
</tr>
</tbody>
</table>

• Area units are the squares of those for the corresponding linear units.
• Large areas of land can be measured in hectares (ha). 1 ha = 10000 m².

**WORKED EXAMPLE 7**

Complete the following metric conversions.

a. 0.081 km² = ______ m²

**THINK**

a. Look at the metric conversion chart. To convert square kilometres to square metres, multiply by 1000000; that is, move the decimal point 6 places to the right.

**WRITE**

a. \(0.081 \text{ km}^2 = 0.081 \times 1000000 \text{ m}^2 = 81000 \text{ m}^2\)

b. 19645 mm² = ______ m²

**THINK**

b. Look at the metric conversion chart. To convert square millimetres to square metres, divide by 1000000; that is, move the decimal point 6 places to the left.

**WRITE**

b. \(19645 \text{ mm}^2 = 19645 \div 1000000 \text{ m}^2 = 0.019645 \text{ m}^2\)

**Area of a rectangle**

• The area of a rectangle can be found using the formula \(A_R = l \times w\), where \(l\) is the length and \(w\) is the width of the rectangle.
• The area of a square can be found using the formula \(A_S = l^2\), where \(l\) is the side length of the square.

**WORKED EXAMPLE 8**

Find the area of a rectangle with dimensions shown below.

![Rectangle with dimensions 8 cm by 5.6 cm]
THINK

1. Write the formula for the area of a rectangle.
2. Identify the values of $l$ and $w$.
3. Substitute the values of $l$ and $w$ into the formula and evaluate. Include the appropriate units.

WRITE

\[ A = l \times w \]

\[ l = 8 \text{ and } w = 5.6 \]

\[ A = 8 \times 5.6 \]

\[ = 44.8 \text{ cm}^2 \]

Area of a triangle

- The area of a triangle, $A_T$, is given by the formula $A_T = \frac{1}{2} \times b \times h$, where $b$ is the base and $h$ is the height of the triangle.
- The base and the height of a triangle are perpendicular (at right angles) to each other.

WORKED EXAMPLE 9

Find the area of each of these triangles in the smaller unit of measurement.

THINK

a 1. Write the formula for the area of a triangle.
2. Identify the values of $b$ and $h$.
3. Substitute the values of $b$ and $h$ into the formula.
4. Evaluate. Remember to include the correct units (cm$^2$).

WRITE

a $A = \frac{1}{2}bh$

\[ b = 7.5, \ h = 2.8 \]

\[ A = \frac{1}{2} \times 7.5 \times 2.8 \]

\[ = 3.75 \times 2.8 \]

\[ = 10.5 \text{ cm}^2 \]

b 1. Write the formula for the area of a triangle.
2. Convert measurements to cm.
3. Identify the values of $b$ and $h$.
4. Substitute the values of $b$ and $h$ into the formula.
5. Evaluate. Remember to include the correct units (cm$^2$).

WRITE

b $A = \frac{1}{2}bh$

\[ b = 180, \ h = 55 \]

\[ A = \frac{1}{2} \times 180 \times 55 \]

\[ = 90 \times 55 \]

\[ = 4950 \text{ cm}^2 \]
Area of a parallelogram

- A **parallelogram** is a quadrilateral with two pairs of parallel sides. Each parallel pair is of equal length.
- A parallelogram can be divided into two triangles by drawing a diagonal.

In the parallelogram PQRS below, are \( \triangle PQR \) and \( \triangle RSP \) congruent?

As their corresponding sides are of equal length, then \( \triangle PQR \equiv \triangle RSP \) (SSS congruency condition).

![Diagram of parallelogram with diagonal and labels](https://example.com/diagram-parallelogram)

- As the area of a triangle is given as \( A_T = \frac{1}{2} \times b \times h \), then the area of a parallelogram must be twice the area of each triangle, so \( A_P \), area of a parallelogram is given by the formula \( A_P = b \times h \), where \( b \) is the base and \( h \) is the height of a parallelogram.
- The base and the height of a parallelogram are perpendicular to each other.

**WORKED EXAMPLE 10**

Find the area of the parallelogram shown.

![Parallelogram with dimensions](https://example.com/diagram-parallelogram-dimensions)

**THINK**

1. Write the formula for the area of a parallelogram.
2. Identify the values of \( b \) and \( h \).
3. Substitute 6 for \( h \) and 13 for \( b \).
4. Multiply the numbers together and include the correct units.

**WRITE**

\[ A = bh \]

\[ b = 13, \ h = 6 \]

\[ A = 13 \times 6 \]

\[ = 78 \text{ cm}^2 \]

Area of a rhombus

- A **rhombus** is a parallelogram with all four sides of equal length and each pair of opposite sides parallel.
- The area of a rhombus can be determined by multiplying the length of the diagonals and dividing by 2: \( A_{RH} = \frac{d_1 \times d_2}{2} \).

Area of a kite

- A **kite** is a quadrilateral with two pairs of equal, adjacent sides and one pair of equal angles.
- The area of a kite can be determined by dividing the kite into two equal triangles and using the formula for the area of a triangle:

\[ A_K = \frac{d_1 \times d_2}{2} \].

![Diagram of rhombus and kite](https://example.com/diagram-rhombus-kite)
Exercise 10.4 Area of rectangles, triangles, parallelograms, rhombuses and kites

FLUENCY

1 WE7 Complete the following metric conversions.
   a. $0.53 \text{ km}^2 = \underline{\underline{553}} \text{ m}^2$
   b. $235 \text{ mm}^2 = \underline{\underline{0.235}} \text{ cm}^2$
   c. $2540 \text{ cm}^2 = \underline{\underline{25400}} \text{ mm}^2$
   d. $542000 \text{ cm}^2 = \underline{\underline{542}} \text{ m}^2$
   e. $74000 \text{ mm}^2 = \underline{\underline{74}} \text{ m}^2$
   f. $3000000 \text{ m}^2 = \underline{\underline{3}} \text{ km}^2$
   g. $98563 \text{ m}^2 = \underline{\underline{98.563}} \text{ ha}$
   h. $1.78 \text{ ha} = \underline{\underline{1780}} \text{ m}^2$
   i. $0.987 \text{ m}^2 = \underline{\underline{987000}} \text{ mm}^2$
   j. $0.0001275 \text{ km}^2 = \underline{\underline{127.5}} \text{ cm}^2$

2 WE8 Find the area of each of the rectangles below.
   a. $9 \text{ cm} \times 4 \text{ cm}$
   b. $25 \text{ mm} \times 25 \text{ mm}$
   c. $3 \text{ m} \times 3 \text{ m}$
   d. $27 \text{ km} \times 45 \text{ km}$
   e. $5 \text{ m} \times 50 \text{ cm}$
   f. $16 \text{ mm} \times 2.1 \text{ cm}$

3 Find the area of each of the squares below.
   a. $5 \text{ mm} \times 5 \text{ mm}$
   b. $16 \text{ cm} \times 16 \text{ cm}$
   c. $2.3 \text{ m} \times 2.3 \text{ m}$

Questions 4 and 5 relate to the diagram at right.

4 MC The height and base respectively of the triangle are:
   A. 32 mm and 62 mm
   B. 32 mm and 134 mm
   C. 32 mm and 187 mm
   D. 62 mm and 187 mm
   E. 134 mm and 187 mm
5. **MC** The area of the triangle is:
   - A 2992 mm
   - B 2992 mm²
   - C 5984 mm
   - D 5984 mm²
   - E 6128 mm²

6. **WE9** Find the area of the following triangles. Where there are two units given, answer using the smaller units.

   a. 
   ![Diagram of triangle with sides 37 mm and 68 mm]
   
   b. 
   ![Diagram of triangle with sides 87.7 m and 40.4 m]
   
   c. 
   ![Diagram of triangle with sides 231.8 mm and 85.7 mm]
   
   d. 
   ![Diagram of triangle with sides 1.9 m and 184.6 cm]
   
   e. 
   ![Diagram of triangle with sides 142.8 mm and 0.162 m]
   
   f. 
   ![Diagram of right triangle with side 22.7 m]

7. **WE10** Find the area of the following parallelograms shown below.

   a. 
   ![Diagram of parallelogram with sides 11 mm and 25 mm]
   
   b. 
   ![Diagram of parallelogram with sides 120 m and 200 m]
   
   c. 
   ![Diagram of parallelogram with sides 32 cm and 20.5 cm]
   
   d. 
   ![Diagram of parallelogram with sides 2.4 mm and 4.6 mm]
   
   e. 
   ![Diagram of parallelogram with sides 1.8 m and 1.5 m]
   
   f. 
   ![Diagram of parallelogram with sides 75 mm and 132 mm]
   
   g. 
   ![Diagram of parallelogram with sides 2.8 m and 6.2 m]
   
   h. 
   ![Diagram of parallelogram with sides 72 m and 68 m]
   
   i. 
   ![Diagram of parallelogram with sides 5.3 m and 1.6 m]
8  a. Find the area of a rhombus whose diagonals are 10 cm and 6 cm.
   b. Find the area of a rhombus whose diagonals are 8 cm and 6 cm.
   c. Find the area of a kite whose diagonals are 20 cm and 9 cm.

UNDERSTANDING

9  Zorko has divided his vegetable patch, which is in the shape of a regular (all sides equal) pentagon, into 3 sections as shown in the diagram at right.
   a. Calculate the area of each individual section, correct to 2 decimal places.
   b. Calculate the area of the vegetable patch, correct to 2 decimal places.

10 Find the area of the triangle used to rack up the pool balls at right.

11 The pyramid at right has 4 identical triangular faces with the dimensions shown. Calculate:
   a. the area of one of the triangular faces
   b. the total area of the 4 faces.

12 Georgia is planning to create a feature wall in her lounge room by painting it a different colour. The wall is 4.6 m wide and 3.4 m high.
   a. Calculate the area of the wall to be painted.
   b. Georgia knows that a 4 litre can of paint is sufficient to cover 12 square metres of wall. How many cans must she purchase if she needs to apply two coats of paint?

13 Calculate the base length of the give-way sign at right.

14 a. Calculate the width of a rectangular sportsground if it has an area of 30 ha and a length of 750 m.
   b. The watering system at the sportsground covers 8000 square metres in 10 minutes. How long does it take to water the sportsground?

15 Find the area of gold braid needed to make the four military stripes shown.
16 What is the area of the block of land in the figure at right?

17 **MC** Which statement about a parallelogram is false?
   A The opposite sides of a parallelogram are parallel.
   B The height of the parallelogram is perpendicular to its base.
   C The area of a parallelogram is equal to the area of the rectangle whose length is the same as the base and whose width is the same as the height of the parallelogram.
   D The perimeter of the parallelogram is given by the formula \( P = 2(b + h) \).
   E The area of a parallelogram is given by the formula \( A = bh \).

18 The base of a parallelogram is 3 times as long as its height. Find the area of the parallelogram, given that its height is 2.4 cm long.

19 A designer vase has a square base of side length 12 cm and four identical sides, each of which is a parallelogram. If the vertical height of the vase is 30 cm, find the total area of the glass used to make this vase. (Assume no waste and do not forget to include the base.)

20 a Find the length of the base of a parallelogram whose height is 5.2 cm and whose area is 18.72 cm\(^2\).
   b Find the height of a parallelogram whose base is 7.5 cm long and whose area is 69 cm\(^2\).

21 The length of the base of a parallelogram is equal to its height. If the area of the parallelogram is 90.25 cm\(^2\), find its dimensions.

**REASONING**

22 If the diagonals of a rhombus bisect each other and intersect at right angles, use mathematical reasoning to show and explain that \( A_{RH} = \frac{1}{2} \times a \times b \), where \( a \) and \( b \) are the lengths of the diagonals of the rhombus.

23 Using mathematical reasoning, determine the area of the kite below in terms of \( a \) and \( b \).

**PROBLEM SOLVING**

24 Show possible dimensions for each of the following shapes so that they each have an area of 36 cm\(^2\).
   a Rectangle   b Parallelogram   c Rhombus

25 A rectangular flower bed measures 20 m by 16 m. A gravel path 2 m wide surrounds it.
   a Draw a diagram representing the flower bed and path.
   b Calculate the area of the flower bed.
   c Calculate the area of the gravel path.
   d If gravel costs $5 per square metre, how much will it cost to cover the path?
26 The area of Victoria can be approximated using a triangle with the measurements shown at right.

a Estimate the area of Victoria by calculating the area of the triangle.

b Use your atlas or the internet to compare your estimate with the actual area of Victoria.

c Explain why the answer you obtained in part a can be regarded only as an estimate.

d How could a more accurate estimate of the area of Victoria be made?

10.5 Area of a circle

• The area of a circle, \( A \), can be found using the formula \( A = \pi r^2 \), where \( r \) is the radius of the circle.

![Diagram of a circle with radius \( r \)]

• The radius of a circle, \( r \), is equal to a half of its diameter, \( D \): \( r = \frac{D}{2} \).

**WORKED EXAMPLE 11**

Find the area of each of the following circles correct to 2 decimal places.

a [Circle with radius 20 cm]

b [Circle with radius 18 cm]

**THINK**

a 1 Write the formula for the area of a circle.

2 Substitute 20 for \( r \) and 3.14... for \( \pi \).

3 Evaluate (square the radius first) and include the correct units.

b 1 Write the formula for the area of a circle.

2 We need radius, but are given the diameter. State the relation between the radius and the diameter.

3 Halve the value of the diameter to get the radius.

**WRITE**

\[ A = \pi r^2 \]

\[ A = 3.14... \times 20^2 \]

\[ = 3.14... \times 400 \]

\[ = 1256.637... \]

\[ = 1256.64 \text{ cm}^2 \]

\[ D = 18; \ r = D \div 2 \]

\[ r = 18 \div 2 \]

\[ = 9 \]
Exercise 10.5 Area of a circle

**INIDIVIDUAL PATHWAYS**

**PRACTISE**
Questions: 1–3, 4a–d, 6, 9, 10

**CONSOLIDATE**
Questions: 1–3, 4a–f, 5, 6, 9, 10, 12

**MASTER**
Questions: 1a, c, f, 2b, d, 3a, c, 4–12

**FLUENCY**

1. Find the area of each of the following circles correct to 2 decimal places.

   - a
   - b
   - c
   - d
   - e
   - f

2. Find the area, correct to 2 decimal places, of:
   - a circle of radius 5 cm
   - a circle of radius 12.4 mm
   - a circle of diameter 28 m
   - a circle of diameter 18 cm.

**UNDERSTANDING**

3. The word *annulus* is the Latin word for *ring*. An annulus is the shape formed between two circles with a common centre (called concentric circles). To find the area of an annulus, calculate the area of the smaller circle and subtract it from the area of the larger circle. Find the area of the annulus, correct to 2 decimal places, for each of the following sets of concentric circles.
An annulus is the shaded area between the concentric circles.

\[ r_1 = \text{radius of smaller circle} \]
\[ r_2 = \text{radius of larger circle} \]
\[ \text{Area}_{\text{annulus}} = \pi r_2^2 - \pi r_1^2 \]

4 Find the area of each of the following shapes. Give your answers to 2 decimal places.
5 Find the minimum area of aluminium foil, correct to 2 decimal places, that could be used to cover the top of the circular tray with diameter 38 cm.

6 What is the area of material in a circular mat of diameter 2.4 m? Give your answer correct to 2 decimal places.

7 How many packets of lawn seed should Joanne buy to sow a circular bed of diameter 27 m, if each packet of seed covers 23 m²?

8 A landscape gardener wishes to spread fertiliser on a semicircular garden bed that has a diameter of 4.7 m. How much fertiliser is required if the fertiliser is applied at the rate of 20 g per square metre? Give your answer to the nearest gram.

**REASONING**

9 Investigate what happens to the diameter of a circle if its area is:
   a doubled
   b quadrupled
   c halved
   d changed by factor of \( n \).

10 Investigate what happens to the circumference of a circle if its area is:
   a doubled
   b quadrupled
   c halved
   d changed by factor of \( n \).

**PROBLEM SOLVING**

11 The total area of wood used to make a set of six identical round coasters is 425 cm².
   a Calculate the area of the wood used in each coaster.
   b Calculate the radius of each coaster correct to 2 decimal places.
   c An 8.5 cm wide cylindrical coffee mug is placed on one of the coasters. Use your answer to part b to decide whether it will fit entirely within the coaster’s surface.

12 Calculate the shaded area in each of the following shapes.

   a [Diagram of a circle with 20 cm and 38 cm radii]
   b [Diagram of a circle with a square cut out, 2 mm by 2 mm, and 7.5 mm radius]
   c [Diagram of a square with a side of 3.5 cm and a circle with the same radius]
10.6 Area of trapeziums

- A **trapezium** is a quadrilateral with one pair of parallel unequal sides.
- The following figures are all trapeziums.

- The height of the trapezium is perpendicular to each of its parallel bases.

To determine the area of a trapezium, draw two lines to create two triangles and one rectangle as shown.

Placing the two triangles together creates one triangle and one rectangle.

The total area of the two shapes, $A$, will give $A = a \times h + \frac{1}{2} \times h \times (b - a)$.

Simplifying this gives $A = \frac{1}{2}(a + b) \times h$.

- The area of a trapezium, $A$, is given by the formula $A = \frac{1}{2}(a + b) \times h$, where $a$ and $b$ are the lengths of parallel sides and $h$ is the height of the trapezium.

**WORKED EXAMPLE 12**

Find the area of the trapezium at right.

**THINK**

1. Write the formula for the area of the trapezium.
2. Identify the values of $a$, $b$ and $h$.

*Note: It does not matter which of the parallel sides is $a$ and which one is $b$, since we will need to add them together.*

**WRITE**

$A = \frac{1}{2}(a + b) \times h$

$a = 10$, $b = 6$ and $h = 4$
3 Substitute the values of \(a\), \(b\) and \(h\) into the formula.

\[
A = \frac{1}{2} \times (10 + 6) \times 4
\]

4 Evaluate (work out the brackets first) and include the correct units.

\[
A = \frac{1}{2} \times 16 \times 4 = 32 \text{ cm}^2
\]

Exercise 10.6 Area of trapeziums

**INDIVIDUAL PATHWAYS**

**PRACTISE**
Questions: 1–4, 9

**CONSOLIDATE**
Questions: 1b, d, e, f, 2, 3, 5, 7, 9, 10

**MASTER**
Questions: 1b, e, f, 2, 3–10

**FLUENCY**

1 WE12 Find the area of each of the following trapeziums.

a

\[
\begin{align*}
&3 \text{ cm} \\
&2 \text{ cm} \\
&6 \text{ cm}
\end{align*}
\]

b

\[
\begin{align*}
&9 \text{ m} \\
&4.5 \text{ m} \\
&6 \text{ m}
\end{align*}
\]

c

\[
\begin{align*}
&5.0 \text{ m} \\
&3.5 \text{ m} \\
&3.0 \text{ m}
\end{align*}
\]

d

\[
\begin{align*}
&14 \text{ mm} \\
&18 \text{ mm} \\
&25 \text{ mm}
\end{align*}
\]

e

\[
\begin{align*}
&8.0 \text{ cm} \\
&0.9 \text{ cm} \\
&2.4 \text{ cm}
\end{align*}
\]

f

\[
\begin{align*}
&50 \text{ m} \\
&48 \text{ m} \\
&80 \text{ m}
\end{align*}
\]

2 MC Which of the following is the correct way to calculate the area of the trapezium shown?

A \[
\frac{1}{2} \times (3 + 5) \times 11
\]

B \[
\frac{1}{2} \times (3 + 5 + 11)
\]

C \[
\frac{1}{2} \times (11 - 3) \times 5
\]

D \[
\frac{1}{2} \times (11 + 5) \times 3
\]

E \[
\frac{1}{2} \times (3 + 11) \times 5
\]

**UNDERSTANDING**

3 A dress pattern contains these two pieces.

\[
\begin{align*}
&30 \text{ cm} \\
&60 \text{ cm}
\end{align*}
\]

\[
\begin{align*}
&60 \text{ cm} \\
&47 \text{ cm}
\end{align*}
\]

Find the total area of material needed to make both pieces.
4 A science laboratory has four benches with the dimensions shown at right. What would be the cost, to the nearest 5 cents, of covering all four benches with a protective coating that costs $38.50 per square metre?

5 Stavros has accepted a contract to concrete and edge the yard, the dimensions of which are shown in the figure at right.

a What will be the cost, to the nearest 5 cents, of concreting the yard if concrete costs $28.00 per square metre?

b The yard must be surrounded by edging strips, which cost $8.25 per metre. Find:
   i the cost to the nearest 5 cents, of the edging strips
   ii the total cost of materials for the job.

6 The side wall of this shed is in the shape of a trapezium and has an area of 4.6 m². Find the perpendicular distance between the parallel sides if one side of the wall is 2.6 m high and the other 2 m high.

7 **MC** Two trapeziums have corresponding parallel sides of equal length. The height of the first trapezium is twice as large as the height of the second. The area of the second trapezium is:

A twice the area of the first trapezium  \[ \text{B} \] half the area of the first trapezium

C quarter of the area of the first trapezium  \[ \text{D} \] four times the area of the first trapezium

E impossible to say

**REASONING**

8 The formula for the area of a trapezium can be proved by dividing it into two triangles as shown.

a Find the area of triangle 1 in terms of the pronumerals shown in the diagram.

b Find the area of triangle 2 in terms of the pronumerals shown in the diagram.

c Find the area of the trapezium by adding the areas of the two triangles together.

**PROBLEM SOLVING**

9 A section of a garden is in the shape of a trapezium as shown.

a Calculate the area of this section of the garden.

b This section of the garden is to be covered with mulch. According to the information on the pack, each bag contains enough mulch to cover 5 m² of surface. How many bags of mulch are needed to complete the job?

c If each bag costs $8.95, calculate the total cost of the mulch.
10.7 Volume of prisms and other solids

Volume
- Volume is the amount of space inside a three-dimensional object.
- Volume is measured in cubic units such as mm$^3$, cm$^3$ or m$^3$.
- Volume units can be converted using the chart below.

Prisms
- Prisms are solid shapes with identical opposite polygonal ends which are joined by straight edges. They are three-dimensional objects that can be cut into identical ‘slices’, called cross-sections.
- Prisms are named according to the shape of their cross-section. The objects below are all prisms.

- Objects that do not have a uniform cross-section cannot be classified as prisms. For example, the objects below are not prisms.
• The volume of any prism is given by the formula \( V = A \times H \), where \( A \) is the cross-sectional area of a prism and \( H \) is the height of a prism.
• The volume of a rectangular prism is given by the formula \( V = lwh \), where \( l \) is the length, \( w \) is the width and \( h \) is the height of the prism.
• A rectangular prism can be cut to form two equal triangular prisms.
• The volume of a cube is given by the formula \( V = l^3 \), where \( l \) is the side length of a cube.
• The height of the prism is not necessarily the height of the object in a true sense of the word. It is just the dimension perpendicular to the cross-section.

\[
V = A \times H
\]

The base of this prism, \( A \), is its cross-section; \( H \) is the height of the prism.

\[
V = A \times H
\]

The base of this prism is not its cross-section. \( H \) represents the depth (or length) of the prism; \( A \) is its cross-section.

**Volume of solids with uniform cross-section that are not prisms**

• The objects with a uniform cross-section whose ends are not polygons (that is, those whose ends are not joined by straight edges) cannot be classified as prisms. For example, the shapes below are not prisms, even though they have uniform cross-sections.

• The formula \( V = AH \), where \( A \) is the cross-sectional area and \( H \) is the dimension perpendicular to it, will give the volume of any solid with uniform cross-section, even if it is not a prism.

**WORKED EXAMPLE 13**

Find the volume of each of the following. Give answers correct to 2 decimal places where appropriate.

**a**

[Diagram of a cylinder with height 5 cm and radius 5 cm]

**b**

[Diagram of a triangular prism with height 8 cm, base 7 cm, and slant height 12 cm]

**c**

[Diagram of a frustum with height 7 cm and base area 13 cm²]
THINK

a 1 Write the formula for the volume of the given shape.

2 Identify the shape of the cross-section and, hence, write the formula to find its area.

3 State the value of \( r \).

4 Substitute the value of \( r \) into the formula and evaluate.

5 State the value of \( H \).

6 To find the volume, multiply the cross-sectional area by the height and include the correct units.

b 1 Write the formula for the volume of a prism.

2 Identify the shape of the cross-section and, hence, write the formula to find its area.

3 State the values of the variables.
(Note: \( h \) is the height of the triangle, not of the prism.)

4 Substitute the values of \( b \) and \( h \) into the formula and evaluate.

5 State the value of \( H \), the height of the prism.

6 To find the volume of the prism, multiply the cross-sectional area by the height and include the correct units.

c 1 Write the formula for the volume of the given shape.

2 State the values of the cross-sectional area and the height of the shape.

3 Multiply the cross-sectional area by the height and include the correct units.

WRITE

a \[ V = A \times H \]

\[ A_{\text{circle}} = \pi r^2 \]

\( r = 3 \)

\[ A = 3.14 \ldots \times 3^2 = 28.27 \ldots \text{cm}^2 \]

\( H = 5 \)

\[ V = 28.27 \ldots \times 5 = 141.37 \ldots \]

\( = 141.37 \text{ cm}^3 \)

b \[ V = A \times H \]

\[ A_{\text{triangle}} = \frac{1}{2}bh \]

\( b = 7, h = 8 \)

\[ A = \frac{1}{2} \times 7 \times 8 = 28 \text{ cm}^2 \]

\( H = 12 \)

\[ V = 28 \times 12 = 336 \text{ cm}^3 \]

c \[ V = A \times H \]

\( A = 13, H = 7 \)

\[ V = 13 \times 7 = 91 \text{ cm}^3 \]
Exercise 10.7  Volume of prisms and other solids

INDIVIDUAL PATHWAYS

- **PRACTISE**
  Questions: 1, 2a, d, g, j, 3, 4, 7, 10

- **CONSOLIDATE**
  Questions: 1, 2b, e, h, k, 3, 5, 6, 8, 10, 11

- **MASTER**
  Questions: 1, 2b, c, i, l, 4–12

REFLECTION
How can you say if a solid has a uniform cross-section?

FLUENCY
1. Which of the three-dimensional shapes below are prisms?
   - a
   - b
   - c
   - d
   - e

2. **WE13** Find the volume of each of the following. Give your answers to 2 decimal places where appropriate.
   - a
   - b
   - c
   - d
   - e
   - f
   - g
   - h
   - i
   - j
   - k
   - l
UNDERSTANDING

3 What volume of water will a rectangular swimming pool with dimensions shown in the photograph below hold if it is completely filled? The pool has no shallow or deep end. It is all the same depth.

4 How many cubic metres of cement will be needed to make the cylindrical foundation shown in the figure at right? Give your answer to 2 decimal places.

5 What are the volumes of these pieces of cheese?
   a

   b

6 What is the volume of the bread bin shown at right? Give your answer to the nearest whole number.
7 How much water will this pig trough, with dimensions shown in the figure at right, hold if it is completely filled? Give your answer in litres to 1 decimal place. 

(Hint: 1 litre $= 1000 \text{ cm}^3$.)

**REASONING**

8 The areas of the three sides of a rectangular box are as shown in the figure. What is the volume of the box? Show all of your working.

9 A vase is shaped like a rectangular prism with a square base of length 11 cm. It has 2 litres of water poured into it. To what height (to 1 decimal place) does the water reach in the vase? Show your working. 

(Hint: 1 litre $= 1000 \text{ cm}^3$.)

**PROBLEM SOLVING**

10 A new (unsharpened) pencil is in the shape of a hexagonal prism. If the area of the hexagonal end is 80 mm$^2$ and the volume of the whole pencil is 14.4 cm$^3$, calculate the length of the pencil.

11 Consider a set of three food containers of different sizes, each of which is in the shape of a rectangular prism.

The smallest container is 6 cm long, 4 cm wide and 3 cm high. All the dimensions of the medium container are double those of the smallest one; all the dimensions of the largest container are triple those of the smallest one.

a Calculate the volume of the smallest container.

b State the dimensions and hence calculate the volume of:

i the medium container

ii the largest container.

c Calculate the ratio of the volumes of:

i the smallest container to the medium container

ii the smallest container to the largest container.

d Consider your answers to part c and use them to copy and complete the following:

If all dimensions of a rectangular prism are increased by factor of $n$, the volume of the prism is increased by a factor of _______.

---

**Measurement and Geometry**

**Topic 10** — Measurement 307
12 A set of cabin tents is being made for a historical documentary. The dimensions of each tent are shown.

a Calculate the area of material required to make each tent, including the floor.

b Calculate the amount of space inside the tent.

10.8 Time

Time — an introduction

• Time is one of our most useful systems of measurement. We can use it to work out how long we have been doing something, or how long we have until we must do something. We can use it to make future arrangements.

• Time is something we all use, every day.

• Time is divided into units. There are:

60 seconds  in  1 minute
60 minutes  in  1 hour
24 hours    in  1 day
7 days      in  1 week
2 weeks     in  1 fortnight
about 4 weeks in 1 month
12 months   in  1 year
about 365 days in 1 year
10 years    in  1 decade
100 years   in 1 century
1000 years  in 1 millennium.

• We also use the word time to refer to an instant (for example, 3 o’clock) rather than a period.
• A clock or watch can display the time in one of two ways.
  – Some clocks display the time in analogue form using hour, minute and second hands that move continuously as they point to numbers on the clock face.
  – Other clocks and watches display a set of digits that change in steps as time passes.

### Time calculations

#### WORKED EXAMPLE 14

**How many minutes are there in \(4 \frac{1}{4}\) hours?**

**THINK**

1. Convert the mixed number to an improper fraction.
2. Multiply the improper fraction by the number of minutes in 1 hour.
3. Evaluate.

**WRITE**

\[
\begin{align*}
4 \frac{1}{4} \text{ hours} &= \frac{4 \times 4 + 1}{4} \\
&= \frac{17}{4} \text{ hours} \\
\frac{17}{4} \text{ hours} &= \frac{17}{4} \times 60 \text{ minutes} \\
&= \frac{1020}{4} \text{ minutes} \\
&= 255 \text{ minutes}
\end{align*}
\]

#### WORKED EXAMPLE 15

**How many minutes are there in 5 days?**

**THINK**

1. Convert the number of days to hours, that is, multiply 5 by 24 hours.
2. Evaluate.
3. Convert the number of hours to minutes, that is, multiply 120 by 60 minutes.
4. Evaluate.

**WRITE**

\[
\begin{align*}
5 \text{ days} &= 5 \times 24 \text{ hours} \\
&= 120 \text{ hours} \\
120 \text{ hours} &= 120 \times 60 \\
&= 7200 \text{ minutes}
\end{align*}
\]

#### WORKED EXAMPLE 16

**Change the following into hours and minutes.**

a. 300 minutes  
   b. 425 minutes

**THINK**

a. 1. Convert minutes to hours, that is, divide 300 by 60.
    2. Evaluate.

b. 1. Convert minutes to hours, that is, divide 425 by 60.
    2. Evaluate.
    3. Write the answer in hours and minutes.

**WRITE**

\[
\begin{align*}
a. \quad 300 \text{ minutes} &= 300 \div 60 \\
&= 5 \text{ hours} \\
b. \quad 425 \text{ minutes} &= 425 \div 60 \\
&= 7 \text{ remainder } 5
\end{align*}
\]

\[
425 \text{ minutes} = 7 \text{ hours } 5 \text{ minutes}
\]
• The suffixes am and pm are used to indicate morning and afternoon, and are derived from ‘ante meridiem’ (meaning before midday) and ‘post meridiem’ (after midday).

*Note:* Noon (or midday) may be written as 12.00 pm, and midnight may be written as 12.00 am.

• One way to find time differences is to mentally calculate how long it is to the next hour, then to the next noon or midnight. The following worked example illustrates this technique.

**WORKED EXAMPLE 17**

Find the time difference between:

a 7.15 pm and 10.25 pm
b 2.50 am and 8.20 pm
c 3.40 am on Tuesday and 5.10 pm on Wednesday (next day).

**THINK**

a 1 Construct a vertical column starting at 7.15 pm and ending at 10.25 pm. Set up two columns with the headings ‘hours’ and ‘minutes’ next to the first time.

2 Write key times between the start and finish times.

3 Calculate the times added to get each key time, and write them under the hours and minutes headings as shown.

4 Add the time differences to find the total time difference.

5 Convert any minute values over 60 to hours and minutes and adjust the answer.

6 Answer the question.

b Repeat steps 1 to 6 in part a.

c Repeat steps 1 to 6 in part a.

**WRITE**


<table>
<thead>
<tr>
<th></th>
<th>Hours</th>
<th>Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.15 pm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.00 pm</td>
<td></td>
<td>45</td>
</tr>
<tr>
<td>10.25 pm</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total time</strong></td>
<td><strong>2</strong></td>
<td><strong>70</strong></td>
</tr>
<tr>
<td></td>
<td><strong>= 3</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

The time difference is 3 hours 10 minutes.

b

<table>
<thead>
<tr>
<th></th>
<th>Hours</th>
<th>Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.50 am</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.00 am</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>12.00 pm</td>
<td>9</td>
<td>00</td>
</tr>
<tr>
<td>8.20 pm</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total time</strong></td>
<td><strong>17</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

The time difference is 17 hours 30 minutes.

c

<table>
<thead>
<tr>
<th></th>
<th>Hours</th>
<th>Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.40 am Tuesday</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.00 am Tuesday</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>4.00 am Wednesday</td>
<td>24</td>
<td>00</td>
</tr>
<tr>
<td>12.00 pm Wednesday</td>
<td>8</td>
<td>00</td>
</tr>
<tr>
<td>5.10 pm Wednesday</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total time</strong></td>
<td><strong>37</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

The time difference is 37 hours 30 minutes.
Exercise 10.8  Time

INDIVIDUAL PATHWAYS

<table>
<thead>
<tr>
<th>PRACTISE</th>
<th>CONSOLIDATE</th>
<th>MASTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questions: 1–7, 8a, d, g, 9a, d, g, 10, 11, 12a, c, 13–16, 24, 26, 27</td>
<td>Questions: 1–7, 8b, e, h, 9b, e, h, 10a, d, g, i, l, 11, 12b, d, 13–18, 22, 24–28</td>
<td>Questions: 1–5, 6b, e, h, 7c, f, i, 8c, f, i, 9c, g, h, i, 10c, h, i, k, 11a, g, k, 12b, d, 13–29</td>
</tr>
</tbody>
</table>

RELECTION What strategies will you use to help you remember how to convert between different units of time?

FLUENCY

1 Match the following activities with the most likely amount of time.
   a  a cricket test match  1 year
   b  writing your name  10 seconds
   c  eating breakfast  15 minutes
   d  building a house  5 days
   e  flying time from Melbourne to Hong Kong  7 hours
   f  being in Year 7  6 months

2 What are the times shown on each of the following analogue clocks?

   a
   b
   c
   d
   e
   f

3 For each of the following, draw a 12-hour clock face and show the time.
   a  8.20 am
   b  8.45 pm
   c  10.50 am
   d  12.00 am
   e  11.05 pm
   f  5.11 pm
   g  7.32 pm
   h  9.24 am
   i  11.16 am

4 Today we use clocks and watches to tell the time. Name two other devices that have been used in the past to measure time.

5 Explain the difference between 2 hours 25 minutes and 2.25 hours.
6 WE14,15 How many minutes are there in each of the following periods?
   a 2 hours       b 2\(\frac{1}{2}\) hours       c 3\(\frac{1}{4}\) hours       d \(\frac{1}{2}\) hour
   e \(\frac{3}{4}\) hour       f 7\(\frac{3}{4}\) hours       g 1 day       h 9 days

7 WE16 Change the following to hours and minutes.
   a 200 minutes       b 185 minutes       c 160 minutes
   d 230 minutes       e 405 minutes       f 95 minutes
   g 610 minutes       h 72 minutes       i 305 minutes

Change the following to minutes.
   a 1 hour 15 minutes       b 2 hours 10 minutes       c 1 hour 50 minutes
   d 4 hours 25 minutes       e 7 hours 35 minutes       f 3 hours 12 minutes
   g 16\(\frac{1}{4}\) hours       h 5\(\frac{1}{4}\) hours       i 6\(\frac{1}{4}\) hours

9 How many:
   a days in a week?       b weeks in a year?
   c seconds in a minute?       d seconds in an hour?
   e seconds in a day?       f hours in a day?
   g hours in a year?       h minutes in a year?
   i minutes in a year?

Note: Assume 1 year = 365 days.

10 What is the time:
   a 1 hour after 4.00 pm?
   b 1 hour before 4.00 pm?
   c 1 hour after 5.30 am?
   d 1 hour 20 minutes after half past 10 am?
   e 1 hour 20 minutes before 10.00 am?
   f 3 hours 18 minutes after 2.00 pm?
   g 2 hours 30 minutes before 4.30 am?
   h 4 hours 35 minutes after quarter to 10 am?
   i 4 hours 35 minutes before 10.05 pm?
   j 5 hours 27 minutes after 1.08 am?
   k 5 hours 27 minutes before 1.08 am?
   l 1 hour 10 minutes before 11.30 am?

11 WE17a,b Find the time difference between:
   a 8.20 pm and 8.35 pm       b 4.15 pm and 5.20 pm
   c 7.15 am and 8.28 am       d 5.17 am and 6.32 am
   e 9.15 pm and 10.08 pm       f 3.16 pm and 5.09 pm
   g 11.28 pm and midnight       h 9.21 am and 1.06 pm
   i 11.10 am and 4.25 pm       j 6.05 am and 6.05 pm
   k half past 6 pm and quarter to 3 am.

12 WE17c Find the time difference between:
   a 7.20 am on Monday and 6.30 pm the next day, Tuesday
   b 4.38 am on Saturday and 1.25 pm the next day, Sunday.
   c 8.45 pm on Wednesday and 10.16 am the next day, Thursday
   d 1.20 pm on Wednesday and 9.09 am the first Friday.
13 **MC** 225 minutes is the same as:
   A 2 hours 25 minutes  B 2 hours 15 minutes  C 3 hours 45 minutes
   D 3 hours 25 minutes  E 2 hours 45 minutes

14 **MC** If the time was 8.45 pm, what would be the time 5 hours 20 minutes later?
   A 1.05 am  B 1.05 pm  C 2.05 pm  D 2.05 am  E 1.10 pm

15 **MC** If a train takes 2 hours and 18 minutes to arrive at its destination and it arrives at 6.03 pm, at what time did it leave?
   A 3.45 pm  B 8.21 pm  C 4.15 pm  D 3.21 pm  E 3.45 am

**UNDERSTANDING**

16 If it takes Joanne 16 minutes to write one page of a letter, how long will it take her to write a letter of three pages?

17 Mathew spends half an hour doing homework each week night. How many hours of homework has he done after 3 weeks?

18 If the time is now 7.55 am in Melbourne, what is the time in Adelaide if South Australian time is half an hour behind Victorian time?

19 If the time is now 8.30 am in Melbourne, what is the time in Perth if Western Australia is two hours behind Victoria?

20 If the time is 9.45 pm in Perth, what is the time in Melbourne? (See question 19.)

21 If the time is 10.05 pm in Adelaide, what is the time in Melbourne? (See question 18.)

22 If Susan takes 25 minutes to walk to the station, waits for the train for 7 minutes, travels on the train for 12 minutes and then takes 8 minutes to walk to her friend’s house, how long has she taken altogether?

23 If James spends 35 minutes on Friday, 2 hours and 12 minutes on Saturday and 1\frac{3}{4} hours on Sunday to complete his assignment, how much time did he take altogether?

**REASONING**

24 In a mirror reflection, the time on an analogue clock face appears to be 25 minutes to 2. What time is it?

25 When would an analogue clock and its mirror image appear exactly the same? Explain your answer.

**PROBLEM SOLVING**

26 You have a training schedule for tennis. If you follow the schedule, how long will you train each week?

---

**Tennis training**
Monday 0630 – 0745
Friday 1650 – 1825
27 You are allowed to stay up until 10:30 pm on Saturday night. What time will you need to start a DVD if you watch:
   a Finding Nemo (97 minutes)?
   b Aladdin (86 minutes)?
   c Star Wars (124 minutes)?

28 A classmate attempted to calculate some time differences. Explain where he may have gone wrong in his calculations and then find the correct answers.
   a 2240
      − 2005
      \[\begin{array}{c}
      235 \text{ min}
      \end{array}\]
   b 9:22
      − 7:38
      \[\begin{array}{c}
      1:84
      \end{array}\]

29 The battery on your new MP3 player is supposed to last for 10 hours. If you listen to music on your MP3 player for 40 minutes per day, how many days will the battery last until you have to charge it again?

10.9 24-hour clock and time zones
- Sometimes the time is given using a 24-hour system or 24-hour clock.
- The hours are numbered from 1 to 24, beginning at midnight.
- The times from midnight to 12.59 pm look very similar to the 12-hour time. At 1.00 pm you need to add 12 hours, making the time 1300 hours.
- Times in the 24-hour system are written as ‘fourteen hundred hours’ (1400) or ‘twenty-three thirty hours’ (2330).
- Notice that in 24-hour time, we always use 4 digits. Some examples are given in the table below.

<table>
<thead>
<tr>
<th>12-hour time</th>
<th>24-hour time</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.00 am</td>
<td>0600 hours</td>
</tr>
<tr>
<td>10.00 am</td>
<td>1000 hours</td>
</tr>
<tr>
<td>12.30 pm</td>
<td>1230 hours</td>
</tr>
<tr>
<td>2.00 pm</td>
<td>1400 hours (add 12 hours to 2.00)</td>
</tr>
<tr>
<td>8.00 pm</td>
<td>2000 hours (add 12 hours to 8.00)</td>
</tr>
<tr>
<td>11.30 pm</td>
<td>2330 hours (add 12 hours to 11.30)</td>
</tr>
</tbody>
</table>

**Worked Example 18**

Find the difference in hours and minutes between the following 24-hour times:
   a 0635 and 2150
   b 1055 and 1543.

**THINK**
   a 1 Set up two columns with the headings ‘hours’ and ‘minutes’.
   2 Write the values, putting the highest hour value first.
   3 Calculate by subtraction.
   4 Write as hours and minutes.

**WRITE**
   a Hours Minutes
      21 50
      06 35
      15 15

15 hours 15 minutes
b 1 Set up two columns with the headings ‘hours’ and ‘minutes’.
2 Write the values, putting the highest hour value first.
3 You cannot take 55 minutes from 43 minutes. Convert 1 hour into 60 minutes and add it to the minutes column. Then rewrite 15 43 as 14 103. (Using 14 103 helps us to do the subtraction, but it is not a real time.)
4 Calculate by subtraction.
5 Write as hours and minutes.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>103</td>
</tr>
<tr>
<td>10</td>
<td>55</td>
</tr>
<tr>
<td>4</td>
<td>48</td>
</tr>
</tbody>
</table>

4 hours 48 minutes

Time zones

• Time changes as we travel around the world. In Europe it is night time when in Australia it is day and it is day time in Europe when we have night.
• To help everyone know what time it is in different countries, the world is divided into 24 time zones. (See the map showing world time zones on page 322.)

<table>
<thead>
<tr>
<th>Time in Perth</th>
<th>Time in Melbourne</th>
<th>Time in Jakarta</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.00 pm</td>
<td>5.00 pm</td>
<td>2.00 pm</td>
</tr>
<tr>
<td>6.00 pm</td>
<td>8.00 pm</td>
<td>5.00 pm</td>
</tr>
<tr>
<td>10.00 am</td>
<td>12 midnight</td>
<td>9.00 am</td>
</tr>
<tr>
<td>10.00 pm</td>
<td>12 midnight</td>
<td>9.00 pm</td>
</tr>
</tbody>
</table>

• If we travel east, we need to set our watches ahead.
• If we travel west, we need to set our watches back.
• Australia is divided into three time zones.
  – Queensland, New South Wales, the ACT, Victoria and Tasmania observe Eastern Standard Time (EST).
  – The Northern Territory and South Australia observe Central Standard Time (CST), which is ½ hour behind EST.
  – Western Australia observes Western Standard Time (WST), which is 2 hours behind EST.
• The time in England is called Greenwich Mean Time (GMT) and is 10 hours behind EST.

<table>
<thead>
<tr>
<th>Time in London (GMT)</th>
<th>Time in Jakarta</th>
<th>Time in Perth</th>
<th>Time in Melbourne (EST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.00 am</td>
<td>2.00 pm</td>
<td>3.00 pm</td>
<td>5.00 pm</td>
</tr>
<tr>
<td>4.00 pm</td>
<td>11.00 pm</td>
<td>Midnight</td>
<td>2.00 am (next day)</td>
</tr>
<tr>
<td>Midday</td>
<td>7.00 pm</td>
<td>8.00 pm</td>
<td>10.00 pm</td>
</tr>
<tr>
<td>Midnight</td>
<td>7.00 am</td>
<td>8.00 am</td>
<td>10.00 am</td>
</tr>
<tr>
<td>3.00 am</td>
<td>10.00 am</td>
<td>11.00 am</td>
<td>1.00 pm</td>
</tr>
</tbody>
</table>
Daylight-saving time

- Many countries around the world have daylight-saving time during summer so that people can make the most of the warm weather.
- When daylight-saving time begins, clocks are turned forward by 1 hour at 2.00 am.
- At the end of daylight-saving time, the clocks are then turned back by 1 hour at 3.00 am.
- In Australia, the states Queensland and Western Australia, and the Northern Territory do not observe daylight-saving time, while the ACT and other states do.
- During daylight-saving, the time in Tasmania, Victoria, New South Wales and ACT is known as Eastern Daylight-Saving Time (EDT). The time in South Australia is known as Central Daylight-Saving Time (CDT).
- During daylight-saving time:
  - Queensland (EST) is 1 hour behind EDT.
  - Northern Territory (CST) is $1\frac{1}{2}$ hours behind EDT.
  - South Australia (CDT) is $\frac{1}{2}$ hour behind EDT.
  - Western Australia (WST) is 3 hours behind EDT.

WORKED EXAMPLE 20

You call your friend in Darwin on Christmas Day from your home in Sydney. It is 7 pm in Sydney. What time is it in Darwin?

THINK

1. Because it is Christmas Day (the middle of summer), Sydney time will be at EDT, which is $1\frac{1}{2}$ hours ahead of Darwin time (CST).

2. Subtract $1\frac{1}{2}$ hours from the Sydney time to give the time in Darwin.

WRITE

Sydney time is EDT and Darwin time is CST. The time in Sydney is $1\frac{1}{2}$ hours ahead of the time in Darwin.

Time in Darwin = 7 pm − 1 h 30 min

= 5.30 pm
Exercise 10.9  24-hour clock and time zones

INDIVIDUAL PATHWAYS

**PRACTISE**
Questions:
1, 2a, d, g, j, 3a, d, g, j, 4a, c, e, g, i, 5–11, 12a, d, g, 13a, d, g, j, 14, 16, 17, 21, 24

**CONSOLIDATE**
Questions:
1, 2b, e, h, 3b, e, h, k, 4b, d, f, h, 5–11, 12b, e, h, k, 13b, e, h, k, 14, 15, 17, 18, 20, 22, 24, 25

**MASTER**
Questions:
1, 2c, f, i, l, 3c, f, i, l, 4a, e, h, 5–11, 12c, f, i, l, 13c, f, i, l, 14, 15, 19–25

**FLUENCY**

1 Match the 12-hour times with the appropriate 24-hour times.
   - 10.12 am  1212  Noon  1120
   - 12.12 pm  1200 11.20 pm  0000
   - Midnight  1012 11.20 am  2320

2 Write each of the following times using the 24-hour clock.
   - a 10.20 am  b 11.30 am  c 5.10 am
   - d 4.15 am  e 5.15 pm  f 6.30 pm
   - g 8.30 am  h 8.40 pm  i Midday
   - j 11.30 pm  k 4.35 am  l 2.30 pm

3 Convert each of the following 24-hour times to 12-hour time.
   - a 2315  b 1310  c 0815
   - d 0115  e 1818  f 1220
   - g 0005  h 1005  i 2005
   - j 1135  k 1520  l 1414

4 Find the difference between each of the following times. (The first time is the earlier time in each case.)
   - a 1005 and 2315  b 1000 and 1215
   - c 1430 and 1615  d 1530 and 1615
   - e 1023 and 2312  f 1135 and 1440
   - g 0820 and 1550  h 0712 and 2008
   - i 1455 and 0015

5 Mary-Jane always arrived at school at 0855 and left at 1526. How long was she at school?

6 Peter wished to record a movie on video. He had a 180-minute tape and a 240-minute tape. The film he wished to record started at 2030 and finished at 2345.  
   - a How long was the movie?
   - b Which tape should Peter use?

7 An aircraft left the airport at 0920 and arrived at its destination at 1305. How long was the flight?

8 A clock shows the time as 1543. What is the correct time if it is known that the clock is 33 minutes slow?
   - A 1576  B 1616  C 1510
   - D 1516  E 1606
9 **MC** A clock shows the time as 2345. What is the correct time if it is known that the clock is 27 minutes slow?

A 2318  
B 2372  
C 2412  
D 0042  
E 0012

10 **MC** A clock shows the time 0857. What is the correct time if it is known that the clock is 48 minutes fast?

A 0809  
B 0811  
C 0945  
D 0805  
E 0905

11 **MC** A clock shows the time 1004. What is the correct time if it is known that the clock is 31 minutes fast?

A 1035  
B 0935  
C 0973  
D 1013  
E 0933

12 **WE19a** What is the time in Melbourne if the time in London (GMT) is as given below?

a 11.00 am  
b 12.30 pm  
c 10.20 am  
d Midnight  
e 2.15 am  
g 3.30 pm  
h 5.45 pm  
i 8.10 am  
j 9.35 pm  
k 1.12 pm  
l 1.12 am?

13 **WE19b** What is the time in London (GMT) if the time in Melbourne is as given below?

a 3.30 am  
b Noon  
c Midnight  
d 5.50 pm  
e 6.40 am  
f 7.20 pm  
g 11.10 am  
h 1325  
i 1550  
j 0615  
k 1855  
l 1935?

14 **WE20** You call your friend in Adelaide on Christmas Day from your home in Cairns, Queensland. It is 5 pm in Cairns. What time is it in Adelaide?

UNDERSTANDING

15 Jamie has made a schedule for football training. He will start exercising at 0615 and stop at 0705. He will also train from 1600 until 1810. For how long will Jamie train each day?
16 **MC** If Suzie wanted to telephone her friend in England before he went to work for the day, what would be the best time for her to ring from Melbourne, Australia?

- **A** 0700
- **B** 1700
- **C** 1900
- **D** 2100
- **E** 2300

17 If the time was 5.00 am in London, what would the time be in:
- **a** Perth?
- **b** Melbourne?
- **c** Jakarta?

18 If the time was 8.00 pm in Perth, what would the time be in:
- **a** London?
- **b** Melbourne?
- **c** Jakarta?

19 If the time was 3.30 pm in Jakarta, what would the time be in:
- **a** London?
- **b** Perth?
- **c** Melbourne?

20 Joe lives in Perth. He wants to ring his brother who lives in Hobart, and his parents who live in Darwin at 1 minute to midnight on New Year’s Eve. What time (Perth time) should he make each call?

21 Using the internet and the preceding map of time zones of the world, investigate other countries in the world that are in the same time zones as Australia. List three cities in other countries that are in the same time zone as Australian capital cities.

**REASONING**

22 Jessica and Connor have to catch the airport train at 8.20 am so they will be on time to catch their plane at the airport. Jessica’s watch is 10 minutes fast, but she thinks it is 5 minutes slow. Connor’s watch is 10 minutes slow, but he thinks it is 10 minutes fast. Each leaves home expecting to arrive at the station just in time to catch the train. Do they both catch the train? Show your working.

**PROBLEM SOLVING**

23 A flight from Melbourne to Perth can take 4 hours. If your flight departs Melbourne airport at 2:10 pm (EST), at what time will you arrive in Perth (WST)?

24 A plane flew a direct route from Melbourne to London. Some of the details of the trip are listed below.
- Departure date: Friday 5 August
- Departure time: 8:00 am
- Flight time: 25 hours

- **a** What was the time and date in Melbourne when the plane arrived in London?
- **b** What was the local time (UTC) when the plane arrived?
10.10 Review

The Maths Quest Review is available in a customisable format for students to demonstrate their knowledge of this topic. The Review contains:

- **Fluency** questions — allowing students to demonstrate the skills they have developed to efficiently answer questions using the most appropriate methods.
- **Problem Solving** questions — allowing students to demonstrate their ability to make smart choices, to model and investigate problems, and to communicate solutions effectively.

A summary on the key points covered and a concept map summary of this chapter are also available as digital documents.

### Review questions

Download the Review questions document from the links found in your eBookPLUS.

### Language

It is important to learn and be able to use correct mathematical language in order to communicate effectively. Create a summary of the topic using the key terms below. You can present your summary in writing or using a concept map, a poster or technology.

<table>
<thead>
<tr>
<th>24-hour clock</th>
<th>diameter</th>
<th>radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>annulus</td>
<td>EST</td>
<td>sphere</td>
</tr>
<tr>
<td>area</td>
<td>GMT</td>
<td>square pyramid</td>
</tr>
<tr>
<td>circumference</td>
<td>metric units</td>
<td>time</td>
</tr>
<tr>
<td>cone</td>
<td>perimeter</td>
<td>time zones</td>
</tr>
<tr>
<td>CST</td>
<td>pi (π)</td>
<td>volume</td>
</tr>
<tr>
<td>daylight saving</td>
<td>prism</td>
<td>WST</td>
</tr>
</tbody>
</table>

Link to assessON for questions to test your readiness FOR learning, your progress AS you learn and your levels OF achievement.

assessON provides sets of questions for every topic in your course, as well as giving instant feedback and worked solutions to help improve your mathematical skills.

www.assesson.com.au

Link to SpyClass, an exciting online game combining a comic book–style story with problem-based learning in an immersive environment.

Join Jesse, Toby and Dan and help them to tackle some of the world’s most dangerous criminals by using the knowledge you’ve gained through your study of mathematics.

www.spyclass.com.au
InVESTIGatION

rICH TASK

Designing a skate park

Skateboarding is an extremely popular activity. Skateboard parks are constructed in many areas for enthusiasts to demonstrate their skills and practise new moves. Two popular pieces of equipment in skate parks are ramps known as the half-pipe and the quarter-pipe. Your local council has decided to build a skate park in your area. The park will have, among the collection of permanent equipment, a half-pipe ramp and a quarter-pipe ramp. You have been asked to provide precise diagrams and measurements to assist in the building of these two structures.
Two different views of your quarter-pipe design are shown below with measurements. The ramp section is made from metal and its length is equivalent to the arc length of a quarter circle with a radius of 2 m.

1. What is the length of the curved part of the ramp?
2. Use a scale diagram to estimate the length of the diagonal metal supports within the frame.
3. Calculate the combined area of the timber backboard, landing platform and the curved section of the ramp.
4. The frame is made from strong square metal piping. If there are 10 horizontal supports in the frame, what is the total length of metal piping used in the construction?
5. How many times will a wheel of a skateboard turn on the curved section of the ramp, given that the diameter of the skateboard wheel is 55 mm?

Your design for the half-pipe contains two quarter-pipes separated by a 2-metre flat section. The quarter-pipes contain the same measurements shown earlier.
6. Draw a side-on view of your half-pipe showing all relevant measurements.
7. What is the total area of metal required to construct the skating section of the half-pipe and landing platforms?
8. Construct a scale model of your design. Your teacher will provide you with materials to use.
Two Australians who have won at Wimbledon

Calculate the areas of the figures below to give the puzzle’s answer code.

- **A**: 8 cm
- **B**: 6 cm
- **C**: 11 cm
- **D**: 12 cm
- **E**: 4 cm
- **F**: 6 cm
- **G**: 3 cm
- **H**: 22 cm
- **I**: 20 cm
- **J**: 4 cm
- **K**: 16 cm
- **L**: 8 cm
- **M**: 9 cm
- **N**: 17 cm
- **O**: 10 cm
- **P**: 5 cm
- **Q**: 13 cm
- **R**: 7 cm
- **S**: 12 cm
- **T**: 6 cm
- **U**: 4 cm
- **V**: 6 cm
- **W**: 10 cm

Answer Codes:

- 55
- 44
- 60
- 66
- 48
- 119
- 54
- 39.25
- 50.24
- 64
- 72
- 24
- 63
Activities

10.2 Perimeter
Digital docs
- SkillSHEET (doc-6956) Multiplying and dividing by powers of 10
- SkillSHEET (doc-6957) Converting units of length
Interactivity
- IP interactivity 10.2 (int-4438) Perimeter

10.3 Circumference
Digital doc
- Investigation (doc-2318) The diameter of a circle and its circumference — any connection?
Interactivity
- IP interactivity 10.3 (int-4439) Circumference

10.4 Area of rectangles, triangles, parallelograms, rhombuses and kites
Digital docs
- SkillSHEET (doc-6958) Areas of squares, rectangles and triangles
- Investigation (doc-2319) Area of a parallelogram
Interactivity
- IP interactivity 10.4 (int-4440) Area of rectangles, triangles, parallelograms, rhombuses and kites

10.5 Area of a circle
Digital doc
- Investigation (doc-2321) Area of a circle
Interactivity
- IP interactivity 10.5 (int-4441) Area of a circle

10.6 Area of trapeziums
Digital docs
- Investigation (doc-2320) Area of a trapezium
- WorkSHEET 10.1 (doc-2322)
Interactivity
- IP interactivity 10.6 (int-4442) Area of trapeziums

10.7 Volume of prisms and other solids
Digital docs
- SkillSHEET (doc-6959) Volumes of cubes and rectangular prisms
- Spreadsheet (doc-2324) Volume of a prism
- Interactivity
- Volume of prisms (int-2754)
Interactivity
- IP interactivity 10.7 (int-4443) Volume of prisms and other solids

10.8 Time
Digital docs
- SkillSHEET (doc-6960) Reading the time (from analogue clocks)
- Spreadsheet (doc-3445) Time differences
Interactivity
- IP interactivity 10.8 (int-4444) Time

10.9 24-hour clock and time zones
Digital docs
- SkillSHEET (doc-6961) 24-hour clock
- WorkSHEET 10.1 (doc-6932)
- Spreadsheet (doc-3447) 12-h to 24-h time
- Spreadsheet (doc-3448) 24-h to 12-h time
- Spreadsheet (doc-3449) Time zones
Interactivities
- Time zones (int-0006)
- IP interactivity 10.9 (int-4445) 24-hour clock and time zones

10.10 Review
Digital docs
- Word search (int-2756)
- Crossword (int-2757)
- Sudoku (int-3189)
Interactivities
- Topic summary
- Concept map

To access eBookPLUS activities, log on to www.jacplus.com.au
**Answers**

**TOPIC 10 Measurement**

### 10.2 Perimeter

1. a $20$ mm = $2$ cm  
   b $13$ mm = $1.3$ cm  
   c $130$ mm = $13$ cm  
   d $1.5$ cm = $15$ mm  
   e $0.03$ cm = $0.3$ mm  
   f $2.8$ km = $2800$ m  
   g $0.034$ m = $3.4$ cm  
   h $2400$ mm = $240$ cm = $2.4$ m  
   i $1375$ mm = $137.5$ cm = $1.375$ m  
   j $2.7$ m = $270$ cm = $2700$ mm  
   k $0.08$ m = $80$ mm  
   l $6.071$ km = $6071$ m  
   m $670$ cm = $6.7$ m  
   n $0.0051$ km = $5.1$ m  

2. a $14$ cm  
   b $12$ cm  
   c $106$ mm  
   d $18$ cm  
   e $240$ mm  
   f $32$ mm  
   g $23$ cm  
   h $72$ mm  
   i $73$ mm  
   j $1260$ cm (12.6 m)  
   k $192$ cm (1.92 m)  
   l $826$ cm  

3. a $1800$ mm $\times 900$ mm = $180$ cm $\times 90$ cm = $1.8$ m $\times 0.9$ m  
   b $2400$ mm $\times 900$ mm = $240$ cm $\times 90$ cm = $2.4$ m $\times 0.9$ m  
   c $2700$ mm $\times 1200$ mm = $270$ cm $\times 120$ cm = $2.7$ m $\times 1.2$ m  

4. $5.40$  

5. $38.16$  

6. $41400$ m or $41.4$ km  

7. a $7$ m  
   b $86$ m  
   c $980$ cm  
   d $86$ cm  

8. a $510$ m  
   b $749.70$  

9. $15.88$  

10. a $11$ cm  
    b $22$ cm  
    c $6.9$ m  

11. a $55$ m  
    b $20$ cm  
    c $2$ bottles  

12. $5.5$ m  

13. a $258$ m  
    b $174$ m  

14. a $217$ m  
    b $2w + 2l + 4h +$ bow  

15. a $\pi 2r$  
    b $\pi 10r$  
    c $\pi 7r$  
    d $\pi 0.82r$  
    e $\pi 7.4r$  
    f $\pi 35r$  

16. a $\pi 8$ m  
    b $\pi 34r$  
    c $\pi 16r$  
    d $\pi 2.86r$  
    e $\pi 0.8r$  
    f $\pi 21.2r$  

17. a $241.90$ km  
    b $37.70$ m  
    c $150.80$ mm  
    d $3.36$ m  
    e $194.78$ mm  
    f $1256.64$ m  

4. a $25.71$ cm  
   b $82.27$ mm  
   c $61.70$ m  
   d $39.28$ mm  
   e $71.42$ cm  
   f $120.82$ cm  
   g $5.88$ m  
   h $252.81$ cm  
   i $252.81$ cm

5. B  

6. C  

7. $55.29$ m  

8. $100.53$ m  

9. $119.38$ mm  

10. $25.13$ m  

11. a $6.00$ m  
    b $20.63$ cm  
    c $23.75$ mm  

12. a $2.01$ cm  
    b $7.54$ m  
    c $24.99$ mm  

13. $21.58$ cm  

14. $19.19$ m  

15. $15.71$ m  

16. $41.82$ km/h  

17. $9.55$ cm  

18. a i $ii$  
    b $i$  
    c $iv$  
    d $ii$  

19. a $25.71$ cm  
    b $483.29$ mm  
    c $31.07$ m  
    d $5.71$ cm  

20. $80$ m  

21. a $60^\circ = \frac{1}{6}$ of circle. Therefore, length of curved line $= \frac{1}{6} \times 2\pi r$  
   and $P = 30.47$ cm.  
   b Length of arc $= 2\pi \times \frac{89}{360}$, use a diagram to calculate the length of the straight edge. $P = 13.74$ cm  

### Challenge 10.1

$25.13$ cm$^2$

### 10.4 Area of rectangles, triangles, parallelograms, rhombuses and kites

1. a $530000$ m$^2$  
   b $2.35$ cm$^2$  
   c $254000$ mm$^2$  
   d $54.2$ m$^2$  
   e $0.074$ m$^2$  
   f $3$ km$^2$  
   g $9.8563$ ha  
   h $17800$ m$^2$  
   i $987000$ mm$^2$  
   j $1275000$ cm$^2$  

2. a $36$ cm$^2$  
   b $1125$ mm$^2$  
   c $4.5$ m$^2$  
   d $1215$ km$^2$  
   e $2.5$ m$^2$  
   f $336$ mm$^2$  

3. a $25$ mm$^2$  
   b $256$ cm$^2$  
   c $5.29$ m$^2$  

4. C  

5. B  

6. a $1258$ mm$^2$  
   b $1771.54$ m$^2$  
   c $9932.63$ mm$^2$  
   d $17537$ cm$^2$  
   e $11566.8$ m$^2$  
   f $257.645$ m$^2$  

7. a $275$ mm$^2$  
   b $24000$ m$^2$  
   c $656$ cm$^2$  
   d $11.04$ m$^2$  
   e $2.7$ m$^2$  
   f $2400$ mm$^2$  

8. a $30$ cm$^2$  
   b $24$ cm$^2$  
   c $90$ cm$^2$  

9. a $42.65$ m$^2$, $60.81$ m$^2$, $42.65$ m$^2$  
   b $146.11$ m$^2$
10 351.98 cm²
11 a 15000 m²
b 60000 m²
12 a 15.64 m²  b 3
13 42 cm
14 a 400 m  b 375 min or 6⅔ h
15 50.4 cm²
16 2052 m²
17 D
18 17.28 cm²
19 1584 cm²
20 a 3.6 cm  b 9.2 cm
21 \( b = h = 9.5 \text{ cm} \)

Area of \( \triangle ABC = \frac{1}{2} \times \text{base} \times \text{height} \)
\[ = \frac{1}{2} \times a \times \frac{1}{2}b \]
\[ = \frac{1}{4} a \times b \]

Area of rhombus \( ABCD = 2 \times \text{area of } \triangle ABC \)
\[ = 2 \times \frac{1}{4} a \times b \]
\[ = \frac{1}{2} a \times b \]

23 \( A_K = \frac{1}{2} a \times b \)

24 Answers will vary. Examples are given.
a Length = 12 cm, width = 3 cm
b Base = 4 cm, height = 9 cm
c Diagonals 12 cm and 6 cm

25 a

Area of \( \triangle ABC = \frac{1}{2} \times \text{base} \times \text{height} \)
\[ = \frac{1}{2} \times \frac{1}{2}a \times \frac{1}{2}b \]
\[ = \frac{1}{4} a \times b \]

Area of rhombus \( ABCD = 2 \times \text{area of } \triangle ABC \)
\[ = 2 \times \frac{1}{4} a \times b \]
\[ = \frac{1}{2} a \times b \]

26 a 212500 km²
b 227600 km²
c Because Victoria is not a triangle
d Divide Victoria into smaller regular shapes.

10.5 Area of a circle
1 a 452.39 cm²  b 4.91 km²
c 2.27 m²  d 0.38 cm²
e 10568.32 cm²  f 206.12 mm²
2 a 78.54 cm²  b 483.05 mm²
c 615.75 m²  d 254.47 cm²
3 a 37.70 cm²  b 1281.77 cm²
c 3189.50 m²  d 50.04 cm²
4 a 157.08 cm²  b 0.39 cm²
c 201.06 mm²  d 1.875 m²
e 39.27 cm²  f 1039.08 cm²
g 77.91 cm²  h 132.54 cm²
i 9.74 cm²

5 1134.11 cm²
6 4.52 m²
7 25 packets
8 173 g
9 a Diameter changes by a factor of 1.414 (\( = \sqrt{2} \)).
b Diameter changes by a factor of 2.
c Diameter changes by a factor of \( \frac{1}{\sqrt{2}} \).
d Diameter changes by a factor of \( \frac{1}{\sqrt{3}} \).
10 a Circumference changes by a factor of 1.414 (\( = \sqrt{2} \)).
b Circumference changes by a factor of 2.
c Circumference changes by a factor of \( \frac{1}{\sqrt{2}} \).
d Circumference changes by a factor of \( \frac{1}{\sqrt{3}} \).
11 a \( A = 70.83 \text{ cm}² \)
b \( r = 4.75 \text{ cm} \)
c The diameter of the coaster is larger than that of the mug, so the coffee mug will fit within the coaster’s surface.
12 a 3279.82 cm²  b 40.18 mm²
c 21.87 cm²  d 54.64 mm²
e 0.75 m²

10.6 Area of trapeziums
1 a 9 cm²  b 33.75 cm²
c 12.75 cm²  d 351 mm² (3.51 cm²)
e 4.68 cm²  f 3120 m²
2 E
3 3062 cm²
4 $88.30
5 a $2730.55  b $332.50
   i $3063.05
   ii $3063.05
6 2 m
7 B
8 a \( A_1 = \frac{1}{2}bh \)
   b \( A_2 = \frac{1}{2}bh \)
   c \( A = A_1 + A_2 + = \frac{1}{2}bh \)
   d \( A = \frac{1}{2}ah \)
   e \( \frac{1}{2}bh \)
9 a 31.15 cm²  b 7  c $62.65
10 a \( 85.2 + \frac{121\pi}{4} \text{ cm}² \)
    b 132.72 cm²

10.7 Volume of prisms and other solids
1 b and e
2 a 84 cm³  b 81 m³
c 14137.17 cm³  d 31415.93 cm³
e 667.98 m³  f 4778.36 cm³
g 84 cm³  h 120 cm³
i 320 m³  j 120 cm³
k 7.5 cm³  l 1.875 m³
3 1200 cm³
4 60.32 m³
5 a 60 cm³  b 84 cm³
6 7380 cm³
7 18.6 L
8 Length 18 cm, width 15 cm and height 10 cm. Volume is 2700 cm³.
9 16.5 cm
10 18 cm
11 a 72 cm³
   b i 12 cm long, 8 cm wide, 6 cm high; \( V = 576 \text{ cm}³ \)
   ii 18 cm long, 12 cm wide, 9 cm high; \( V = 1944 \text{ cm}³ \)
   c i : 8  ii : 27
d If all dimensions of a rectangular prism are increased by a factor of \( n \), the volume of the prism is increased by a factor of \( n^3 \).
12 a 29.40 m²
   b 10.5 m³

Challenge 10.2
297 m²
10.8 Time

1 a-f A cricket test match — 5 days, writing your name — 10 seconds, eating breakfast — 15 minutes, building a house — 6 months, flying time from Melbourne to Hong Kong — 7 hours, being in Year 7 — 1 year.

2 a 5 o'clock
c 23 minutes past 7
e 14 minutes past 9
b 4 minutes past 5
d 5 minutes past 1
f 13 minutes past 7

3 a d
b c

c a
b d

e b
d c
f b
g d
h f
i b

4 Sundial and hourglass

5 2.25 hours = $2\frac{1}{4}$ hours, which is 2 hours and 15 minutes

6 a 120
d 30
g 1440
e 45
f 465
h 12960
7 a 3 h 20 min
c 2 h 40 min
e 6 h 45 min
g 10 h 10 min
d 3 h 31 min
e 465 min
f 3600
g 52
h 1440

10.9 24-hour clock and time zones

1 10.12 am = 1012, 12.12 pm = 1212, Midnight = 0000, Noon = 1200, 11.20 pm = 2320, 11.20 am = 1120

2 a 1020
c 0510
e 1715
g 0830
i 1200
k 0435
b 1130
d 0415
f 1830
h 2040
j 2330
l 1430

3 a 11.15 pm
c 8.15 am
e 6.18 pm
g 12.05 am
i 8.05 pm
k 3.20 pm
b 11.10 pm
d 1.15 am
f 12.20 pm
h 10.05 am
j 11.35 am
l 2.14 pm

4 a 13 h 10 min
c 1 h 45 min
e 12 h 49 min
g 7 h 30 min
i 9 h 20 min
d 2 h 15 min
f 45 min
h 3 h 5 min

5 a 3 h 15 min
e 3 h 45 min
b B
d E
f 10
h 11
12 a 9.00 pm  b 10.30 pm  c 8.20 pm  d 10 am (next day)  e 10 pm  f 12.15 pm  g 1.30 am (next day)  h 3.45 am (next day)  i 6.10 pm  j 7.35 am (next day)  k 11.12 pm  l 11.12 am

13 a 5.30 pm (previous day)  b 2.00 am  c 2.00 pm  d 7.50 am  e 8.40 pm (previous day)  f 9.20 am  g 1.10 am  h 0325  i 0550  j 2015 (previous day)  k 0855  l 0935

14 5.30 pm

15 3 hours

16 B

17 a 1 pm  b 3 pm  c 12 pm  d 10 pm  e 7 pm

18 a Midday  b 10 pm  c 7 pm

19 a 8.30 am  b 4.30 pm  c 6.30 pm

20 Brother 8.59 pm, parents 10.29 pm

21 Answers could include:
- Perth — Singapore, Kuala Lumpur, Cebu City in the Philippines,
- Denpasar in Bali
- Brisbane — Port Moresby in Papua New Guinea.

22 Connor misses the train by 20 minutes.

23 4.10 pm

24 a 9.00 am on 6 August  b 11.00 pm on 5 August

Investigation — Rich task
1 3.14 m
2 2.5 m
3 13.35 m²
4 44.4 m
5 18.18 times

6

7 28.2 m²
8 Teacher to check.

Code puzzle
Cash and Hewitt