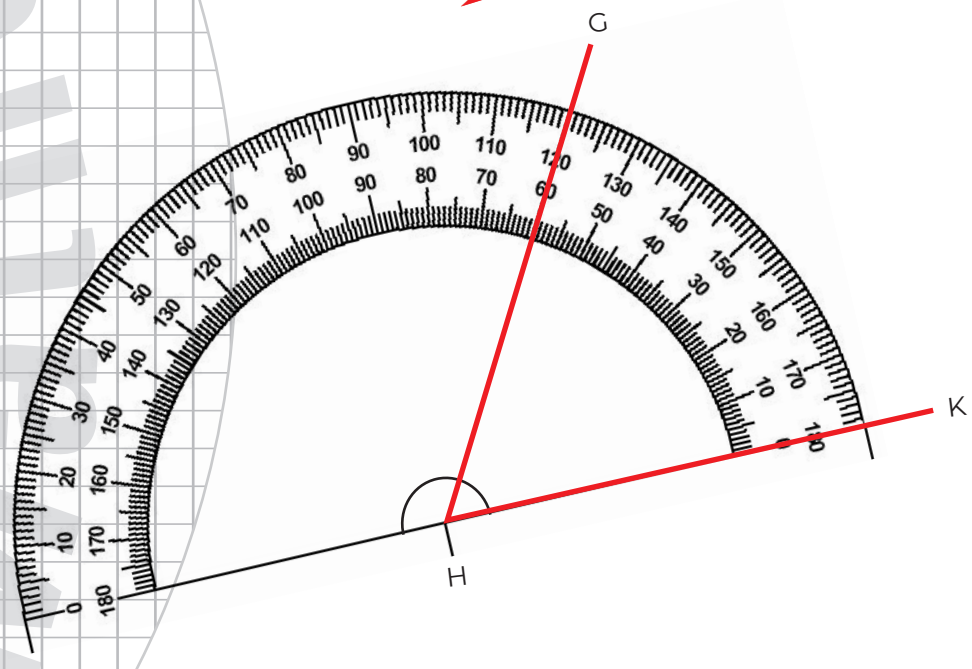
Measurement Review Guide



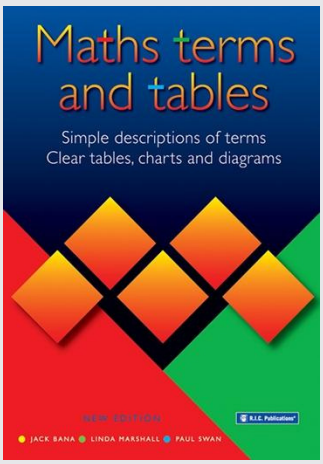
Paul Swan, Linda Marshall

Measurement Review Guide

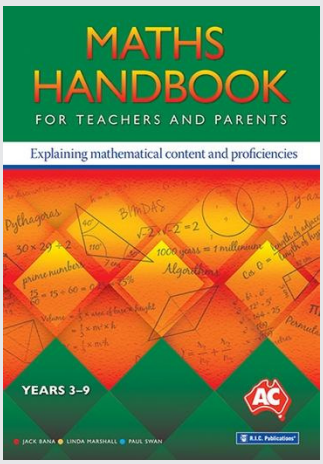
*The intention of this **Guide** is to assist in reviewing your understanding of Measurement concepts. The booklet is divided into aspects of Measurement: **Length, Area, Volume, Capacity, Mass and Time.** Test yourself on the **Measurement Check** before you read through the rest of the guide. Once you have checked your answers, work through the sections where you need assistance.*

Paul Swan, Linda Marshall

** For further support, see:*



Dictionary of Maths words Years 4 - 9, with pictures and examples



Explanations and worked examples of maths problems Years 4 - 8

Table of Contents

Measurement Check

*Test yourself on the **Measurement Check** before you read through the rest of the guide. Once you have checked your answers, work through the sections where you need assistance.*

Length

Circle one answer for each question

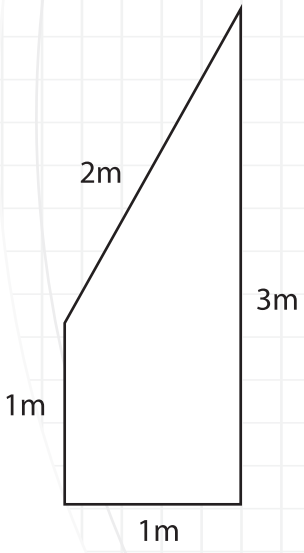
1. 27 millimetres is the same as:
   a. 0.27 centimetres
   b. 2.7 centimetres
   c. 27 centimetres
   d. 270 centimetres
   e. 2700 centimetres

2. The twelve year old was 1.54 metres tall. We could say he was:
   a. 0.0154 centimetres tall
   b. 0.154 centimetres tall
   c. 1.54 centimetres tall
   d. 15.4 centimetres tall
   e. 154 centimetres tall

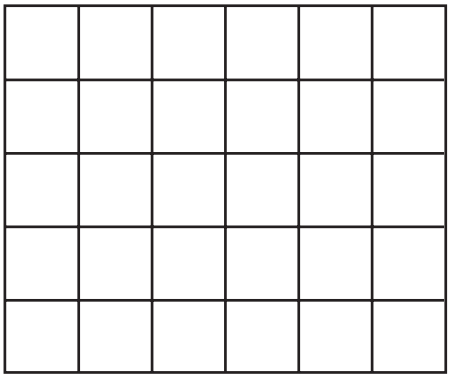
3. Helen jogged 2 785 metres. How many kilometres did she jog?
   a. 2 785 km
   b. 278.5 km
   c. 27.85 km
   d. 2.785 km
   e. None of these

4. Arrange these lengths 0.006 km, 2 752 mm, 6.47 m and 38.9 cm from smallest to largest. Is it:
   a. 2 752 mm, 38.9 cm, 6.47 m, 0.006 km
   b. 38.9 cm, 2 752 mm, 0.006 km, 6.47 m
   c. 0.006 km, 6.47 m, 38.9 cm, 2 752 mm
   d. 6.47 m, 0.006 km, 38.9 cm, 2 752 mm
   e. None of these

5. The perimeter of this garden bed is:
   a. 7 m
   b. Between 2 m^2 and 3 m^2
   c. 6 m
   d. Between 4 m and 5 m
   e. Can't tell

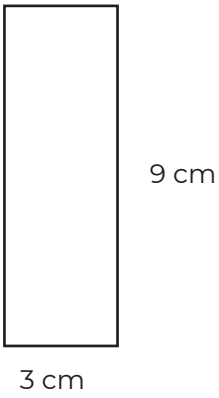


6. What is the perimeter of this rectangle?



   a. 18 units
   b. 19 units
   c. 22 units
   d. 30 units
   e. none of these

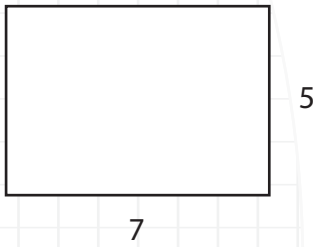
7. The perimeter of this rectangle is:



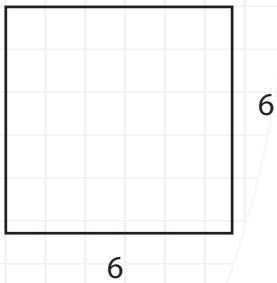
   a. 54 cm
   b. 27 cm
   c. 24 cm
   d. 12 cm
   e. none of these

8. Which rectangle has the greatest perimeter?

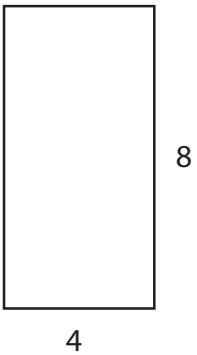
a)



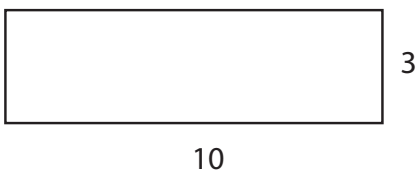
b)



c)



d)

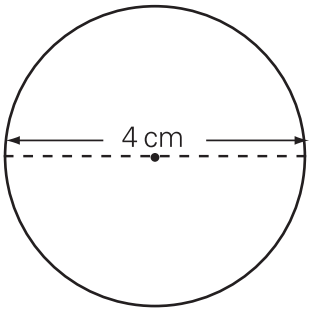


   e. They are all the same

Length

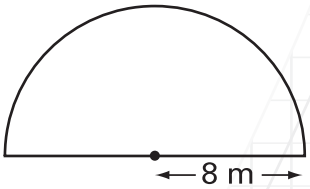
9. The circumference of the circle shown is approximately:

   a. 6 cm
   b. 12 cm
   c. 24 cm
   d. 48 cm
   e. None of these



10. The perimeter of this semi-circular garden bed is approximately:

   a. 32 m
   b. 64 m
   c. 48 m
   d. 24 m
   e. 40 m

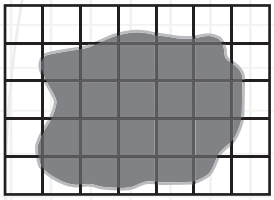


11. How long is this line? Measure it in **mm** and **cm**.

Area

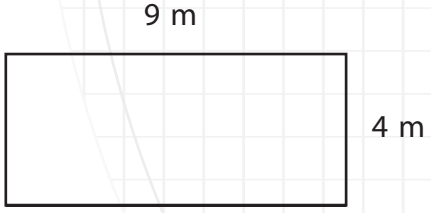
1. The area of the shaded region is about:

   a. 10 square centimetres
   b. 18 square centimetres
   c. 23 square centimetres
   d. 25 square centimetres
   e. None of these



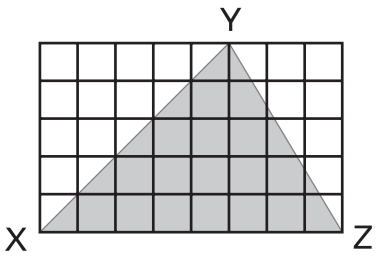
2. What area of lawn could be planted in the rectangular plot shown?

   a. 72 square metres
   b. 36 square metres
   c. 26 square metres
   d. 13 square metres
   e. None of these



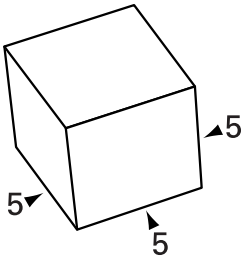
3. What is the area of the triangle XYZ if each small square is one unit?

   a. 13 units
   b. 14 units
   c. 26 units
   d. 40 units
   e. None of these



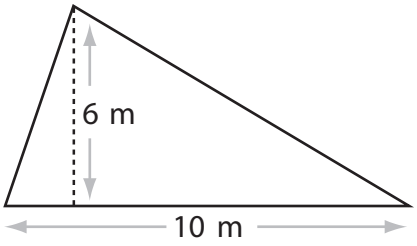
4. How much paper is needed to completely cover the box (cube)?

   a. 75 square units
   b. 100 square units
   c. 125 square units
   d. 150 square units
   e. None of these



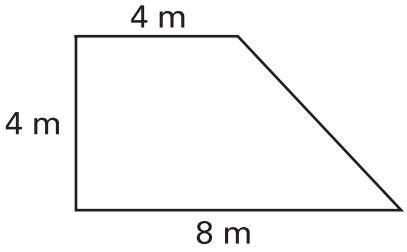
5. What is the area of this triangle?

   a. 15 square units
   b. 30 square units
   c. 60 square units
   d. 120 square units
   e. None of these



6. A brass plate has the dimensions shown. What is its area?

   a. 12 cm^2
   b. 16 cm^2
   c. 24 cm^2
   d. 32 cm^2
   e. 128 cm^2



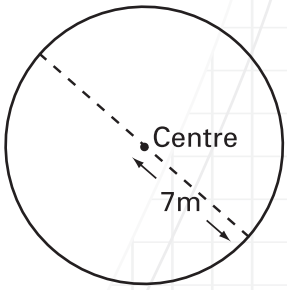
7. A vegetable garden is 12 square metres. A gardener made a new garden by making each edge double those of the original garden.
   The area of the new garden is:

   a. 48 m^2
   b. 36 m^2
   c. 28 m^2
   d. 24 m^2
   e. 14 m^2

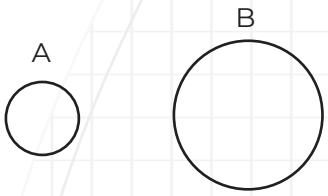
Area

8. A farm is rectangular in shape with lengths 1.6 km and 0.6 km. Find the area of the farm in hectares?
   a. 0.96 hectares
   b. 9.6 hectares
   c. 96 hectares
   d. 960 hectares
   e. 9 600 hectares

9. The area of the circle drawn here is approximately:
   a. 20 m^2
   b. 45 m^2
   c. 90 m^2
   d. 150 m^2
   e. None of these

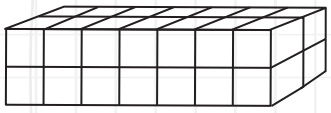


10. When the diameter of circle B is double the diameter of circle A, the area of the circle B compared to the area of circle A is:
   a. half
   b. double
   c. three times
   d. four times
   e. None of these



Volume

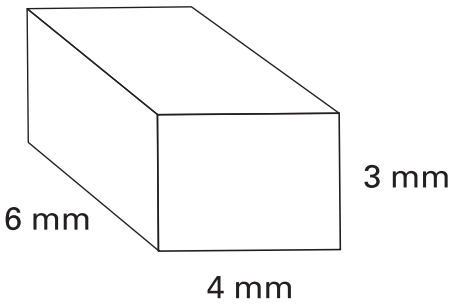
1. The diagram below represents a rectangular prism made up of identical cubes. How many small identical cubes are there?
   a. 14
   b. 18
   c. 28
   d. 36
   e. None of these



2. 1 cubic metre (m^3) is equivalent to:
   a. 1 000 cm^3
   b. 10 000 cm^3
   c. 100 000 cm^3
   d. 1 000 000 cm^3
   e. None of these

3. The volume of the rectangular prism drawn here is:

   a. 12 mm^3
   b. 13 mm^3
   c. 26 mm^3
   d. 52 mm^3
   e. None of these

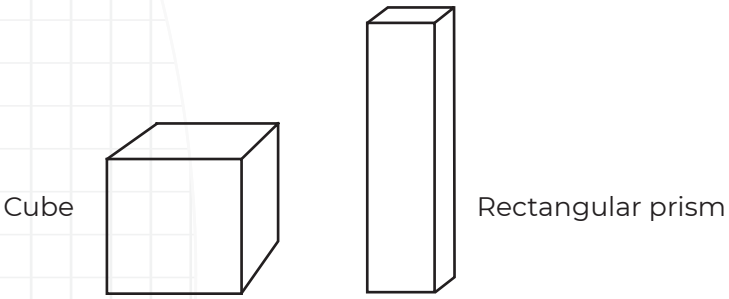


4. A hollow rectangular prism has a capacity of 32 litres. To make a container of double this capacity a person made a new prism, the lengths of each edge being double those of the original prism.

   The capacity of the new prism is:

   a. 64 litres
   b. 96 litres
   c. 128 litres
   d. 256 litres
   e. None of these

5. Two boxes with lids were made from **equal amounts** of the same cardboard. One was made into a cube, the other into a rectangular prism as shown in the diagram below:



   When the two boxes were completely filled with sand:

   a. the cube held more sand than the rectangular prism;
   b. the cube held the same amount of sand as the rectangular prism;
   c. the cube held less sand than the rectangular prism;
   d. cannot tell without the lengths of the sides being supplied to each figure.
   e. the cube held exactly twice as much sand.

Capacity

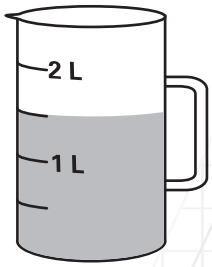
1. Jill drank 0.25 litres of fruit juice.

   How many millilitres of juice did she drink?

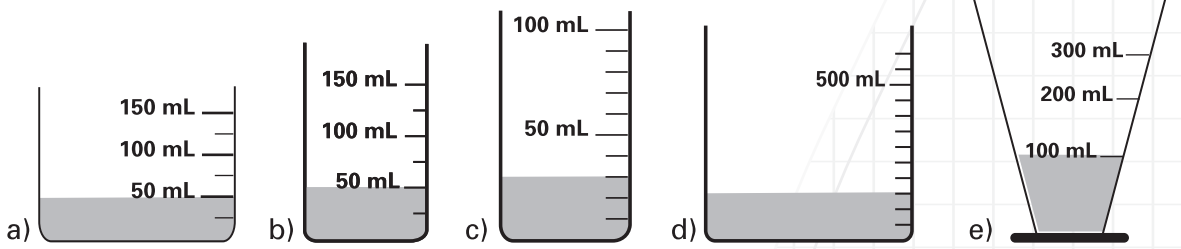
   a. 0.25 mL
   b. 2.5 mL
   c. 25 mL
   d. 250 mL
   e. None of these

2. The amount of water in this jug is

   a. half a litre.
   b. one litre.
   c. one and a half litres.
   d. two litres.
   e. We can't tell from the diagram.



3. Which container has the least liquid?



4. A water tank has a capacity of 4.75 kilolitres.

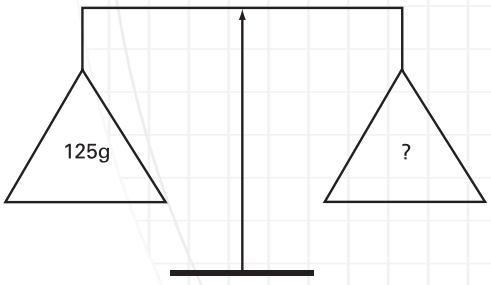
   How many litres does the water tank hold when it is full?

   a. 475 L
   b. 4075 L
   c. 4750 L
   d. 47500 L
   e. We can't tell from the information given.

Mass

1. For the pans to balance what mass must be put in the right hand pan?

   a. 0.125 mg
   b. 0.125 kg
   c. 1.25 kg
   d. 12.5 kg
   e. None of these



2. When compared with his mass and weight on Earth an astronaut on the Moon has:
   a. approximately the same mass, less weight
   b. approximately the same weight, less mass
   c. approximately the same weight, approximately the same mass
   d. approximately the same mass, greater weight
   e. None of these

Time

1. What time is shown on this clock?
   a. 2 past 4
   b. 12 past 4
   c. 4 past 2
   d. 4 to 3
   e. None of these

2. A train was due at 12.50 am but it was 100 minutes early. At what time did it arrive?
   a. 1.50 am
   b. 2.30 am
   c. 11.10 pm
   d. 11.50 pm
   e. None of these

3. Robert arrived at the Smithtown bus terminal at 9.15 pm.
   How long did he have to wait to catch a bus into Perth?
   a. 0 minutes
   b. 2 minutes
   c. 32 minutes
   d. 45 minutes
   e. None of these

BUS TIMETABLE PERTH – SMITHTOWN

FROM PERTH			TO PERTH		
0713	1520	1840	0640	1040	1658
0750	1545	1945	0710	1200	1725
0845	1618	2115	0730	1325	1807
1000	1645	2220	0745	1435	1912
1122	1709	2325	0805	1503	2147
1245	1730	-	0830	1600	2252
1410	1800	-	0917	1622	-

4. When she went to bed, Ella's bedside clock showed the time as:

Her watch showed the correct time thus:

When her alarm went off at 6:25 the next morning, the correct time was:

a. 6 o'clock
b. 5 past 6
c. ten past six
d. six thirty-five
e. half past six

End of Measurement Check

Turn to the next page to check your answers

Answers to Measurement Check

Length

1. b)
2. e)
3. d)
4. b)
5. a)
6. c)
7. c)
8. d)
9. b)
10. e)
11. 170 mm /17cm

Area

1. b)
2. b)
3. e) (20 Units)
4. d)
5. b)
6. c)
7. a)
8. c)
9. d)
10. d)

Volume

1. c)
2. d)
3. e) (72 mm^2)
4. d)
5. a)

Capacity

1. d)
2. c)
3. d)
4. c)

Mass

1. b)
2. a)

Time

1. b)
2. c)
3. c)
4. d)

How did you do?

Use the section indicators to locate the sections you would like to improve on.

Review Section

- Length
- Area
- Volume
- Capacity
- Mass
- Time

Conversions

There are 10 millimetres in 1 centimetre

10 mm = 1 cm

1 mm = $^{1}/_{10}$ cm or 0.1 cm

Therefore

1 mm = 0.1 cm
5 mm = 0.5 cm
8 mm = 0.8 cm

If you measured a line and found it measured 22 millimetres, then you could say that it measured just over 2 centimetres.

20 mm = 2 cm
2 mm = 0.2 cm
22 mm = 2.2 cm
(This is the same as dividing 22 by 10)

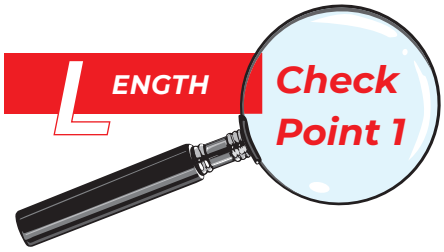
We could also change centimetres into millimetres.

4.6 cm = 4 cm + 0.6 cm

1 cm = 10 mm
Then 4 cm = 40 mm
0.6 cm = 6 mm
4.6 cm = 46 mm
(This is the same as multiplying by 10)

8.2 cm could be rewritten as
8.2 x 10 = 82 mm

When converting from a large unit to smaller units you would expect there to be more of the smaller units.



Measuring Length

1. Measure the following segments and record your answer in millimetres. Then rewrite your answer in centimetres.
   a. _____
   b. _____
   c. ___

Converting Lengths

2. Rewrite the following lengths in centimetres.
   a. 83 mm
   b. 50 mm
   c. 8 mm

3. Rewrite the following lengths in millimetres.
   a. 8.7 cm
   b. 5 cm
   c. 0.3 cm

More Conversions

Other units of measure to look at are metres and kilometres

A length of one metre is equal to 100 centimetres.

1 m = 100 cm

Measure out 100 cm to see how long a metre is. See if you could also make a metre long stride. For most people metre strides are strange because we don't normally walk using metre strides.

Sometimes we come across distances expressed as decimals.

2.34 metres

We know we have two whole metres and a little more.

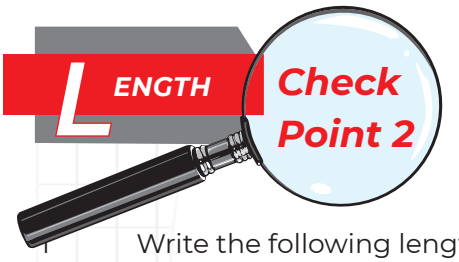
0.34 metres converts to $^{34}/_{100}$
34 out of 100 metres = 34 cm
So 2.34 metres = 2 m 34 cm

We now can convert metres to centimetres.

2 m = 200 cm (Multiplying by 100)
2.34 m = 234 cm

We can also convert centimetres to metres.

200 cm = 2 m (Dividing by 100)
234 cm = 2.34 m



1 Write the following lengths in metres.

a. 400 cm
b. 1 000 cm
c. 2 400 cm
d. 723 cm
e. 306 cm
f. 470 cm

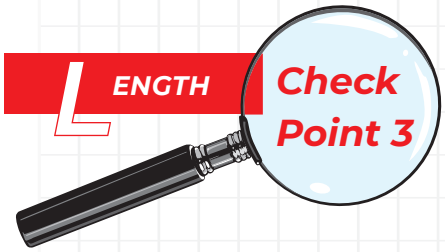
2 Write the following lengths in cm.

a. 2 m
b. 18 m
c. 4.23 m
d. 5.03 m
e. 9 m
f. 11.3 m

54 centimetres can also be expressed as part of a metre. 54 centimetres is less than 1 metre. Therefore, we have 0 whole metres and 54 centimetres. If there are 100 centimetres in a metre, then 54 centimetres represents the fraction $\frac{54}{100}$.

$\frac{54}{100}$ converts to 0.54

Therefore 54 centimetres = 0.54 metre.
If you think about it, you are using the skill of dividing by 100.



1. Write these lengths in metres.
   a. 70 cm
   b. 7 cm
   c. 524 cm
   d. 231.4 cm
   e. 84.3 cm
   f. 7.8 cm

2. Order these lengths from smallest to largest.

(a)	256 cm	2.45 m	0.24 m	2926 mm
(b)	296 mm,	296 cm	2.92 m	0.294 m.

So far we have studied these measurement facts.

10 mm = 1 cm
100 cm = 1 m

Then it must be that:

1000 mm = 1 m

You can now express metres as millimetres and millimetres as metres.

2 m	= 2 x 1000	= 2000 mm
5 m	= 5 x 1000	= 5000 mm
2.456 m	= 2.456 x 1000	= 2456 mm

Notice we are using the skill of multiplying by 1000 to convert metres to millimetres.

You can now express metres as millimetres

2000 mm = 2000 ÷ 1000 = 2 m
5000 mm = 5000 ÷ 1000 = 5 m
2456 mm = 2456 ÷ 1000 = 2.456 m

Here we are using the skill of dividing by 1000.

Another way of thinking about this type of conversion
is to change the millimetres (mm) into thousandths of a metre.

245 mm is not a whole metre.
It is only a part of a metre.

There are 1000 mm in 1 metre, so 245 mm is equal to 245 out of 1000 or $\frac{245}{1000}$.
This converts to 0.245 m

To measure long distances we use kilometres.

1000 m = 1 km

Therefore 2 km = 2000 m (multiplying by 1000)
5 km = 5000 m
5.5 km = 5.5 x 1000 = 5 500 m

You can also convert metres to kilometres.

5 000 m = 5 000 ÷ 1000 = 5 km
2 256 m = 2 256 ÷ 1000 = 2.256 km
792 m = 792 ÷ 1000 = 0.792 km

If you are skilled at multiplying by 10, 100, 1000 and dividing by 10, 100, 1000 then you should find these conversions relatively easy.

So far we have seen...

10 mm = 1 cm
100 cm = 1 m
1000 mm = 1 m

LENGTH Check Point 4

1. What unit of measure would you use to measure the following lengths, distance and objects?

   a. The length of a room
   b. Your height
   c. The distance between Perth and Bunbury
   d. The gap needed in a spark plug
   e. The distance between Midland and Fremantle
   f. The width of your finger nail

2. Rewrite the following lengths in kilometres

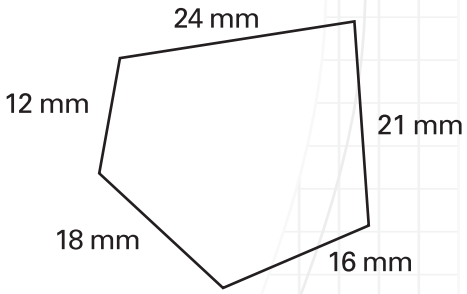
   a. 2592 metres
   b. 895 metres
   c. 44 296 metres
   d. 67 metres

3. Rewrite the following lengths in metres.

   a. 5.5 kilometres
   b. 7.29 kilometres
   c. 0.295 kilometres
   d. 0.076 kilometres

Length: Perimeter

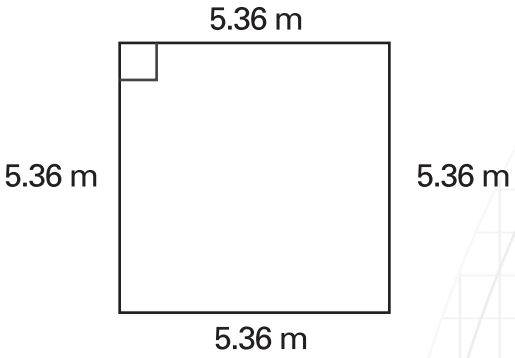
The total distance around a figure is called the **perimeter** of a figure.
You need to add the lengths of all the sides together.



In this example, we add the lengths of each of the sides.
That is 24 mm + 21 mm +16 mm + 18 mm +12 mm
So, the perimeter is 91 mm.

When the perimeters of squares and rectangles are calculated the solution is easier to find because these two figures have important, easily recognisable properties.

Look at this figure. It is called a square because all the sides are equal and the angles are 90°.



We can calculate the perimeter by adding 5.36 m + 5.36 m + 5.36 m + 5.36 m = 21.44 m or by multiplying one side by 4 because all the sides are the same length.

5.36 x 4 = 21.44 m

In each case we either add each length

$\ell + \ell + \ell + \ell =$ ***Perimeter***

or

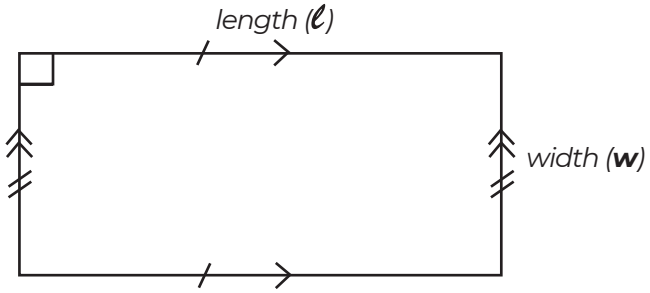
Take one length and multiply by 4

$4\ell =$ ***Perimeter***

Therefore, when calculating the perimeter of a square we can use this formula

Perimeter = $4 \times \ell$

Calculating the perimeter of a rectangle



Notice that the sides opposite each other are equal and parallel.
The angles are all equal to 90°.

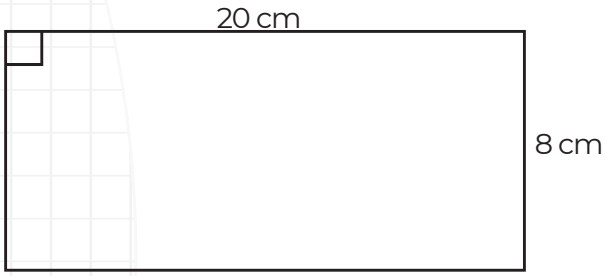
Call the length ℓ and the width, w.

We can calculate the perimeter by adding each side.

$$P = \ell + \ell + w + w$$
$$= 2\ell + 2w$$
$$= 2(\ell + w)$$

So if you add the $\ell + w$ and multiply by two you calculate the perimeter of a rectangle.

Calculate the perimeter of the following rectangle.



Perimeter = $2(\ell + w)$
= 2 (20 + 8) cm
= 2 (28) cm
= 56 cm

Check to see if this is correct by adding all the sides.

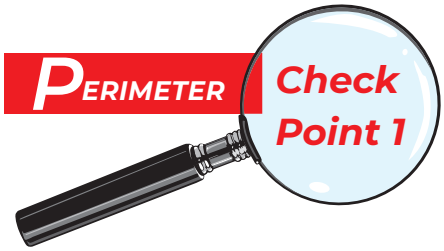
It is important to draw a clear diagram which shows the length and width.

Consider this problem.

Find the perimeter of a rectangle whose length is 8 metres and whose width is 4 m.

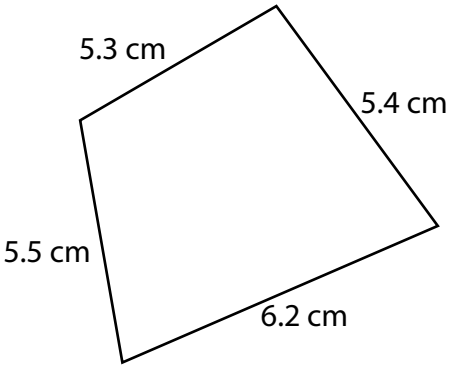
Draw a diagram
Calculate the answer

P = 2 (8 + 4) m
P = 24 m (remember to put in the correct unit)

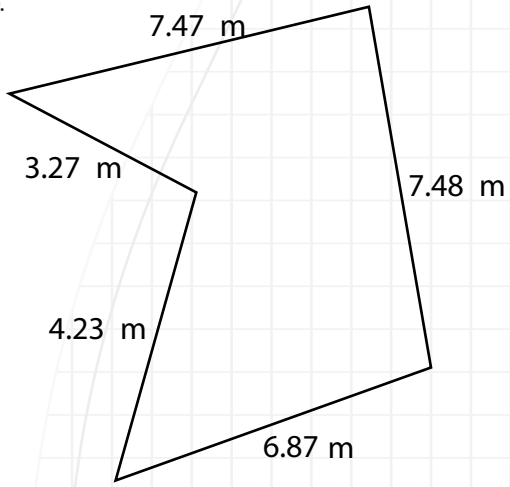


1. Find the distance around the following figures, given the measurements shown.

a.



b.



2. The top of a cabinet is 80 cm long and 65 cm wide.
What length of beading would be required to fit round the edges?

3. What is the perimeter of a rectangular playing field which measures 1.75 kilometres in length and 500 metres in width?
[Note: you will need to convert lengths so that both are the same unit.]

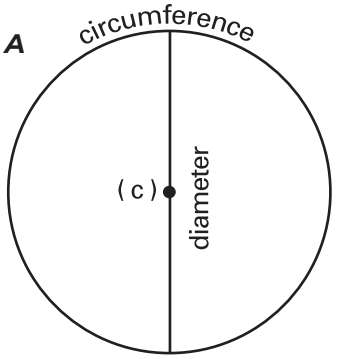
4. The rectangular runway on which the planes land is 2.9 kilometres long and 525 metres wide. How far would you have to walk if you want to walk around the runway's perimeter?
[Note: you will need to convert lengths so that both are the same unit.]

Length: Circumference

Calculating the perimeter of a circle is a more difficult exercise. The perimeter of a circle is known as its **circumference**. There are some other features of a circle that you must also know in order to understand how to calculate the circumference (perimeter) of a circle.

(Fig A) A diameter is the line passing from one side of the circumference to another point on the circumference and passing through the centre.

Fig A

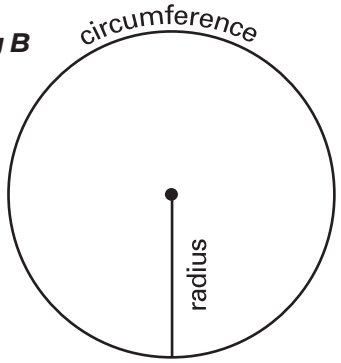


(Fig B) A radius (r) extends from the centre of a circle to any point on the circumference.

Notice that a diameter (D) is made up of 2 radii (r).

Therefore, ***D = 2r***

Fig B



If you measure a great number of circles you would find that the circumference would be a little over three times the length of the diameter.

Therefore, we could say

circumference ≈ 3 x diameter.

≈ means 'is approximately equal to'

The closest we need to get to this approximate size of the relationship between the diameter and the circumference is about 3.14.
You may see circumference written using the Greek letter ***"pi" (π)***

i.e. **C = πD (π ≈ 3.14).**

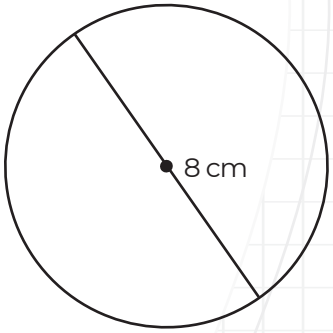
You could also express the circumference as ***3.14*** (or π) ***x 2r*** because ***d = 2r.***
So now you could calculate the circumference of a circle by knowing either the length of the diameter, or the length of the radius.

Note: People often confuse the formula C = 2 πr for calculating the **circumference** of a circle with the formula πr^2 for calculating the **area** of a circle. It is for this reason that it is recommended that the formula C = π x D is used for calculating the circumference of a circle. If the radius is given, simply double it to give the diameter.

Look at these examples.

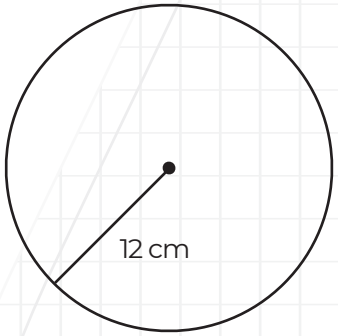
Find the circumference of a circle with an 8 cm diameter.

C = 3.14 x D
= 3.14 x 8 cm
= 25.12 cm



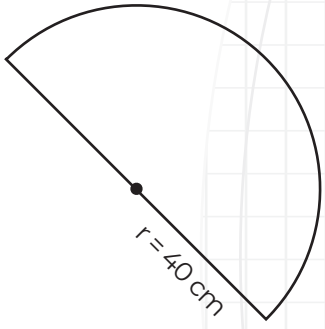
Find the circumference of a circle with a radius of 12 centimetres.
If the radius is 12 cm, the diameter must be 24 cm because
a diameter is twice the length of a radius.

C = 3.14 x D
C = 3.14 x 24 cm
= 75.36 cm



A semi-circular telephone table needed new veneer edging.
To work out the perimeter, we need to first calculate the circumference of the whole tabletop.

C = 3.14 x D
C = 3.14 x 80 cm
= 251.2 cm



Only half the circumference is needed (125.6 cm) as well as the length of the straight edge, which is 80 cm.

The total perimeter is 125.6 cm + 80 cm = 205.6 cm

CIRCUMFERENCE Check Point 2

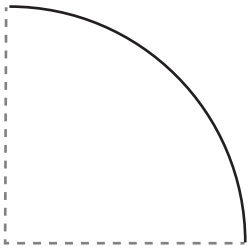
1. Calculate the circumference of a circle with a diameter of 15 cm.

2. A circular fish pond is 3.5 metres across. Calculate its circumference.

3. What is the circumference of a circular garden bed with a radius of 15 m?

4. A racing car completes 20 laps on a circular track of diameter 168 metres.
   How many metres does the car travel?
   What is that in kilometres?

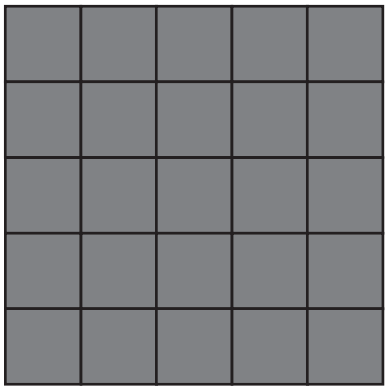
5. A gardener is designing a flower bed in the shape of a clock.
   She only wants to put a border around the top right arc of the bed with blue flowers.
   How long will the edge be?



Area of Squares and Rectangles

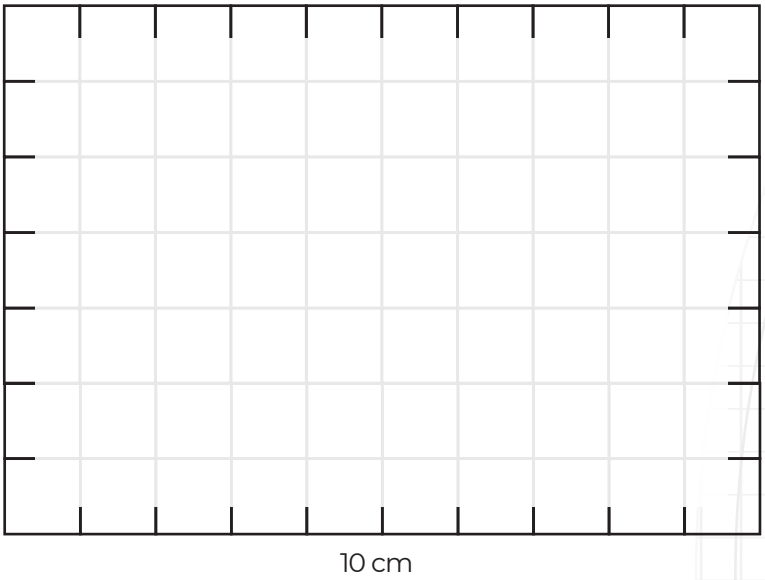
The area of a figure is the amount of surface it covers.

This is a 1 centimetre square; it covers 1 square centimetre (1 cm^2) of the surface of this page.



This is a 5 centimetre square; it covers 25 square centimetres (25 cm^2) of the surface of this page.

Please note: the order of saying this 25 cm^2 is "twenty-five square centimetres".



This rectangle is 10 cm by 7 cm; it covers 70 square centimetres (70 cm^2) of the surface of this page.

The formula for finding the area of a rectangle is:

Area = length x width
A = ℓ x w

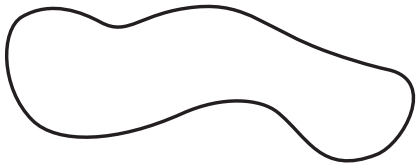
Where A = number of square units in the area.
ℓ = number of units in the length
w = number of units in the width

and the length and width must be in the **same unit**.

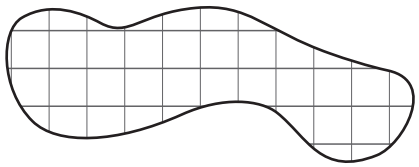
Area of irregular shapes

To work out the area of an irregular shape, the shape can be overlaid onto grid paper, or have a 1 cm^2 grid drawn inside it..

Look at this example.
What is the area of this shape?



To work this out draw a 1 cm^2 grid inside it. (Note: this is not to scale.)



There are two methods to solve this:

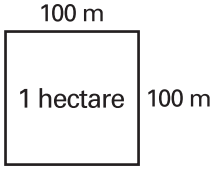
Method 1:
Count the whole squares (15) Then count as a whole square any that are over $^1/_2$ square in size (4). Now add them together (19). So the area is about 19 cm^2.

Method 2:
Count the whole squares (15) Look for part squares that can add together to approximate full squares (4). Now add them together (19). So the area is 19 cm^2.

The standard units of area are:

Square millimetres	mm^2
Square centimetres	cm^2
Square metres	m^2
Hectares	ha

A hectare is equal to an area of a square with sides measuring 100 metres (the length of a school racetrack).
1 hectare = 100 m x 100 m
= 10 000 m^2



For very large area measurements use square kilometres (1000 m x 1000 m).

Remember to use the correct unit when completing area calculations.

Consider this example.

The garden bed is 22 metres long and 7.5 metres wide. Calculate its area.

A = ℓ x w
= 22 x 7.5
= 165 m^2
The area of the garden bed is 165 m^2.

Find the areas of the following rectangles whose lengths (ℓ) and widths (w) are given.

1.

a) ℓ = 14 cm, w = 7 cm
b) ℓ = 11.3 m, w = 5.6 m

2. The cover of a book is 29.5 cm long and 21.5 cm wide.
What is the area of the book cover?

Area: Changing Dimensions

What happens to the **area** of a shape if you make it:

a) twice as long?
b) twice as long and twice as wide?

Look at the unit square. It has a length of 1 cm and a width of 1 cm.

Figure 1.

$A = 1\ cm^2$

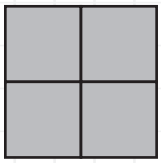
a) Make it twice as long.

Figure 2.

$A = 2\ cm^2$

b) Make the original square twice as long and twice as wide.
You are increasing the original square by a factor of 2.

Figure 3.

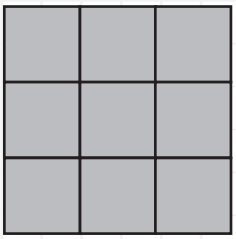


$A = 4\ cm^2$

Notice the **area** of this shape is 4 times the area of the original shape (Figure 1).

What happens if you increase the original shape by a factor of 3?
The length and the width will each be increased to 3 cm.

Figure 4.



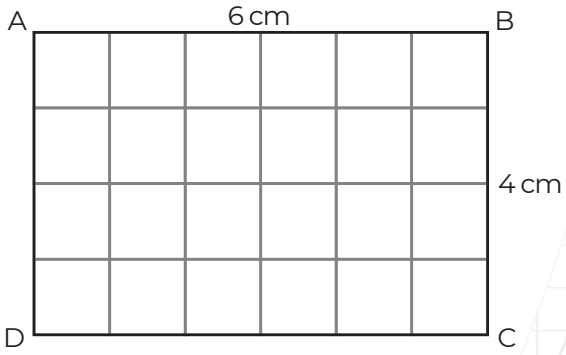
This information can be can be described in a table.

Figure	Dimensions	Area	Rrelationship to figure 1
1	1 x 1	1	Original shape
2	2 x 1	2	Twice original (2 x)
3	2 x 2	4	4 times original (4 x)
4	3 x 3	9	9 times original (9 x)

Area: Area of Triangles

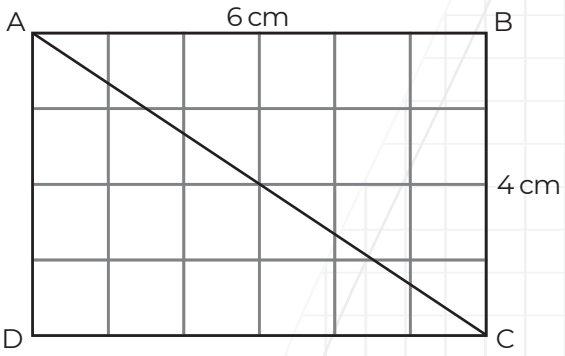
The area of triangles can be developed from previous knowledge about the area of a square or rectangle.

Look at this rectangle:



Area of rectangle = ℓ x w
= 6 cm x 4 cm
= 24 cm^2

Now if you cut the rectangle in half by drawing a diagonal from A to C you create two congruent triangles:



Congruent means the same size and shape

Look at each triangle, they each represent half the area of rectangle ABCD.

Triangle ADC = $^1/_2$ of ABCD or $\frac{ABCD}{2}$

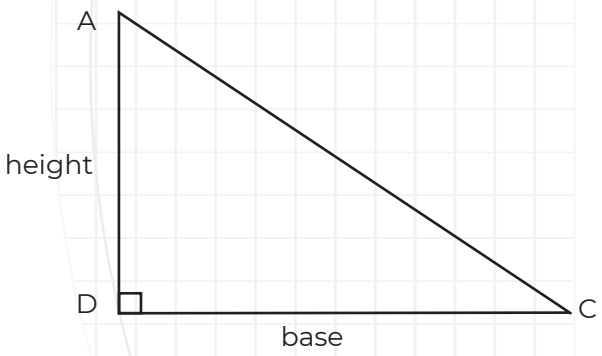
Therefore the area of ADC = $^1/_2$ area of ABCD
Area of triangle ADC = $^1/_2$ ℓ x w (remember, ℓ x w *is the formula for the area of the rectangle)*

Triangle ADC stands on its base DC which is the same as the length of ABCD.

You now substitute the length (ℓ) of DC with the base (b) of triangle ADC.

The width of ABCD is the height (h) of triangle ADC.

Substitute width with height.

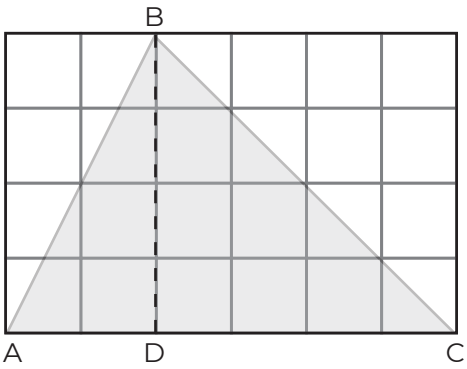


Now the area of triangle ADC = $^1/_2$ (base x height)
or $\frac{\text{base height}}{2}$

Sometimes the height is described as the perpendicular (straight up and down) height.

Consider this example.

Copy this diagram onto grid paper, and cut it out. Shade the triangle ABC. Now cut along the lines AB and BC. You will have 2 small triangles and a larger one. The smallest triangle exactly covers ΔABD; and the medium triangle exactly covers ΔBCD. So the area of triangle ABC is half of the original rectangle. This shows that the formula for working out the area of a triangle is still ½(b × h)

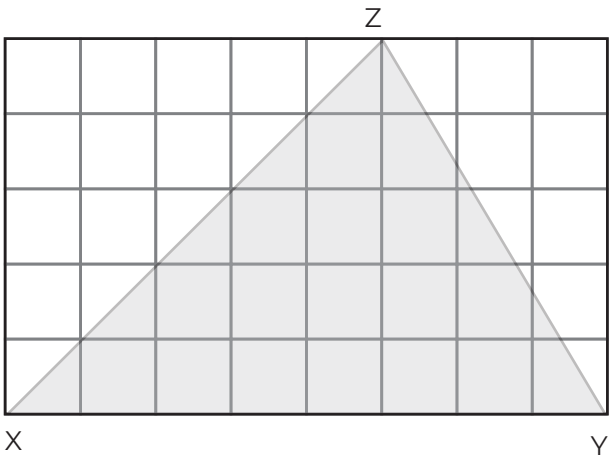


AREA OF A TRIANGLE *Check Point 2*

1. What is the area of triangle XYZ?

   Calculate the area without using the formula.

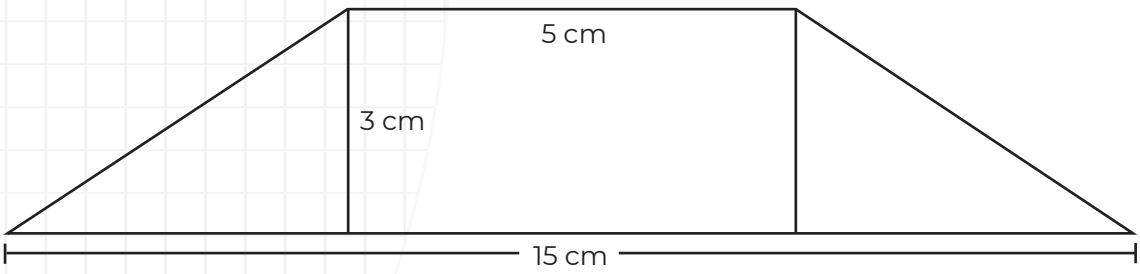
   Show how this could be done.



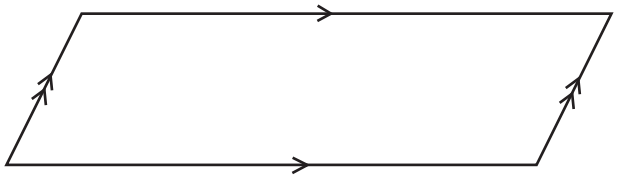
2. Calculate the area of a triangle with a base of 12 cm and a height of 8 cm.

3. How many metres of sail cloth would be needed to make a triangular sail 10 metres high with a base of 8 metres?

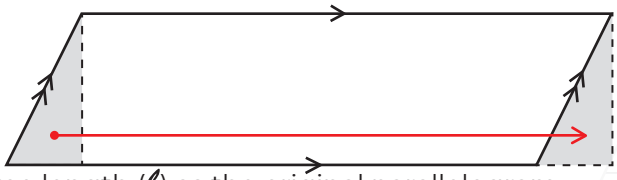
4. Calculate the area of this trapezium.



A **parallelogram** is a quadrilateral with both pairs of opposite sides parallel, and its opposite sides are congruent.



To work out the area of a parallelogram, we can imagine cutting off one triangle and translating (sliding) it to its opposite side, making a rectangle.
Note, you could copy the shape, cut it out and translate it yourself to check if it works.

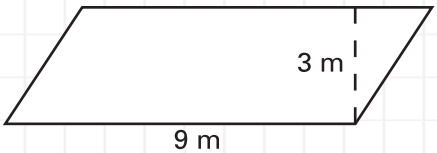


The rectangle has the same length (ℓ) as the original parallelogram.
The width (***w***) of the rectangle is the same as the perpendicular height of the original parallelogram.

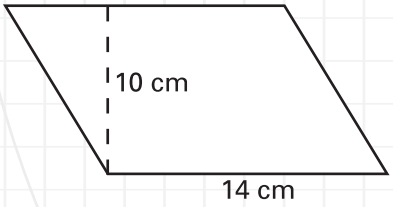
So the area is ℓ x ***w*** *for the rectangle*
ℓ x ***h*** for the parallelogram (with '***h***' being the perpendicular height)

AREA OF A PARALLELOGRAM

1. Calculate the area of this parallelogram.

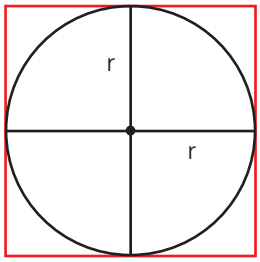


2. Calculate the area of this parallelogram.



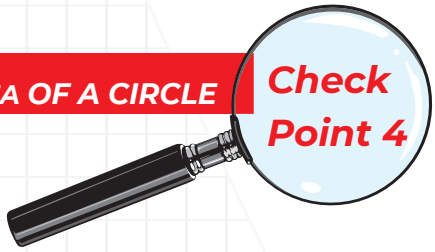
Area: Area of Circles

The diagram shows a circle bounded by a square. The area of each small square may be found by multiplying the radius by the radius (r x r = r^2). There are four such squares so the area of the large square would be $4r^2$.
The area of the circle is clearly less than the area of the square. Roughly it would be just over the area of three squares or $3r^2$. More precisely it is $3.14r^2$ or πr^2



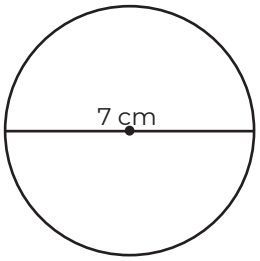
Area (Circle) = πr^2

Area of a Circle

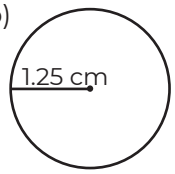


1. Calculate the area of these circles.

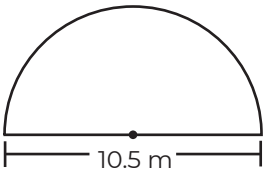
a)



b)



2. What is the area of a semi-circular garden with a diameter of 10.5 m?



Volume and Capacity

The volume of an object is the amount of space the object occupies or encloses. A rectangular solid might ***occupy*** the same amount of space as 24 one-centimetre cubes. An empty box might ***enclose*** a space which could be occupied by 24 one-centimetre cubes. We call this capacity. A centimetre cube is a cube which has a length, width and height of 1 cm, e.g. it has a volume of 1 cubic centimetre or 1 cm^3.

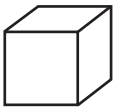


Figure 1

A rectangular solid occupying 24 centimetre cubes could look like this:

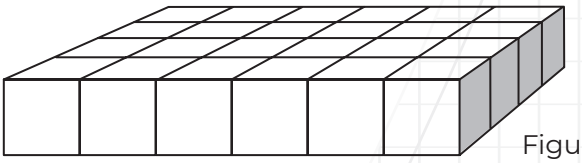


Figure 2

Count the number of centimetre cubes.
We would say that the volume of this rectangular solid is 24 cubic centimetres (cm^3).

Look at this rectangular prism.
There are 8 blocks in the first layer, 8 in the middle and 8 on the top layer; i.e. 3 layers of 4 x 2.
The volume is 4 x 2 x 3 = 24 cm^3.

The formula for the volume of a prism is ℓ x ***w*** x ***h***

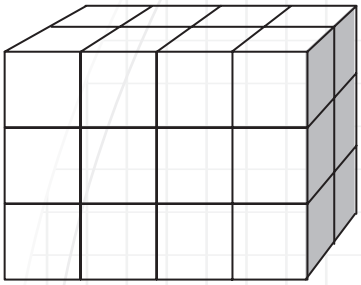


Figure 3

What do you notice about Figure 2 and Figure 3?

Their volumes are the _____ but their shape is not.

What is the volume of this cube?

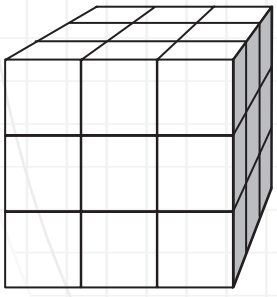


Figure 4

Count the cubes
The volume of Figure 4 is? _____
Now check, using the formula for the volume of a prism.

What is the volume of figure 5?

The volume of Figure 5 is? _____

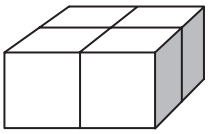


Figure 5

What is the volume of figure 6?

Volume of Figure 6 _____

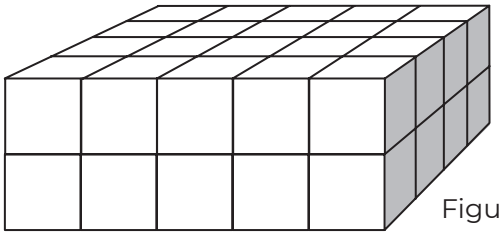
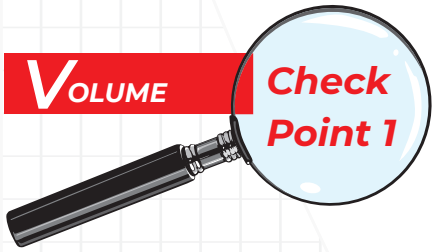


Figure 6



a) Complete the following table using Figures 2, 3, 4, 5, and 6 above.

Figure	Length	Width	Height	Volume
2				
3				
4				
5				
6				

b) Explain how the **dimensions** of the rectangular prism can be used to find its volume.

Surface Area & Volume: Are They Related?

Surface area is the amount of cover around an object. It is like the amount of wrapping paper you would need to cover it completely.
When calculating the **surface area** of a solid you must count the number of squares on each face. Look at Figure 7.

How many squares are on each face? _____ (4)
How many faces does this cube have? _____ (6)
Therefore, 4 + 4 + 4 + 4 + 4 + 4 = 24 square units (24 cm^2)
or 6 x 4 = 24 cm^2

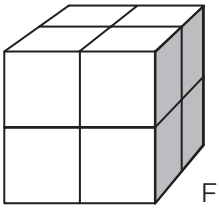


Figure 7

It is square units because we are calculating surface ***area, i.e. all the outside surfaces.***
The volume of Figure 7 = 8 cubic units (8 cm^3).
Surface area of Figure 7 = 24 units (24 cm^2)

Check Point 2

1. Look at these shapes. Count the cubes and count the squares to determine the volume and surface area of each figure.

Figure 8

V = _____
SA = _____

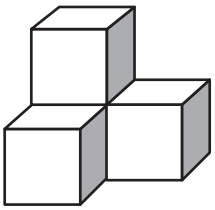


Figure 9

V = _____
SA = _____

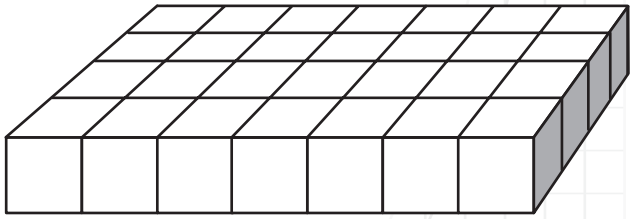


Figure 10

V = _____
SA = _____

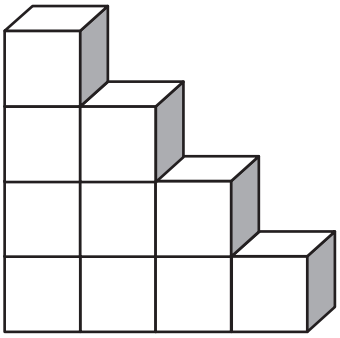


Figure 11

V = _____
SA = _____

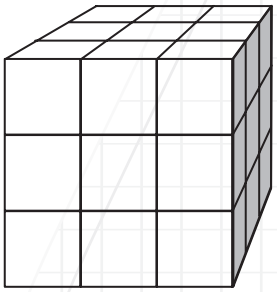


Figure 12

V = _____
SA = _____

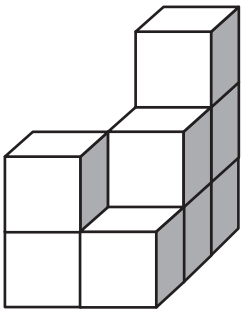
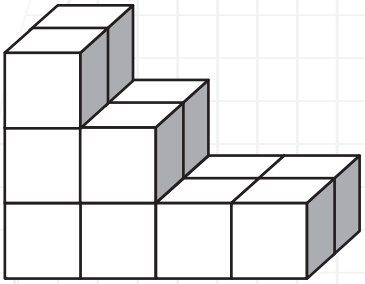


Figure 13

V = _____
SA = _____



Now fill in this table:

Figure	Volume	Surface Area
8		
9		
10		
11		
12		
13		

2. Look at Figures 14, 15, 16, and complete the table below:

Figure 14

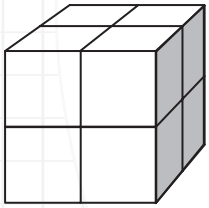


Figure 15

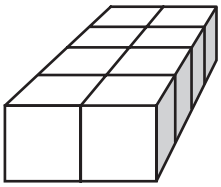


Figure 16

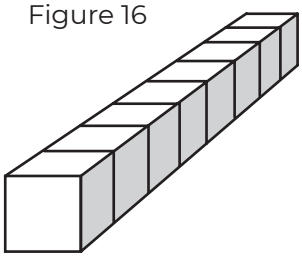


Figure	Length	Width	Area of Base	Height	Volume	Surface Area
14	2	2	4	2	8	24
15	2			1	8	
16		8		1	8	

3. Find 3 different cube models that have a volume of 27.
You may find it necessary to manipulate cubes to complete this table.

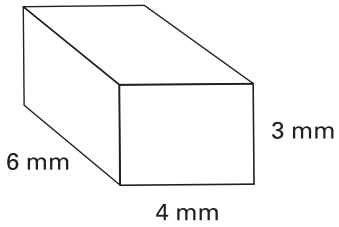
Figure	Length	Width	Area of Base	Height	Volume	Surface Area
					27	
					27	
					27	

There are two methods for finding volume of a prism

Method 1 Solution: Use , *w, h* to find volume

Method 2 Solution: Use area of base x height

4. a) How many cubic millimetres would be needed to fill a box measuring 6 mm x 4mm x 3 mm ?



b) Calculate the surface area of this box.
You could restate this and ask, how much paper would be required to completely cover the box?

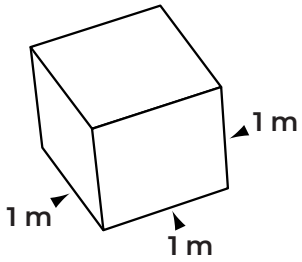
5. a) What is the volume of a box measuring 6 cm x 4 cm x 2 cm?
Show calculation. Remember to use the correct unit.

b) What is the surface area of the box?

Volume: Metric Units

Given 10 mm = 1 cm and 100 cm = 1 m it is possible to calculate the relationship that exists between cubic millimetres, cubic centimetres and cubic metres.

A cubic metre measures 1 m x 1 m x 1 m = 1 m^3 (1 cubic metre)



To change 1 m^3 to cm^3 you need to change the length of each edge to centimetres.

Therefore ℓ x w x h
1 m x 1 m x 1 m = 1 m^3

To change to centimetres it becomes
100 cm x 100 cm x 100 cm
= 1 000 000 cubic centimetres

Hence, we can say, there are:
1 000 000 cubic centimetres in 1 cubic metre
1 000 000 cm^3 = 1 m^3

We can also compare cm^3 and mm^3

Since 10 mm = 1 cm

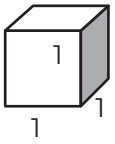
1 cm^3 = 1 cm x 1 cm x 1 cm
= 10 mm x 10 mm x 10 mm

1 cubic centimetre (cm^3) = 1 000 cubic millimetres (mm^3)

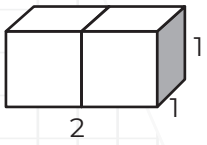
Using this information you can now convert cm^3 to m^3, mm^3 to cm^3, etc.

What happens to the volume of a rectangular prism if you make it:

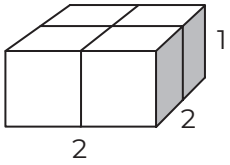
a) twice as long?
b) twice as long and twice as wide, and
c) twice as long and twice as wide, twice as high as the unit cube?



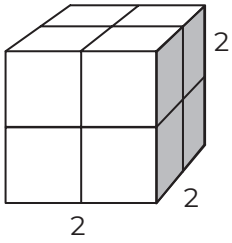
a)



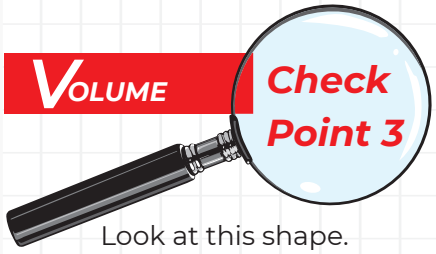
b)



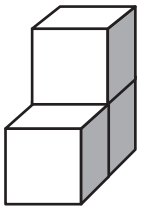
c)



Model	Dimensions	Volume cm³	Comment
a)	2 x 1 x 1	2	Twice as big as the unit cube (2 x)
b)	2 x 2 x 1	4	Four times as big as the unit cube (4 x)
c)	2 x 2 x 2	8	Eight times as big as the unit cube (8 x)

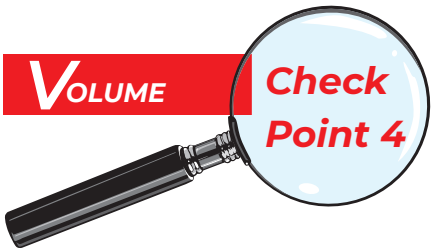


Look at this shape.



1. What would be the volume of this shape if you made it twice as long, twice as wide and twice as high?

2. What would be its volume if you increase length, width and height by a factor of 3? (ie. 3 times as long, 3 times as wide and 3 times as high)



1. ***Approximately how many cubic metres in:***

a) 5 272 648 cm^3
b) 6 000 000 cm^3
c) 6 756 cm^3

2. ***How many cubic centimetres in:***

a) $4m^3$
b) 1.8 m^3
c) $0.125m^3$

3. ***Convert the following:***

a) 1 000 mm^3 = _____ cm^3
b) 63 cm^3 = _____ mm^3
c) 1 000 000 cm^3 = _____ m^3
d) 1 000 cm^3 = _____ m^3
e) 7 253 mm^3 = _____ cm^3

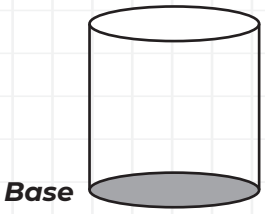
Volume: **Volume of a Cylinder**

We found that to calculate the volume of a rectangular prism we could use:
the area of the base x height.

This generalisation is also used to calculate the volume of other 3D prisms, so in this case:

Volume of a cylinder = area of base x height

It is important to note here that the base of a cylinder is a circle.



The **area** of a circle, as we found earlier is πr^2.
So, the **volume** of a cylinder is $\pi r^2 \times h$.

What is the volume of a cylinder which has a diameter of 18 cm and a height of 65 cm?

Volume of cylinder = $\pi r^2 \times h$

$\pi = 3.14$
r = 9 (D=18 cm so r = 9 cm)
Vol of cylinder = 3.14 x 9 x 9 x 65
= 16 532.1 cm^3

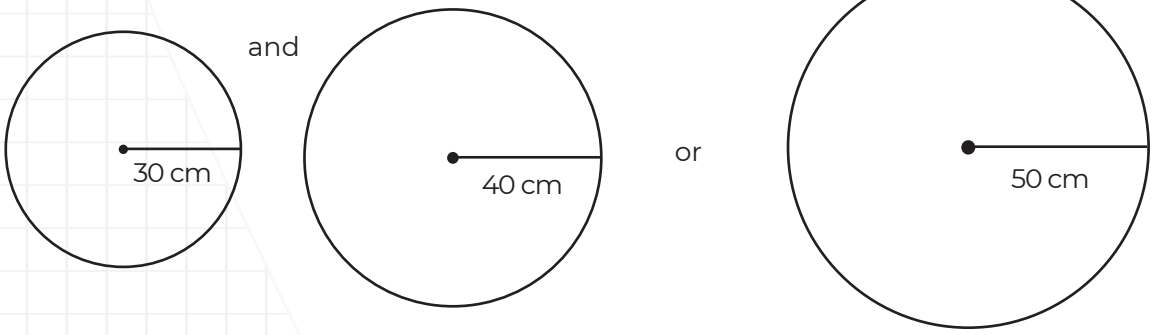
Since there are 1 000 000 cm^3 in 1 m^3.

16 532.1 cm^3 converts to 0.0165321 m^3
0.0165321 m^3 should be rounded off to either second or third decimal place

Hence our answer is approximately equal to 0.017 m^3.

Check Point 5

1. Which will carry the most water?



a) Two pipes, one with 30 cm radius and the other with 40 cm radius and both 1 metre high.

b) One pipe with 50cm radius and 1 metre high.

Capacity

The capacity of a litre cool drink bottle is 1 litre. Capacity is the amount of liquid or gas an object may hold. Look at the different containers in the supermarket. Some will hold litres, whereas others will hold millilitres.

The units of capacity are:
Kilolitres (kL) - Very large capacities use kilolitres (1000 L = 1 kL).
Litres (L) - Large containers use litres.
Millilitres (mL) - Smaller containers use millilitres.
e.g. a car's tank holding 60 L of petrol and a can of soft drink usually holds 375 mL.

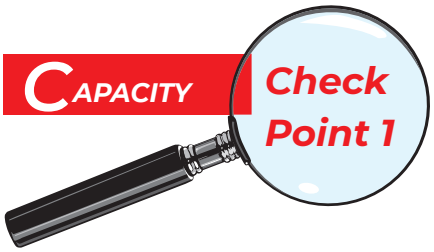
1 000 millilitres (mL) = 1 Litre (L)

Converting from litres to millilitres

2.5 litres = 2.5 x 1 000 = 2 500 mL
2.375 litres = 2.375 x 1 000 = 2 375 mL

Converting from millilitres to litres

4 562 millilitres = 4 562 ÷ 1 000 = 4.562 L
250 millilitres = 250 ÷ 1 000 = 0.250 L



If you are skilled at multiplying by 10, 100, 1000 and dividing by 10, 100, 1000 then you should find these conversions relatively easy.

1 Convert the following from litres (L) to millilitres (mL).

(a) 4.2 L = _____ mL
(b) 6 L = _____ mL
(c) 4.250 L = _____ mL
(d) 0.075 L = _____ mL

2 Convert the following from millilitres (mL) to litres (L).

(a) 2 275 mL = _____ L
(b) 625 mL = _____ L
(c) 5 mL = _____ L
(d) 11 726 mL = _____ L

Mass

In our society we use the term weight when we are really talking about an object or person's mass. Simply put - if you want to lose weight go to the moon, as the force of gravity affects weight but not mass.

We may say our weight is 72 kilograms.
We should be saying our mass is 72 kilograms.
The process of finding a mass, however, is called weighing.

The units of mass are

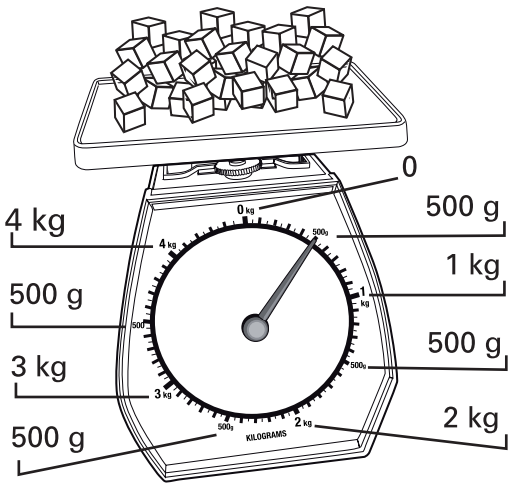
Grams	- used when measuring small amounts
Kilograms	- for many of our everyday measurements
Tonnes	- for very heavy masses
1 000 g	= 1 kilogram (kg)
1 000 kg	= 1 tonne (t)

Mass Check Point 1

1. Two dogs weigh 4.2 kg and 5.8 kg.
   How many more *grams* does one dog weigh than the other?

2. How many kilograms are there in 2.3 tonnes?

3. What is the mass of these blocks?



Telling the time

In our society today we have different types of watches and clocks. Some use a ***12-hour system*** whereas others - especially digital - use a ***24-hour system***. In order to understand and tell the time we must know something about these two forms of time.

The 12 Hour Clock

On this 12 hour clockface we can say the time is between 10:35 and 10:40.

Let's say it is 10:38.

To work out **durations of time**, we need to remember that there are:

60 seconds in 1 minute
60 minutes in 1 hour
24 hours in one day
7 days in 1 week
52 weeks in 1 year
365 days in 1 year
or 366 days in a leap year

With calculations of time, a calculator is not much help, as it works on Base 10.
So if you want to know how long an event lasted if it started at **11:30** and finished at **1:55**, one way to do it is to **add on the time**.

11:30 to 12:00 is 30 minutes
12:00 to 1:00 is 1 hour
1:00 to 1:55 is 55 minutes

We now have to add 30 minutes, 1 hour, and 55 minutes.
We get 1 hour and 85 minutes.
We know that there are 60 minutes in 1 hour,
so 85 minutes is the same as 1 hour and 25 minutes.

Therefore, the event lasted for 2 hours and 25 minutes.

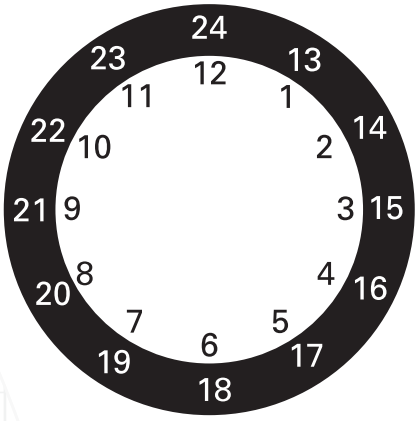
What is the time difference between the following given times?

1. 11:21 am and 3:15 pm
2. 8:30 pm and 1:27 am
3. 11:42 pm and 8:23 am

The 24 Hour Clock

All times shown in 24-hour clock:
a.m. hours shown in the inner ring / p.m. hours shown in the outer ring

0001	12:01 a.m.
0100	1:00
0200	2:00
0300	3:00
0400	4:00
0500	5:00
0600	6:00
0700	7:00
0800	8:00
0900	9:00
1000	10:00
1100	11:00
1200	12:00 Noon

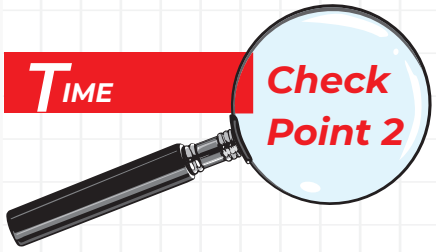


1300	1:00 p.m.
1400	2:00
1500	3:00
1600	4:00
1700	5:00
1800	6:00
1900	7:00
2000	8:00
2100	9:00
2200	10:00
2300	11:00
2400	12:00 Midnight

What is 10:38 am in 24-hour time? Look at the 24-hour clock.
10:00 am is shown as 1000 hours. Therefore 10:38 am would be shown as 1038 hours.

What about 10:38 pm? 10:00 pm is shown as 2200 hours.
Therefore 10:38 pm would be shown as 2238 hours.

You need to be able to understand both forms of telling the time because timetables can be written using either a 12-hour clock system or a 24-hour clock system. Frequently bus, train and airline timetables are written in 24-hour time to avoid confusion between morning and afternoon schedules.



1. Write the following 12 hour times as 24 hour times. (Hint: Use the 24-hour table above.)

a) 5:00 am
b) 12:00 noon
c) 3:00 pm
d) 12:00 midnight

2 Write these 12 hour times as 24 hour times.

a) 6:25 am
b) 12:23 pm
c) 8:14 pm
d) 1:33 pm

3. What time is shown on this clock?

4. A train was due at 4:20 am but it was 80 minutes late. At what time did it arrive?

5 Joshua arrived at the Dianella bus terminal at 4:12 pm. How long did he have to wait to catch a bus into Perth. Explain your answer.

Use this bus timetable to answer.

BUS TIMETABLE PERTH – DIANELLA					
FROM PERTH			TO PERTH		
0713	1520	1840	0640	1040	1658
0750	1545	1945	0710	1200	1725
0845	1618	2115	0730	1325	1807
1000	1645	2220	0745	1435	1912
1122	1709	2325	0805	1503	2147
1245	1730	-	0830	1600	2252
1410	1800	-	0917	1622	-

6. Which one of these is closest to 6 pm?

a) 0605 b) 1559 c) 0542 d) 1759

Answers for Check Points

Length

Check Point 1

1. a) 42 mm; 4.2 cm b) 108 mm; 10.8 cm c) 6 mm; 0.6 cm
2. a) 8.3 cm b) 5 cm c) 0.8 cm
3. a) 87 mm b) 50 mm c) 3 mm

Check Point 2

1. a) 4 m b) 10 m c) 24 m d) 7.23 m e) 3.06 m f) 4.7 m
2. a) 200 cm b) 1800 cm c) 423 cm d) 503 cm e) 900 cm f) 1130 cm

Check Point 3

1. a) 0.7 m b) 0.07 m c) 5.24 m d) 2.314 m
   e) 0.843 m f) 0.078 m
2. a) 0.24 m 2.45 m 256 cm 2926 mm
   b) 0.294 m 296 mm 2.92 m 296 cm

Check Point 4

1. a) metres b) centimetres c) kilometres d) millimetres
   e) kilometres f) millimetres
2. a) 2.592km b) 0.895 km c) 44.296 km d) 0.067 km
3. a) 5500 m b) 7290 m c) 295 m d) 76 m

Perimeter

Check Point 1

1. a) 22.4 cm b) 29.32 cm
2. 290 cm or 2.9 m
3. 4.5 km
4. 6.85 km or 6850 m

Check Point 2 (Circumference)

1. 47.1 cm
2. 10.99 m
3. 94.2 m
4. 10 550.4 m or 10.5504 km (approx. 10.55 km)
5. 3.925 m

Area

Check Point 1

1. a) 98 cm^2 b) 63.28 m^2
2. 634.25 cm^2

Check Point 2

1. 20 cm^2; can be done by dividing the rectangle into 2 triangles
2. 48 cm^2
3. 40 m^2
4. 30 cm^2

Check Point 3

1. 27 m^2
2. 140 cm^2

Check Point 4

1. a) 38.465 cm^2 b) 4.91 cm^2
2. 43.27 m^2

Volume

Check Point 1

1. a)

Figure	Length	Width	Height	Volume
2	6	4	1	24 cubic units
3	4	2	3	24 cubic units
4	3	3	3	27 cubic units
5	2	2	1	4 cubic units
6	5	4	2	40 cubic units

b You can find the volume by multiplying the **length x width x height**.

Check Point 2

1.

Figure	Volume	Surface area
8	4 cm^3	18 cm^2
9	28 cm^3	78 cm^2
10	10 cm^3	36 cm^2
11	27 cm^3	54 cm^2
12	8 cm^3	32 cm^2
13	14 cm^3	42 cm^2

2.

Figure	Length	Width	Area of Base	Height	Volume	Surface area
14	2	2	4	2	8	24
15	2	4	8	1	8	28
16	1	8	8	1	8	34

3.

Length	Width	Area of Base	Height	Volume	Surface area
3	3	9	3	27	54
9	3	27	1	27	78
27	1	27	1	27	110

4. a) 72 mm^3 b) 108 mm^2
5. a) 48 cm^3 SA of Box: 88cm^2

Check Point 3

24 cubic units (or 24 cm^3)
81 cubic units (or 81 cm^3)

Check Point 4

a) Approx 5.2 m^3 b) 6 m^3 c) Approx 0.007 m^3
a) 4 000 000 cm^3 b) 1 800 000 cm^3 c) 125 000 cm^3
a) 1 cm^3 b) 63 000 m^3 c) 1 m^3
d) 0.001 m^3 e) 7.253 cm^3

Check Point 5

1. Two pipes (30 cm radius and 40 cm radius) will carry the same amount of water as the 50 cm radius pipe. (which is 7850mL)

Capacity

Check Point

1. a) 4200 mL b) 6000 mL c) 4250 mL d) 75 mL
2. a) 2.275 L b) 0.625 L c) 0.005 L d) 11.726 L

Mass

Check Point

1. 1600 grams
2. 2300 kilograms
3. 500 grams

Time

Check Point 1

1. 3 hours 54 minutes or 234 minutes
2. 4 hours 57 minutes or 297 minutes
3. 8 hours 41 minutes or 521 minutes

Check Point 2

1. a) 0500 hours b) 1200 hours c) 1500 hours d) 2400 hours
2. a) 0625 hours b) 1223 hours c) 2014 hours d) 1333 hours
3. 8:26
4. 5:40 am
5. 10 minutes
6. d) 1759