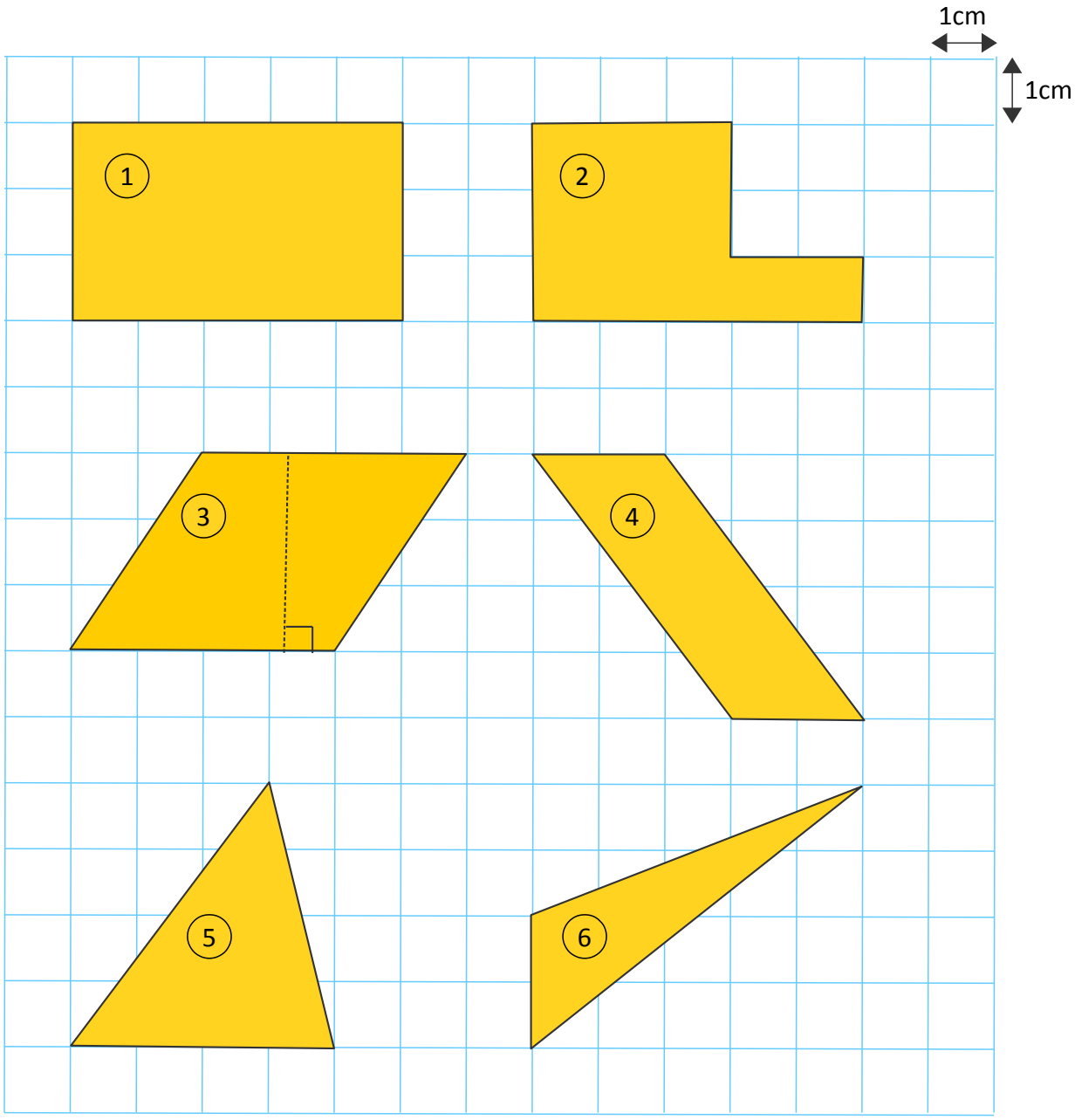
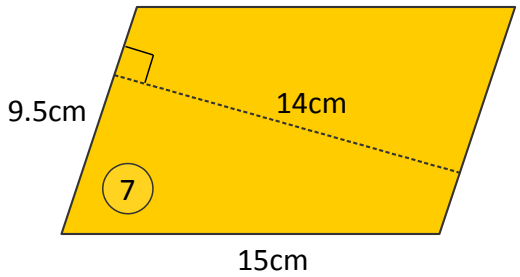
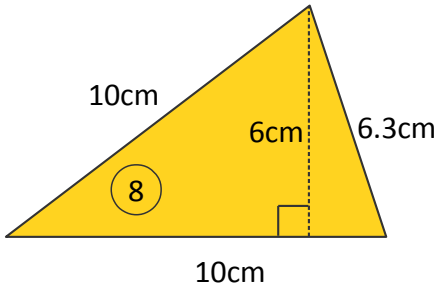
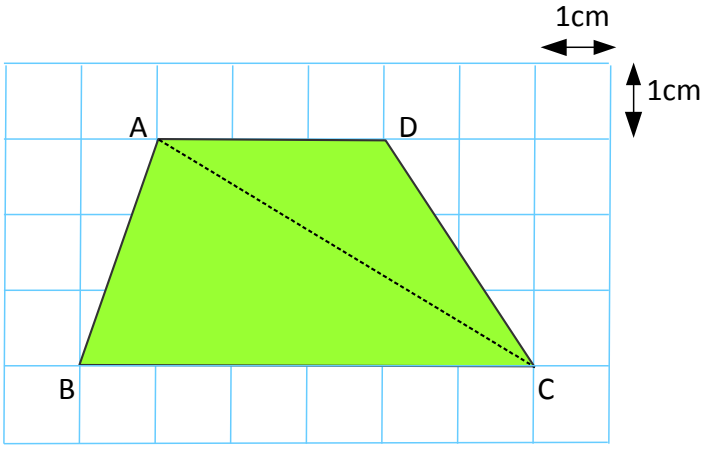
What do you know about the area of a shape?







Let's think about how to might find the area of the trapezium ABCD



1 Can you explain how our three pupils answered the question?

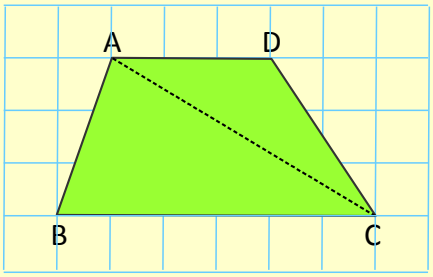
Alice

Alice's idea

We can split trapezium ABCD into triangles ABC and ADC using a diagonal...

Area = 6 x 3 ÷ 2 + 3 x 3 ÷2

= 9 + 4.5 = 13.5cm^2



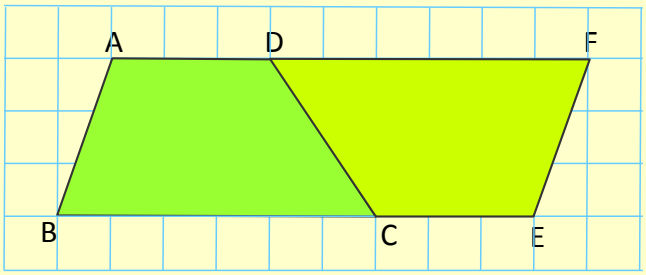
Evie

Evie's idea

We can form a parallelogram ABEF by combining two of trapezia ABCD. The area of the trapezium is half the area of the parallelogram.

Area = 9 x 3 ÷ 2 = 27 ÷ 2

= 13.5cm^2



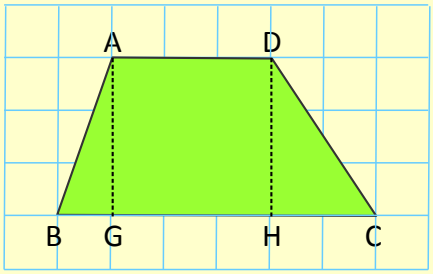
Sarah

Sarah's idea

We can split into 2 triangles, ABG and DHC, and a square AGHD.

Area = 1 x 3 ÷ 2 + 2 x 3 ÷ 2 + 3 x 3

= 1.5 + 3 + 9 = 13.5cm^2

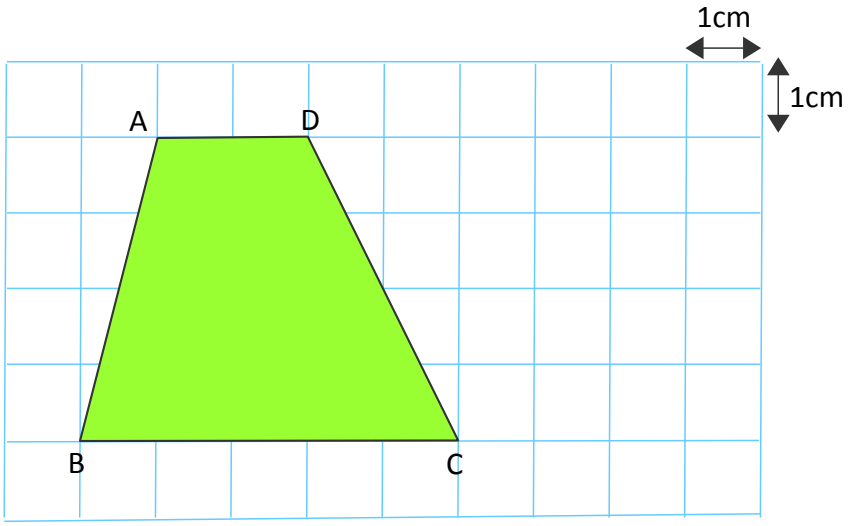




Jon

We can find the area of a trapezium by splitting it into triangles or by using a parallelogram.

2 Can you use Evie's method to find the area of this trapezium?

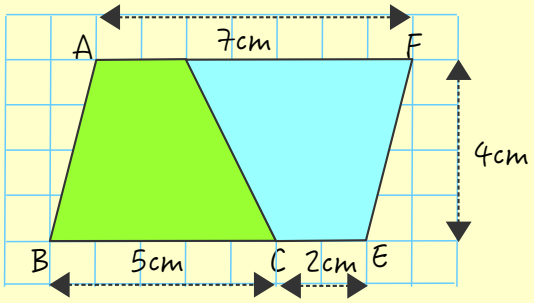


Matthew's working



Matthew

I have added an identical trapezium rotated by 180° to form a parallelogram.
The area of the parallelogram is $7 \times 4 = 28cm^2$
So the area of the trapezium is $28 \div 2 = 14cm^2$.



3 Can you explain in your own words where the dimensions of the parallelogram come from?



Alice

I think I know how to find a formula for the area of any trapezium...

4 What do you think Alice has noticed?

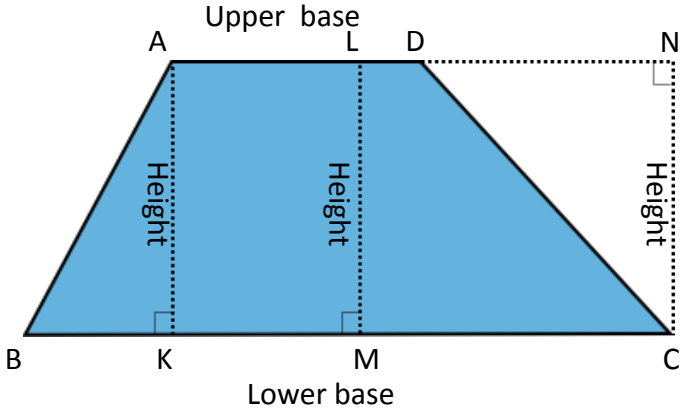


Taro

Taro's explanation

The base of the parallelogram is the sum of the lengths of the parallel sides.
The height of the parallelogram is the direct distance between the two parallel sides.
The area of the trapezium is half the area of the parallelogram

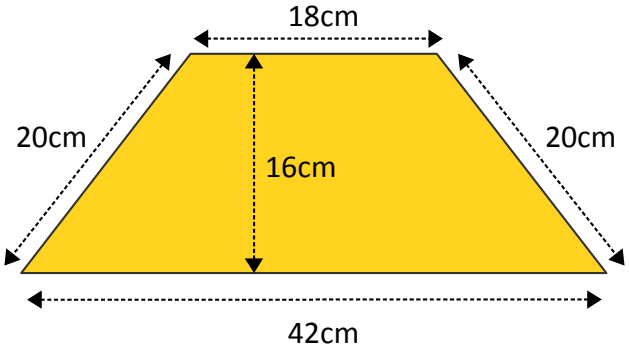
In the trapezium on the right, the two parallel sides are AD and BC. BC is sometimes called the lower base and AD is then called the upper base.
The length of a segment that is perpendicular to both the upper and lower bases, such as segment AK, is called the **height** of the trapezoid.
Also, the lengths of the segments LM and NC are the height.



Look at this trapezium

What is the length of

1. The lower base?
2. The upper base?
3. The height?
4. Write down the calculation you would use to calculate the area of the base.
5. What is the area of the trapezium?





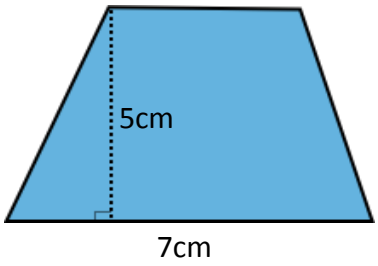
Jon

The area of a trapezoid is calculated using the following formula :
Area of Trapezoid = (Upper base + lower base) x height ÷ 2

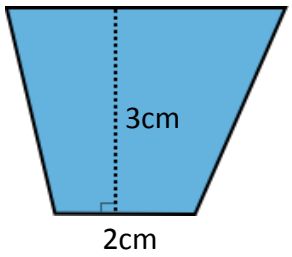
Fitness check

Calculate the area of the following trapezia...

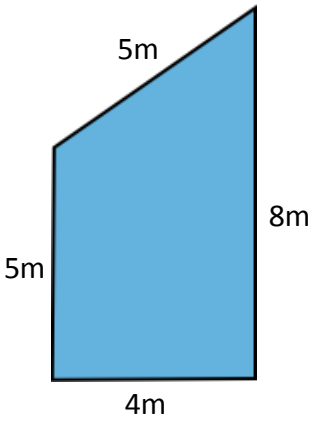
(1)



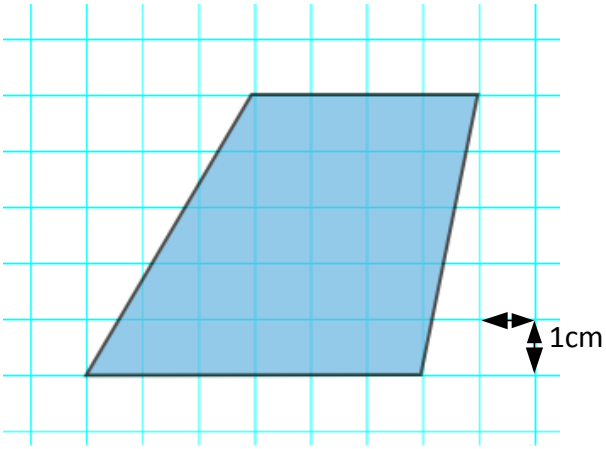
(2)



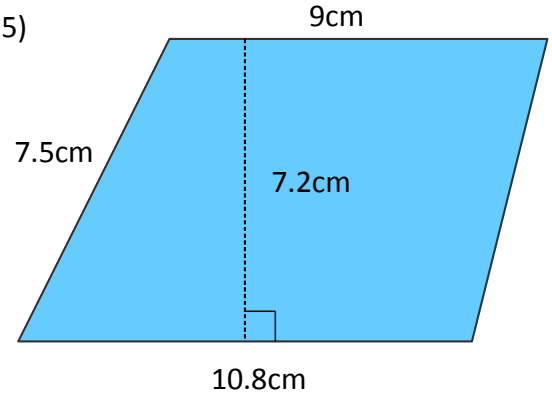
(3)



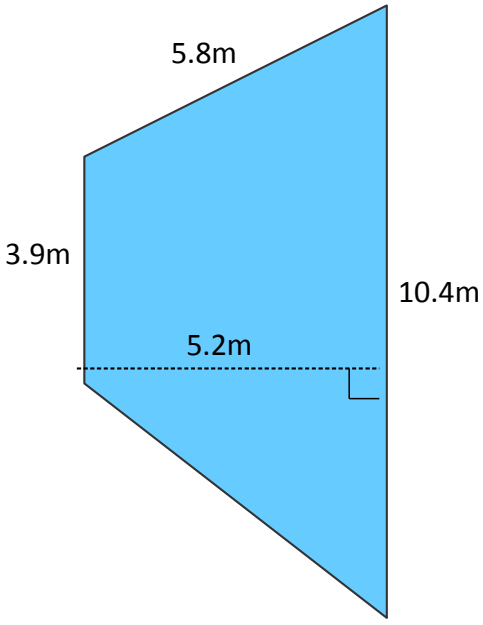
(4)



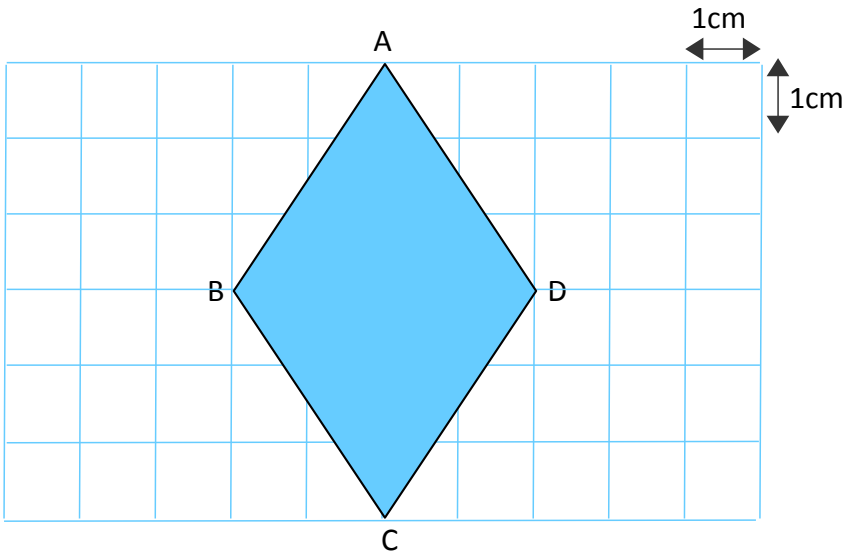
(5)



(6)



5 Think about how to find the area of the rhombus ABCD below.



Explain the three students' ideas below using diagrams and math sentences

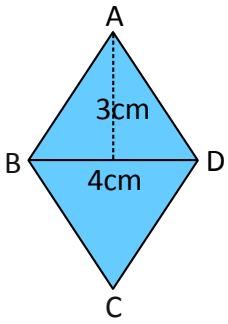


Alice

I split the rhombus into 2 triangles...

My calculation for the area is

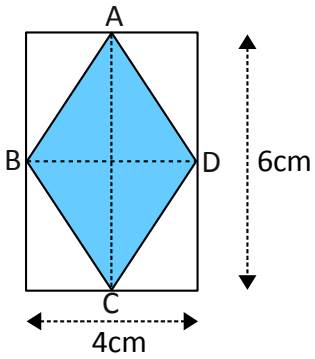
4 x 3 ÷ 2 x 2





Evie

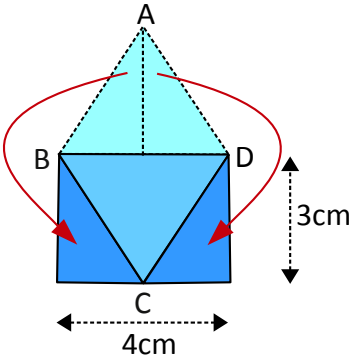
I drew a rectangle around the rhombus. The area of the rhombus will be half the area of the rectangle.
My calculation for the area is
4 x 6 ÷ 2





Sarah

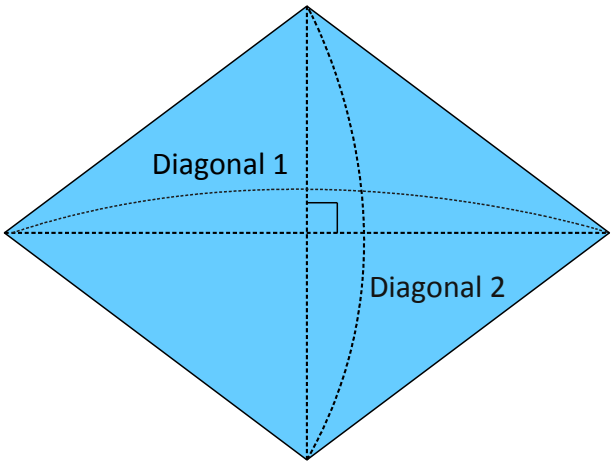
I changed the rhombus into a rectangle by sliding two of the triangles down.
My calculation for the area is
4 x 3



What is the area of rhombus ABCD?

Using Evie's idea, think about how to calculate the area of a rhombus.

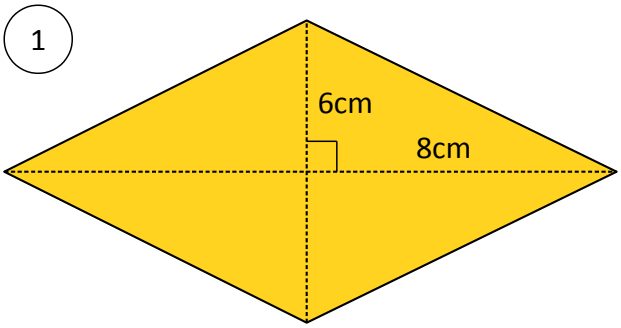
Area of Rhombus = (Diagonal 1 x Diagonal 2) ÷ 2



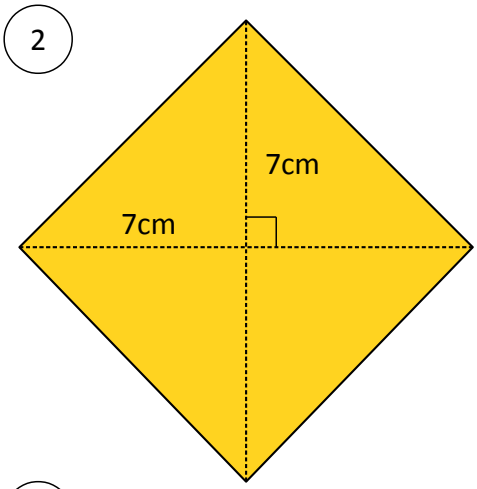
Fitness check

Calculate the area of the following rhombi...

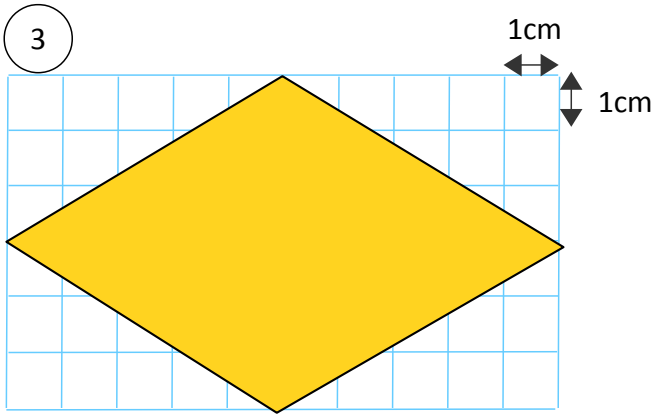
1



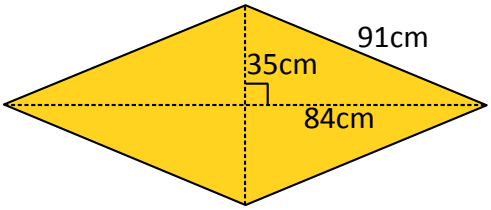
2



3



4



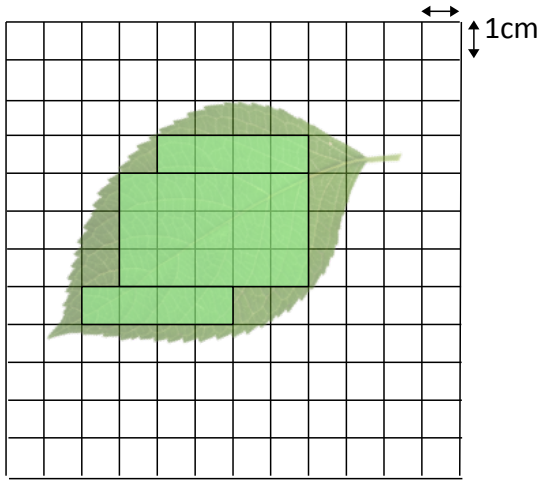


Jon

Let's try and find the approximate area of a leaf by using a grid...

We can find the approximate area of the leaf by using a grid.





(1) Firstly, count the number of small squares that are completely inside the leaf...

(1) squares

(2) Now,count he number of small squares that are partially inside the leaf...

(2) partial squares

(3) Assume the area of each partial square that is inside the leaf as half of the area of one square. So (2) ÷ 2 ...

(3) squares

(4) Add (1) and (3) together to find an estimate for the area of the leaf.

(1) + (3) = (4)

Using this strategy, estimate the area of the leaf.

Using this strategy, can you estimate the area of various shapes?

Let's think about how we can estimate larger areas

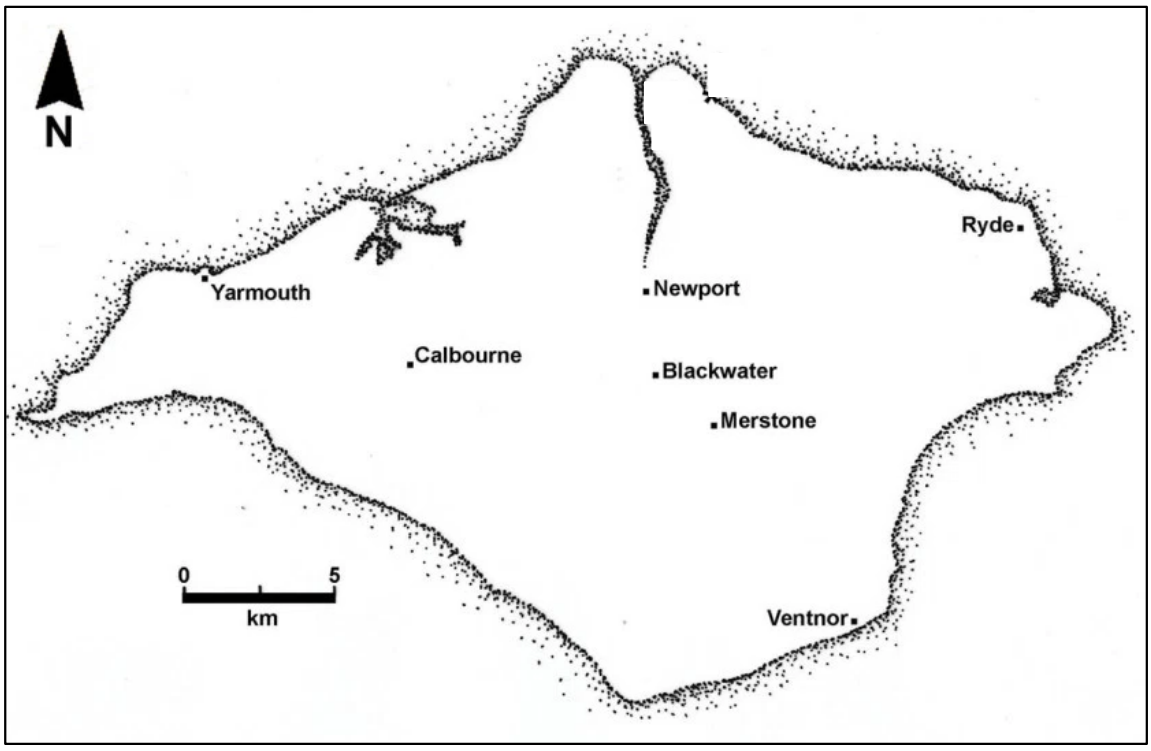


Jon

To express a large area like the area of country, a county or an even an island, we use a square with 1km sides as the unit.

The area of a square with 1km sides is 1 square kilometre, and is expressed as $1km^2$.

6 Can you estimate the area of the Isle of Wight using the grid method?

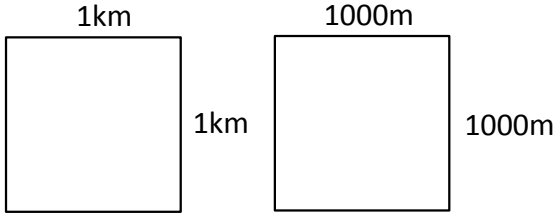




Amber

What would the area of the Isle of Wight be if I worked in metres instead of kilometres?

7 Can you express in $1km^2$ in terms of m^2?
The diagram below might help.



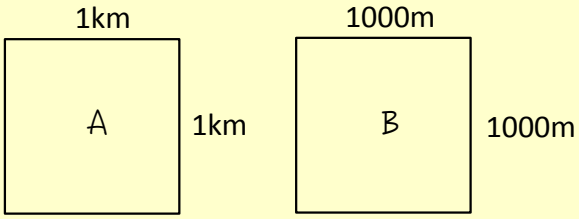
Let's think about how we can estimate larger areas



Sarah

Sarah's working

Area A = 1 x 1 = 1km²
Area B = 1000 x 1000 = 1000000m²
But they are the same area
So 1km² = 1000000m²



A new unit of measure

For large areas we often measure the area in **hectares** where

1 hectare is written as **1ha** and represents an area of 10 000m².

8 Can you work out how to convert 1km² into hectares?

Changing units

Convert

1. 9000cm² into m²
2. 5km² into m²
- 5km² into hectares
4. 30 hectares into m²
5. 30 hectares into km²
6. 750 000m² into hectares



Taro

I thought the Isle of Wight looks a bit like a rhombus. So I estimated the area from the measurements of my rhombus.

9 Can you use Taro's idea to estimate the area of the Isle of Wight? How did your answers compare?

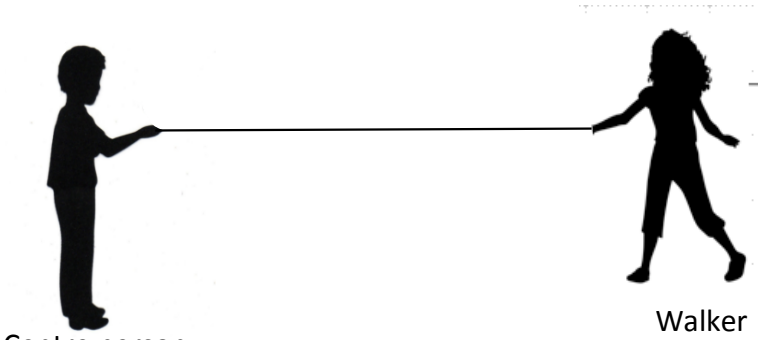
Let's think about how we can estimate larger areas

10

Estimate the area of the Isle of Man either by the grid method or by replacing it with a suitable shape.



How far is it around a circle?



Centre person
(CP)

Walker
(W)

This is an outdoor activity. It will begin with your teacher demonstrating what you have to do. You will need your notebooks with the table shown below pre-drawn, a pen and a ball of string. You will then work in pairs.

Initially the walker (W) and the centre person (CP) stand together each holding the string.

The walker then steps out five paces and hold the string taut and marks the starting position.

The centre person then pivots on the same spot as the walker moves round keeping the string taut.

The walker counts the number of steps taken before reaching the start position.

You then swap over and repeat the process, this time taking a different number of steps before deciding on the starting position.

Before each turn, make a guess as to how many paces it will take to complete the walker's journey.

Radius	5	9	7	6	10	...	...
My guess							
Our steps							

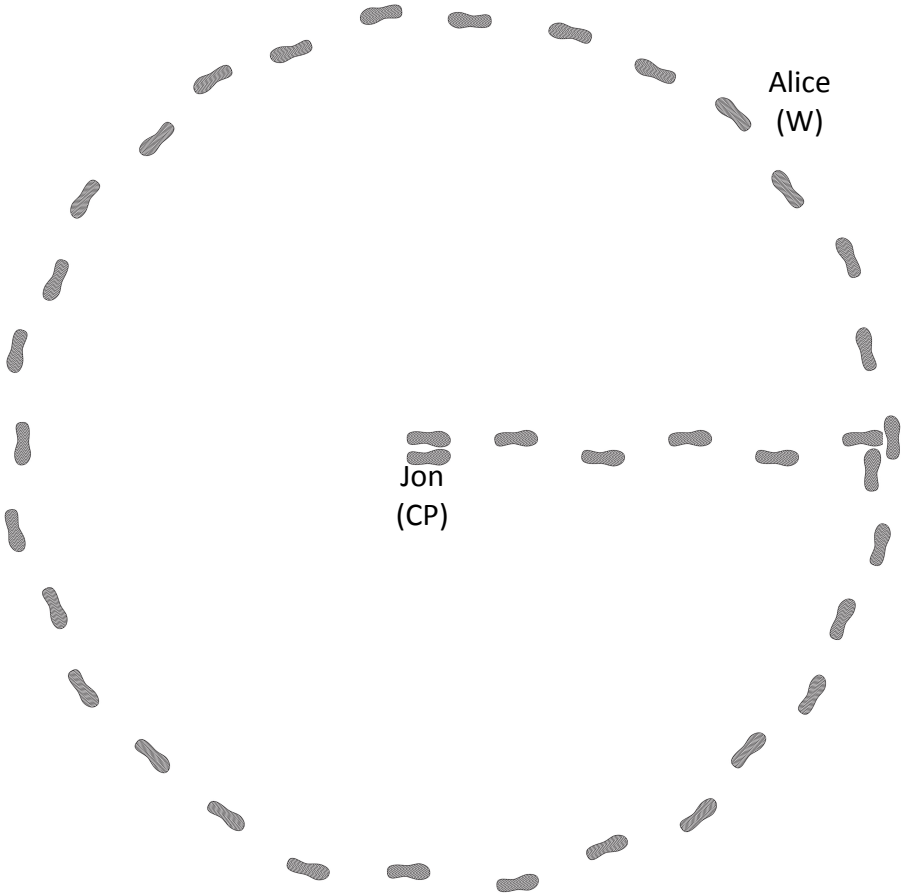
Some questions for you to think about.

1. How would you describe the path the walker takes each time?
2. Are your guesses becoming more accurate?
3. Can you see a relationship between the distance round the circle and the distance out from the centre?
4. Does the relationship work in all cases?
5. Does it matter if you take big steps or small steps?



Alice

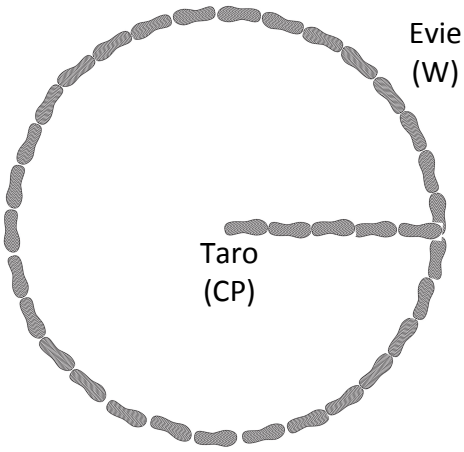
I stepped out 5 paces from Jon and then it took me 30 paces to go round in a circle.





Evie

I used tiny steps. I took 5 small steps out but I also took 30 steps around the circle.





Taro

So the size of your step makes no difference. That's a surprise.



Matthew

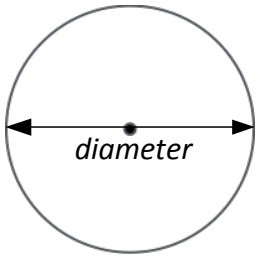
Matthew's results

Radius	5	9	7	6	10
My guess	25	50	43	36	60
Our steps	31	55	42	36	61

The distance around the outside is always about six times the radius.

11

The length around a circle is called the circumference. Investigate the relationship between the diameter and the circumference of a circle.





Jon

We could make circles out of paper strips and measure the diameters?

Or we could estimate the circumference from the perimeters of polygons drawn inside and outside of a circle ...



Matthew



Sarah

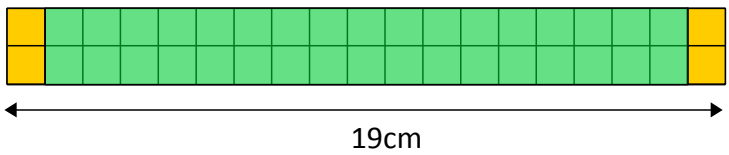
Or we could just measure some everyday round objects.

Investigating Jon's idea



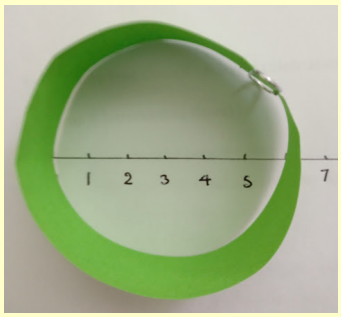
Jon

I began by cutting out a strip of paper 19cm long and two centimetres wide from a sheet of 1cm square paper. I formed a ring by overlapping the two orange coloured rectangles. I then measured the diameter of the ring.



The circumference is now 18cm and the diameter is 6cm.
My other results are:

Circumference	Diameter
24cm	8cm
30cm	10cm
60cm	20.5cm



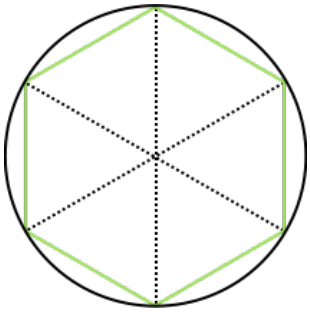
The circumference is always roughly three times the diameter.

Investigating Matthew's idea

Using Matthew's idea, estimate about how many times longer the circumference is than the diameter.

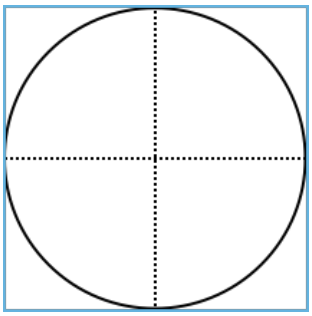

Matthew

I began by drawing a regular hexagon with a diameter of 12cm. I then drew a circle with radius 6cm with the same centre.



The circumference of the circle is a little more than the perimeter of the regular hexagon.

I then drew a square with sides 12cm to surround the circle as shown on the right.

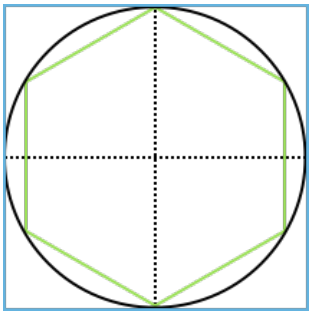


The perimeter of the square is more than the circumference diameter of the circle?


Matthew

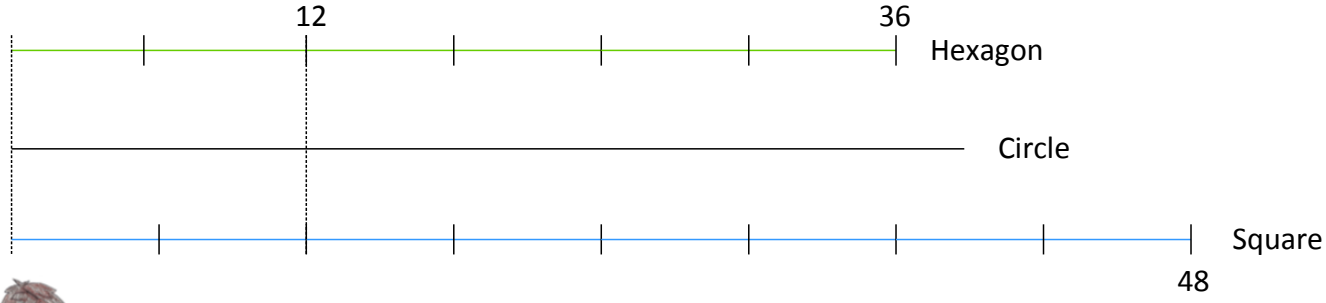
Mathew's results

The perimeter of the hexagon is 6 x 6 = 36cm.
The diameter of the circle is 12 cm and so the circumference is more than three times the diameter of the circle.
The perimeter of the square is 4 x 12 = 48cm.
And so the circumference is less than four times the diameter of the circle.




Matthew

I then straightened out the perimeters and used a length of cotton to measure the circumference of the circle. Here are my results




Matthew

So the circumference of a circle is a little bit more than three times the diameter.

Investigating Sarah's idea



Sarah

I measured the diameters and circumferences of various circular objects you see around you. I measured them with a ruler to 1dp and summarised my data in a table as shown below.













	Frying pan	Mug	Green Tray	Silver tray	Wheel	Flower pot top	Flower pot bottom
Circumference (cm)	22	25	79	63	195	53	41
Diameter (cm)	7	8	25	20	62	17	13
Circumference ÷ diameter	3.14	3.13	3.16	3.15	3.15	3.12	3.15

What is the ratio of the circumference to the diameter in each case?

Round your answer to the hundredths place. Write them in the bottom row of the table above.

12 What do you notice about the ratio of the circumference to the diameter in any circle? What conclusion can you make?



Matthew

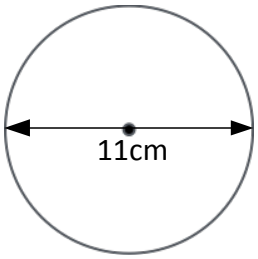
In fact the ratio of the circumference to the diameter is a constant, called pi, a Greek letter written as π. The value of pi is about 3.14.

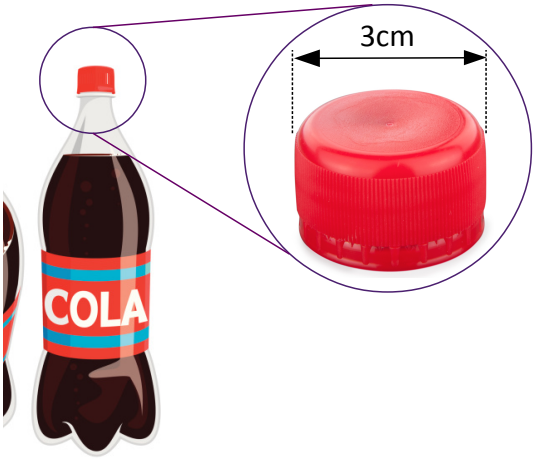
Pi = Circumference ÷ Diameter, which also means the circumference = Pi x diameter

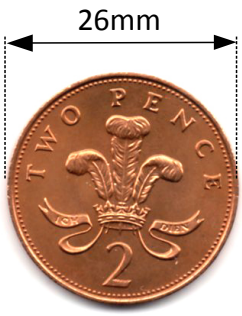
The is normally written as C = πd or C = 2πr where r is the radius of the circle

13 Using this formula, what is the circumference of a circle with diameter 14cm?

Now find the circumferences of these circles...

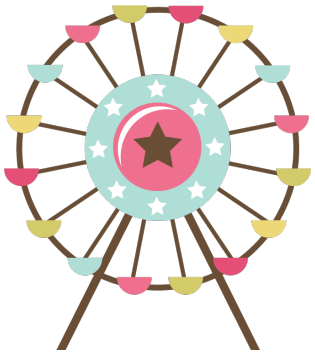






The trundle wheel on the right has a circumference of 1m. What is the diameter of the wheel on this trundle wheel? Round your answer to the nearest tenths place.





A Ferris wheel is in the shape of a circle with a 40m radius. When this Ferris wheel makes one rotation, how far will the passenger car travel?

1. Using a circle with a radius of 5cm, draw a regular pentagon and a regular hexagon.

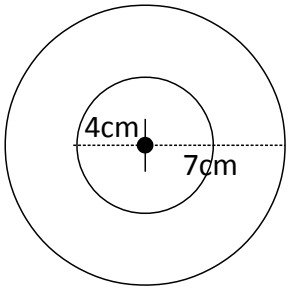
2. Find the circumferences of...

   a) a circle with a diameter of 6cm

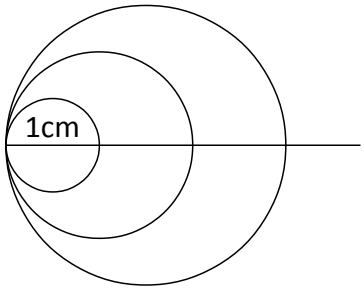
   b) a circle with a radius of 7cm

3. What is the diameter of a circle if its circumference is 314m?

4. In the diagram on the right, how much longer is the length of the circumference of the outer circle compared to the length of the circumference of the inner circle?

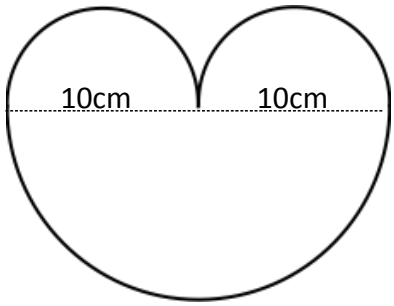


5. Is the length of the circumference proportional to the length of the radius? Investigate by completing the table below...



Radius (cm)	1	2	3	4	5	6
Circumference (cm)						

6. Find the length around the heart shape figure



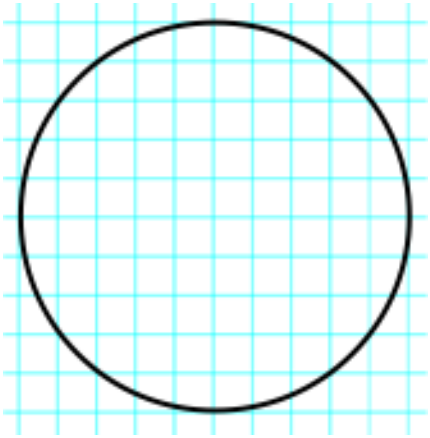
7. There is a circle with a radius of 4cm and a circle with a radius of 5cm. The sum of the circumferences of these two circles is equal to the circumference of a circle with a radius of how many cm?

Let's think about how we can estimate the area of a circle



Alice

Based on the figures that are enclosed with straight segments...





Sarah

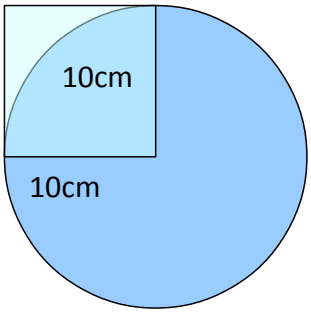
Since the size of a circle is determined by the length of its radius, I think there may be a relationship between the area and the radius..

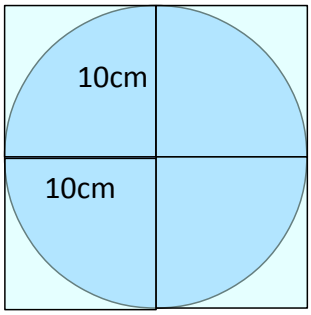
Let's think about how to work out the area of a circle

14

Let's think about how we might estimate the area of a circle with a radius of 10cm. Think about comparing it to the area of a square with 10cm sides.

Use the figures below to estimate the area

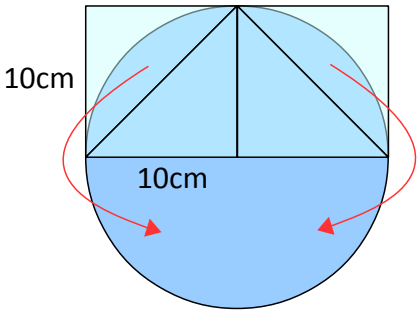






Matthew

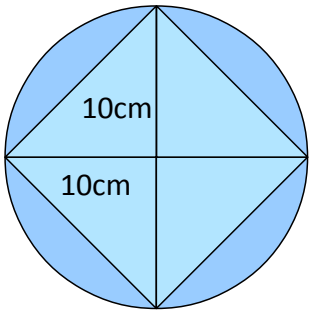
The area of the circle is less than 4 times the area of the square.



But more than two times the area of the square



Evie



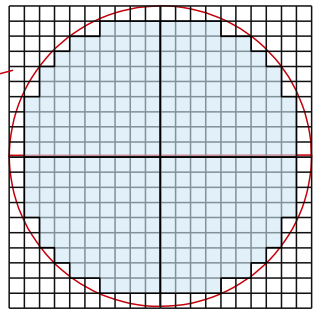
15 Let's think about how we might estimate the area of the circle more accurately.

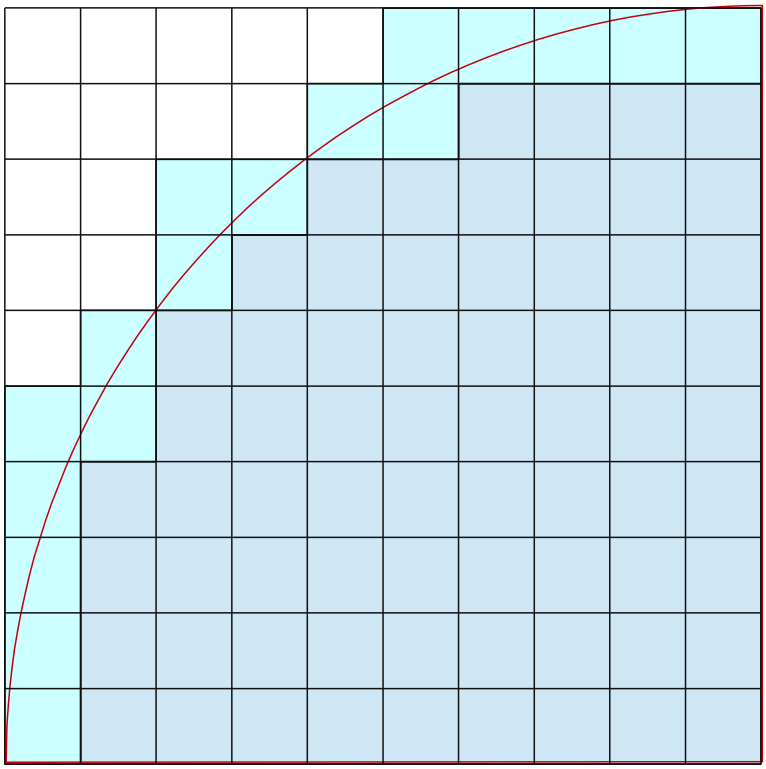


Matthew

We could think about how many $1cm^2$ squares there will be...

So I drew an accurate diagram on 1cm grid paper and counted the number of squares in the circle.





The number of ☐ squares is ☐ and the area they cover is ☐ cm^2.

The number of ☐ squares is ☐

I am counting each of these as half a covered square and so the area they cover is ☐ cm^2.

My estimate for this area is ☐ cm^2

And so my estimate of the area for the whole circle is ☐ cm^2.

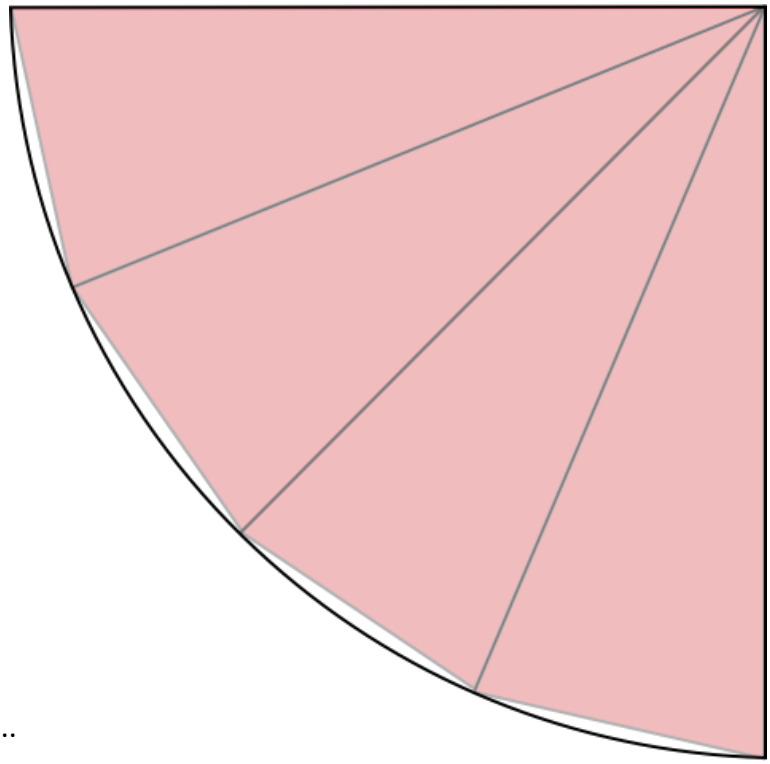
Based on Matthew's method, about how many times as big is the area of a circle with a radius of 10cm than the area of a square with 10cm sides? ☐

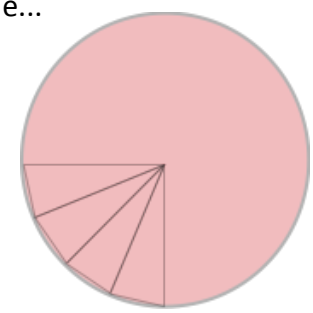
Area of Circles



Evie

I worked out my estimate by drawing a regular 16-a-gon inside the circle...





One Triangle...

Base ☐ cm

Height ☐ cm

Area ☐ x ☐ ÷2 = ☐

Area of circle...

☐ X 16 ☐ = ☐

Answer about ☐ cm^2

What will happen if we increase the number of vertices of a regular polygon?



Sarah

Based on Evie's method, about how many times as big is the area of a circle with a radius of 10cm than the area of a square with 10cm sides? ☐

Discuss what you have observed about these results.

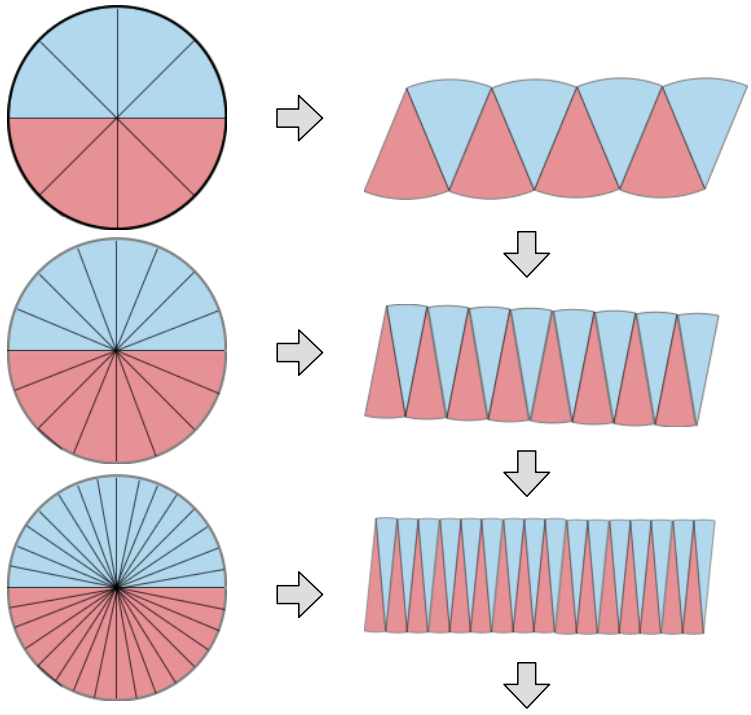
It seems like the area of a circle is also related to Pi



Jon

Area of Circles

16 Look at the picture below and think about a formula to calculate the area of a circle.



If we keep dividing the circle into smaller and small pieces and rearrange those pieces, what shape is it becoming?

A half of the circumference can be calculated by diameter x Pi ÷ 2, which equals the radius x Pi

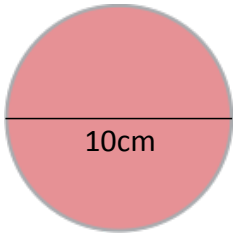

Jon

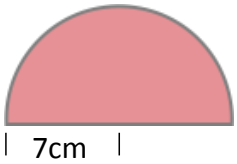
The area of a circle can be calculated using the following formula...

Area of Circle = Radius x Radius x Pi = πr^2

1) Calculate the area of a circle with a radius of 10cm using the formula above.

2) Calculate the area of the following circles.





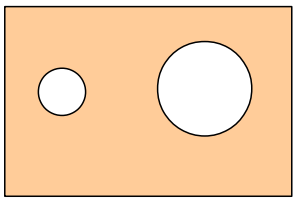


Compound shapes

Some questions to try

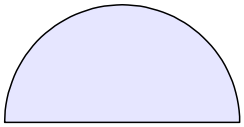
1. A circle has radius 5cm.
   a) Calculate the diameter of the circle.
   b) Calculate the circumference of the circle.
   c) Calculate the area of the circle

2. A rectangular card measure 12cm by 8cm. Two circular holes are cut in the card, one with radius 2cm and the other with radius 4cm.



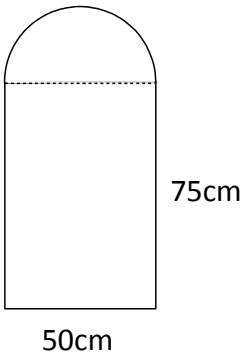
   a) What is the area of each circle?
   b) What is the remaining area of card after the circles have been removed?
   c) Would the area of card remaining be more or less if instead a circle of radius 6cm had been removed?

3. Calculate the area and the perimeter of a semicircle with diameter 13cm.

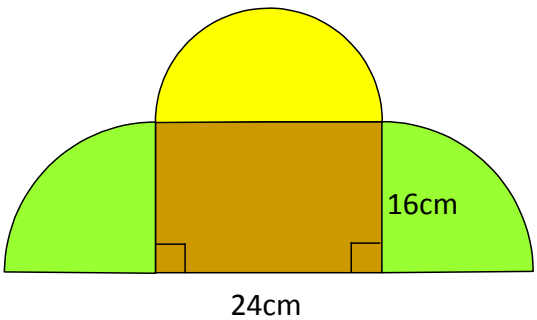


4. The circumference of a circle is 37cm.
   a) Calculate the radius of the circle.
   b) Calculate the area of the circle.

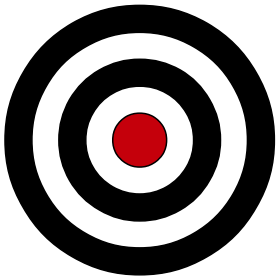
5. The diagram shows an arch window made in the shape of a semicircle on top of a rectangle. Calculate the area of the window.



6. Calculate the area of the mask shown below.



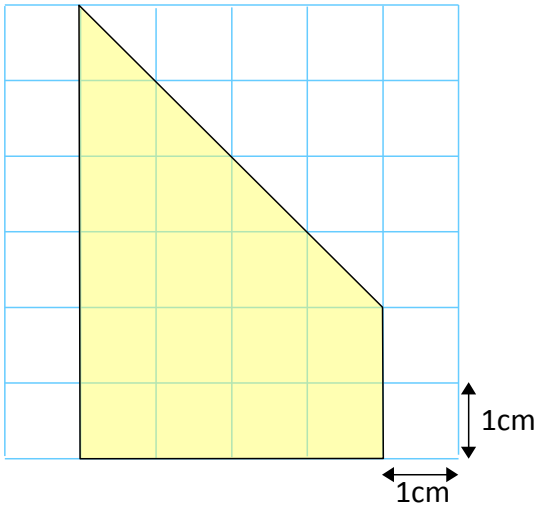
7. A target is made of 5 concentric circles each with a radius of 1cm more than the previous circle. If the third circle has a radius of 5cm, what is



   a) What is the radius of each circle?
   b) Calculate the area of each colour.

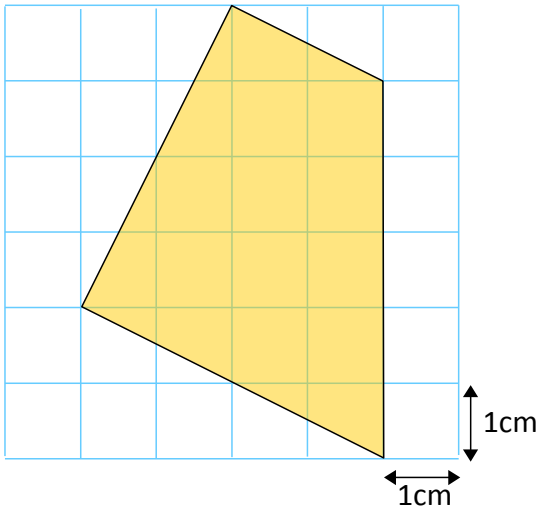
Geometry 3c: Mastery questions (area)

1. A trapezium is placed on a grid of 1cm by 1cm squares as shown.
   What is the area of the trapezium?



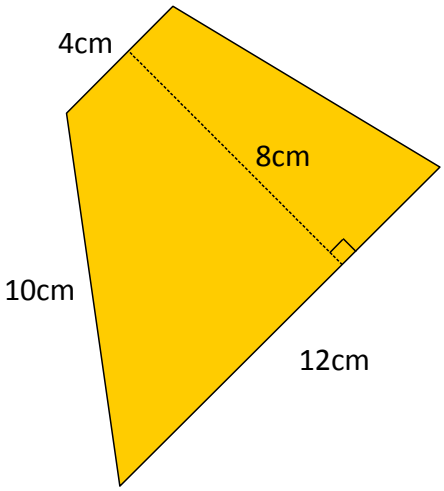
A	B	C	D
$32cm^2$	$20cm^2$	$16cm^2$	$12cm^2$

2. What is the area of this trapezium?



A	B	C	D
$12cm^2$	$15cm^2$	$18cm^2$	$20cm^2$

3. What is the area of this trapezium?

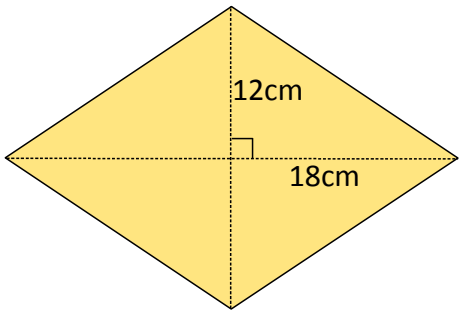


A	B	C	D
$64cm^2$	$80cm^2$	$34cm^2$	$128cm^2$

Geometry 3c: Mastery questions (area)

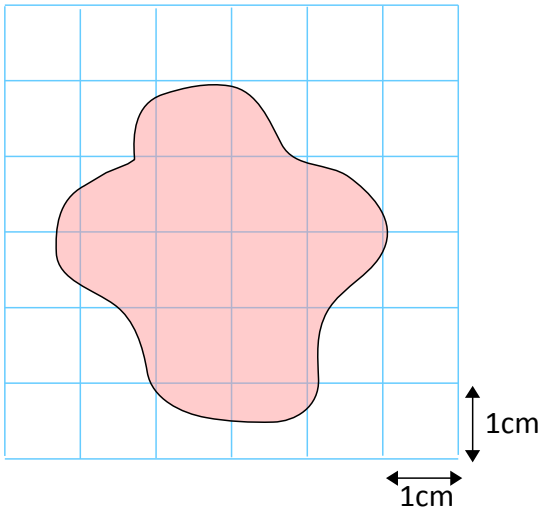
4. What is the area of the rhombus?

A	B	C	D
$30cm^2$	$54cm^2$	$108cm^2$	$216cm^2$



5. Estimate the area of this shape

A	B	C	D
$8cm^2$	$10cm^2$	$12cm^2$	$14cm^2$

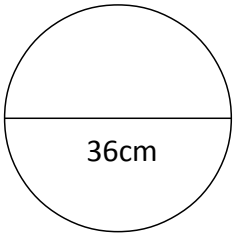


6. The distance around a circle is ...

A	Just less than six times the radius
B	Exactly six times the radius
C	Just over six times the radius
D	Just over three times the radius

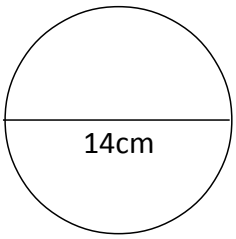
7. The circumference of this circle is approximately ...

A	B	C	D
108cm	54cm	144cm	216cm



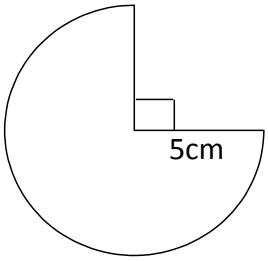
8. What is the circumference of this circle to 1dp?

A	B	C	D
42.0cm	44.0cm	84.0cm	88.0cm



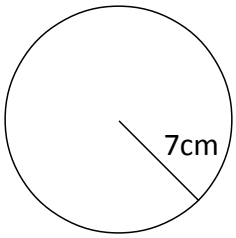
Geometry 3c: Mastery questions (area)

9. What is the circumference of this shape (to 1 dp)



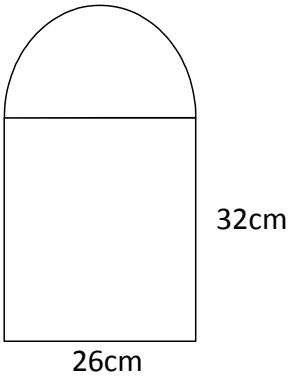
A	B	C	D
31.4cm	23.6cm	33.6cm	41.4cm

10. What is the area of this circle (to 1 dp)?



A	B	C	D
153.9cm^2	154cm^2	44cm^2	307.9cm^2

11. This shape is made from a rectangle and a semi-circle. What is its area (to 1 dp)?



A	B	C	D
832.0cm^2	530.9cm^2	1097.5cm^2	1362.9cm^2

12. A circle has a circumference of 51.52cm. What is the radius of the circle (to 1 dp)

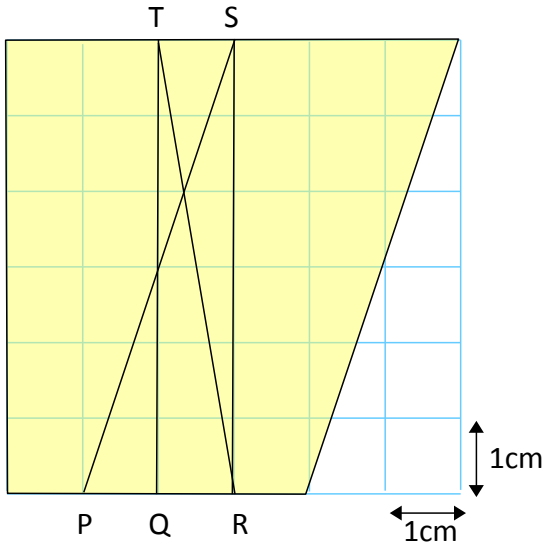
A	B	C	D
16.4cm	8.2cm	8.6cm	17.2cm

13. A semi-circle has an area of 138.80m. What is the diameter of the semi-circle to 1dp?

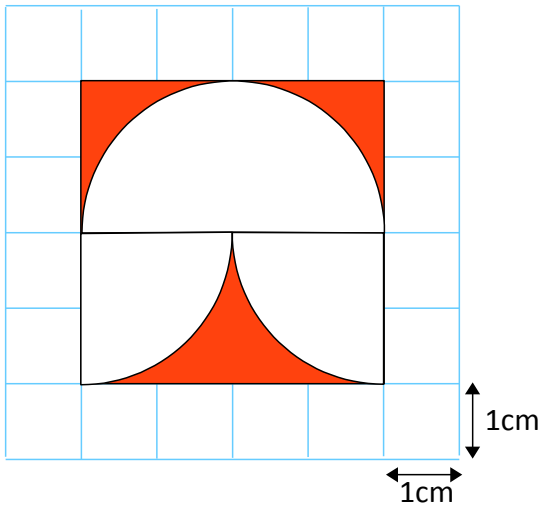
A	B	C	D
18.8cm	9.6cm	19.2cm	9.4cm

14. Which of these lines cuts the shaded area into two equal areas? You must show your working.

A	B	C	D
PS	QT	RT	RS



15. Calculate the red area in this badge. You must show your working.



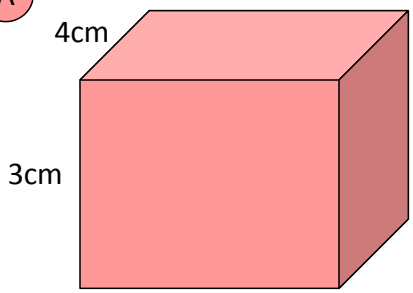
Let's think about how to calculate volume



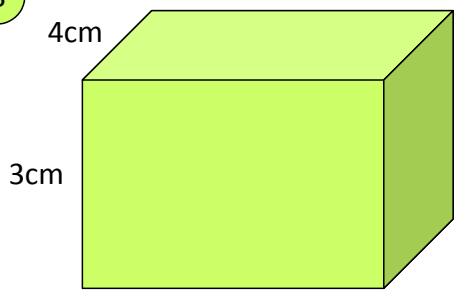
Alice

Which one takes up the most space?

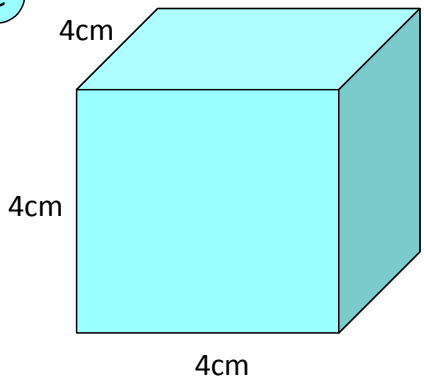
A



B



C



If you compare A and B, then ...



Jon

If you compare A and C then ...



Sarah



Matthew

But how do you compare B and C?

1

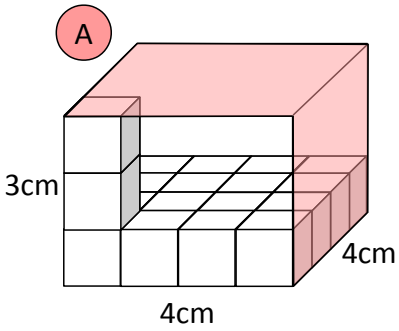
Which one takes up the most space B or C and by how much.
Let's think about how to compare them.

Let's think about how to calculate volume



Taro

This is how I think about calculating the volume of a cuboid.



2

Can you explain how this diagram shows you how to calculate the volume of a cuboid?



Sarah

You can get 16 on the bottom layer.

… and there are 3 layers.



Jon

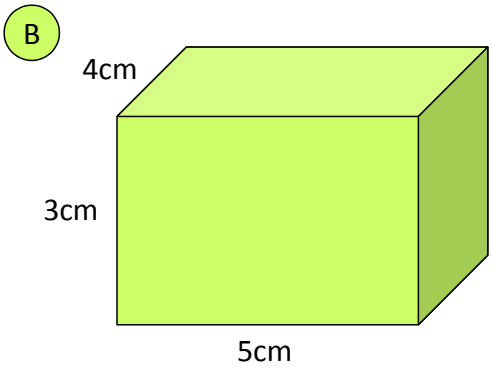


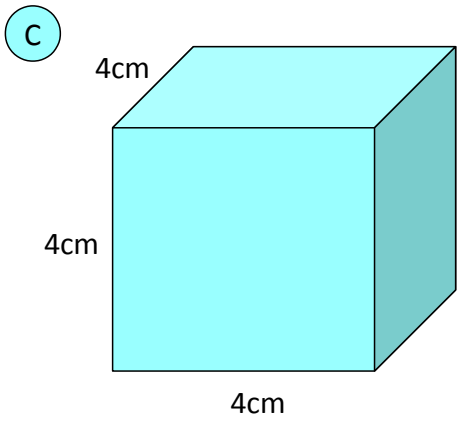
Alice

So the volume is 16 x 3 = 48cm^2.

3

Use Taro's approach to find the volume of the other two cuboids and then put all 3 in ascending order by volume.





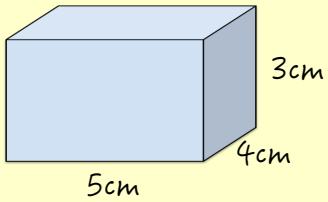


Alice

I've thought of an easy way of calculating the volume of a cube or a cuboid.

Alice's idea

Calculate the area of the base that's $5 \times 4 = 20cm^2$ (which is also how many cubes will fit on the base) and then multiply by the height (which is the number of layers).
So the volume is $20 \times 3 = 60cm^3$.





Matthew

Matthew's notes

The volume of cubes and cuboids can be calculated using the following steps..

Measure the length, width and height
Multiply the three numbers that express the lengths of the three edges

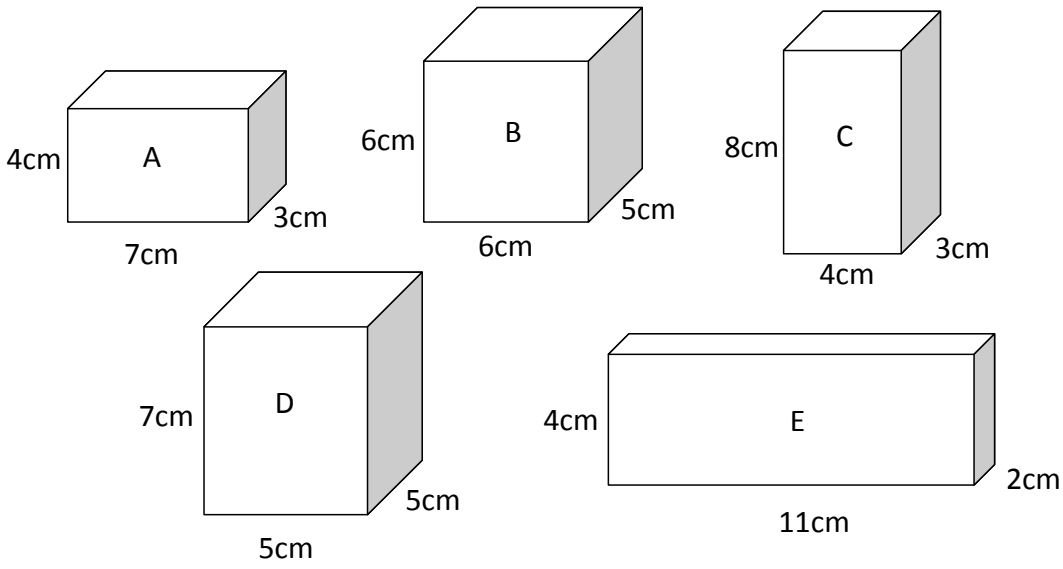
The volume of cubes can be calculated using the following formulas...

Volume of cuboids = length x width x height
Volume of cubes = edge x edge x edge

4

Can you explain why Matthew's and Alice's ideas always give the same answer?

1. Using these ideas, put these cubes in ascending order by volume.

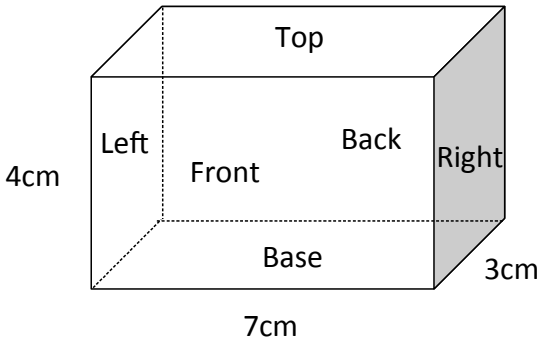


Let's think about how to calculate surface area



Mr T

If we want to paint the outside of a solid cube, then we have to paint the six faces.
By the surface area of a cuboid, we mean the total area of the six faces.



5 Can you find the surface area of this cuboid?



Amber

Matthew's notes

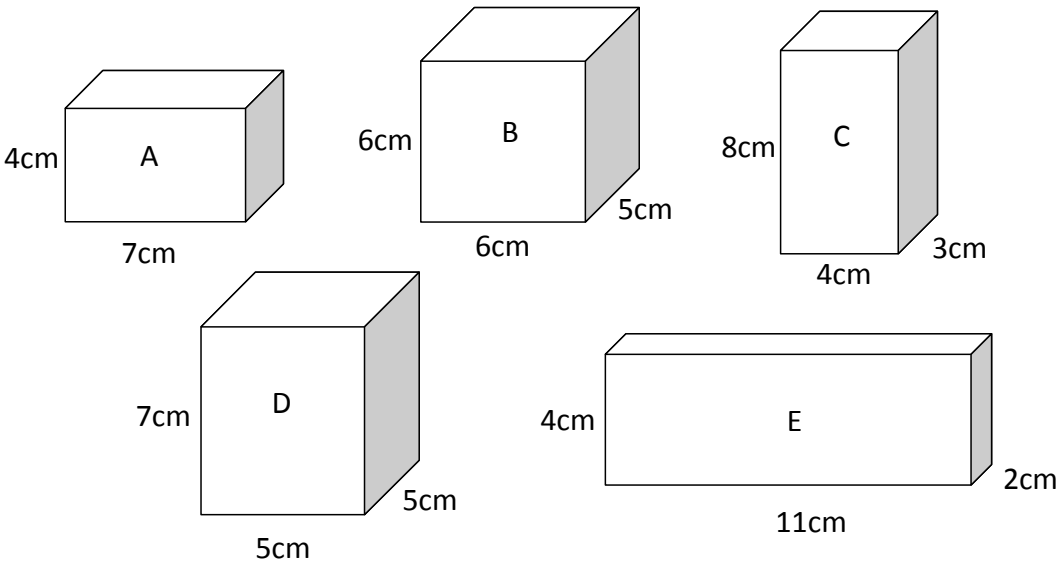
The area of the front and back faces are both $7 \times 4 = 28cm^2$

The area of the side faces are both $3 \times 4 = 12cm^2$

The area of the top and base are both $3 \times 7 = 21cm2$

So the total surface area is $2\ (28 + 12 + 21) = 2 \times 61 = 122cm^2$.

2. Using these ideas, put these cubes in ascending order by surface area.



Let's think about how to calculate the volume of compound shapes



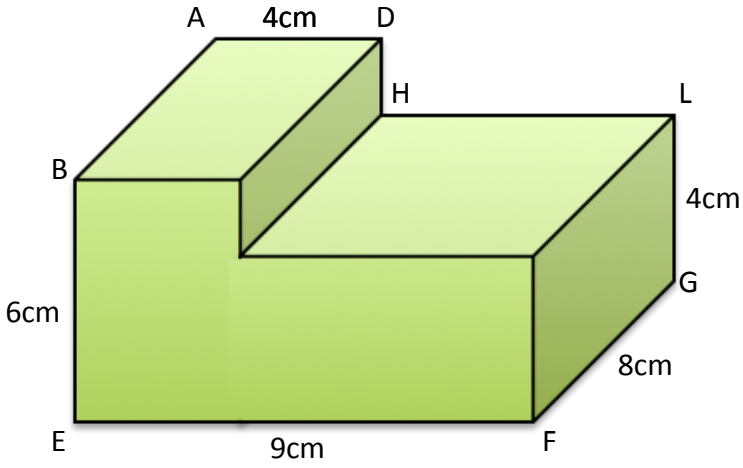
Mr T

Think about how you might find the volume of compound shapes.



Jon

Let's think about how found the area of compound shapes. That might help.



6

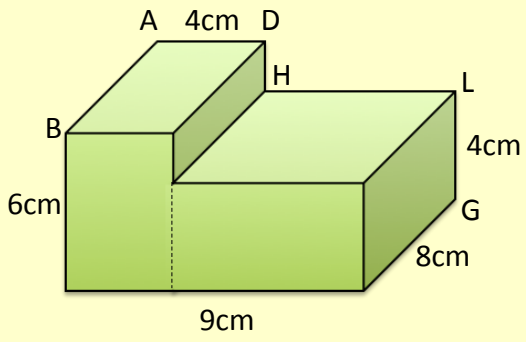
Write down your ideas so that other people can understand them.

1. Express your idea using pictures, maths sentences and words.



Amber

Amber's notes



The volume of the shape will be

$4 \times 6 \times 8 + 5 \times 4 \times 8$

$= 192 + 160 = 352 cm^3$.

7

Can you explain Amber's thinking and her calculation?



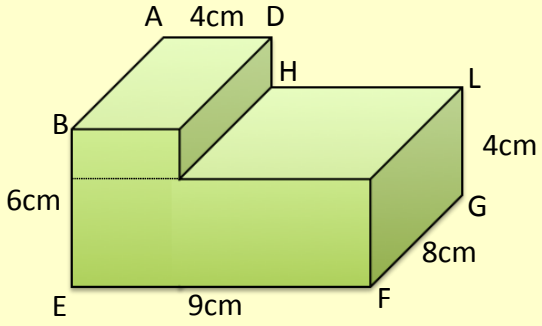
Mr T

Here are three more ideas. In each case can you explain their thinking and their calculation?

Sarah's notes



Sarah



The volume of the shape will be

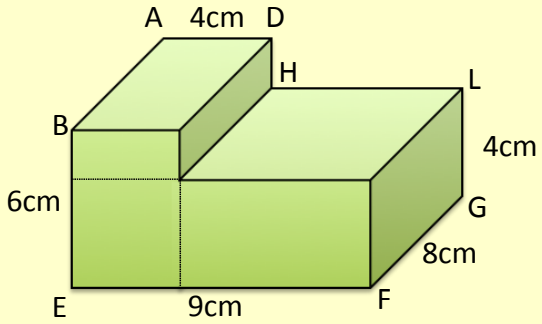
$4 \times 9 \times 8 + 4 \times 8 \times 2$

$= 288 + 64 = 352\text{cm}^3$.

Alice's notes



Alice



The volume of the shape will be

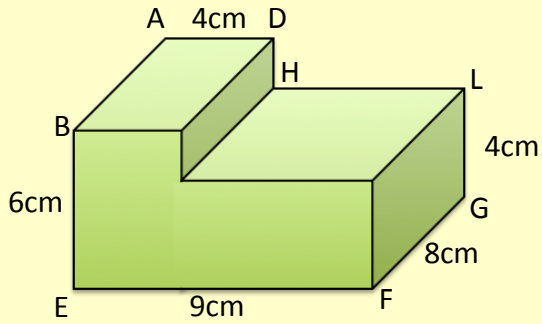
$4 \times 2 \times 8 + 4 \times 4 \times 8 + 4 \times 5 \times 8$

$= 64 + 128 + 160 = 352\text{cm}^3$.

Taro's notes



Taro



The volume of the shape will be

$6 \times 9 \times 8 - 5 \times 2 \times 8$

$= 432 - 80 = 352\text{cm}^3$.

8

Can you explain in what way Taro's method is different to the other three solutions?



Jon

Jon's notes

In each of the first 3 cases, the compound shape was split into cuboids.
They used what they already know about calculating the volume of a cuboid.
They then added the bits together to find the whole volume.
Taro actually added another cuboid onto the compound shape to make it a cuboid.
He then used his previous knowledge to work out the volume of the new cuboid and subtracted the volume of the cuboid he had added.



Evie

So we can either split the shape into cuboids or add pieces on to make a cuboid

And then all we need to do is use what we have learned so far, don't we?

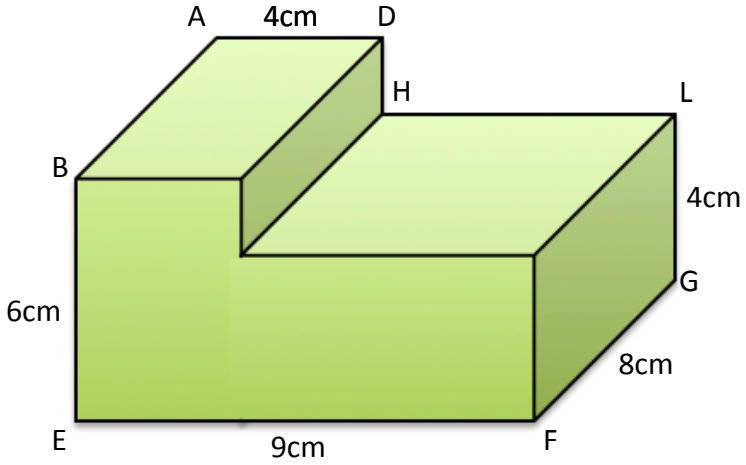


Alice



Mr T

Let's now think about how we can find the surface area of compound shapes.



9

Can you work out the surface area of this shape?

Matthew's notes



Matthew

There are 6 rectangular faces

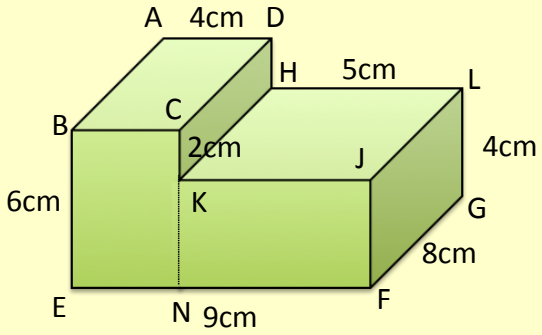
FGLJ area $4 \times 8 = 32cm^2$

JLHK area $5 \times 8 = 40cm^2$

KHDC area $2 \times 8 = 16cm^2$

ABCD area $4 \times 8 = 32cm^2$

ABEM area $6 \times 8 = 48cm^2$



EFGM area $9 \times 8 = 72$ (M is a hidden vertex)

The front is made up of 2 rectangles

BCNE area $= 6 \times 4 = 24cm^2$

NFJK area $= 5 \times 4 = 20\ cm^2$

The area of the front face will be $24 + 20 = 44cm^2$

The area of the back face will also be $44cm^2$

So the total surface area is

$32 + 40 + 16 + 32 + 48 + 72 + 44 + 44 = 328cm^2$

Sarah's notes



Sarah

My idea is much simpler

Imagine the 6 rectangles are made from one piece of card that is 30cm x 8cm

Then the area of the card is $240cm^2$

The front and rear faces are both $44cm^2$ as Matthew said.

So the total area is $240 + 88 = 328cm^2$

Taro's notes



Taro

My idea is quite different.

Imagine you split the shape into two cuboids

Then the surface area of the left hand cuboid is

$2(6 \times 8 + 4 \times 8 + 6 \times 4) = 2 \times 104 = 208cm^2$

The surface area of the right hand cuboid is

$2(5 \times 8 + 4 \times 8 + 5 \times 4) = 2 \times 92 = 184cm^2$

But we didn't have to paint the area where they are stuck together

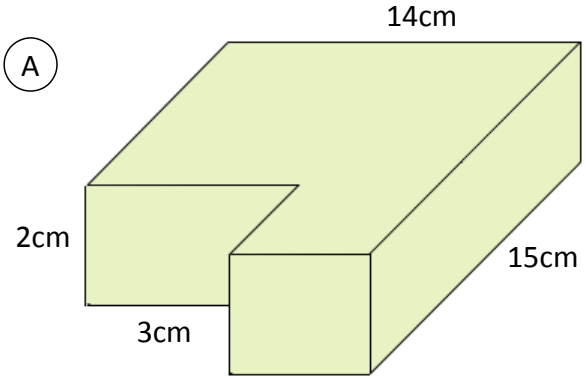
This area is $4 \times 8 = 32cm^2$

So the surface area is $208 + 184 - 2 \times 32 = 328cm^2$.

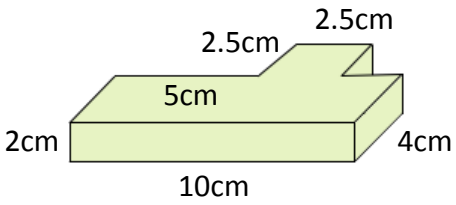
Fitness check

1. Each of these shapes is made from joining different cuboids together. Calculate the volume of each of these figures below in as many different ways as you can.

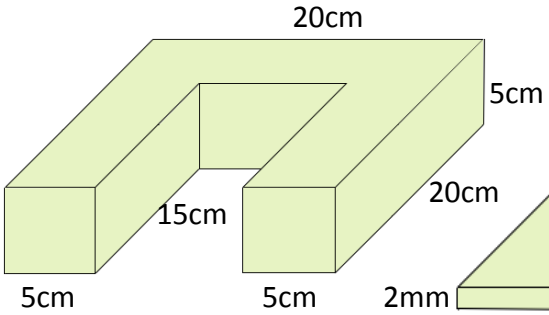
A



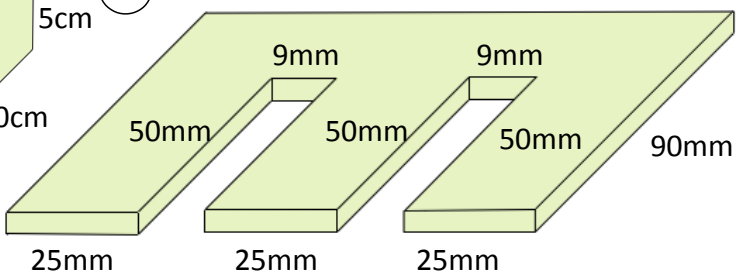
B



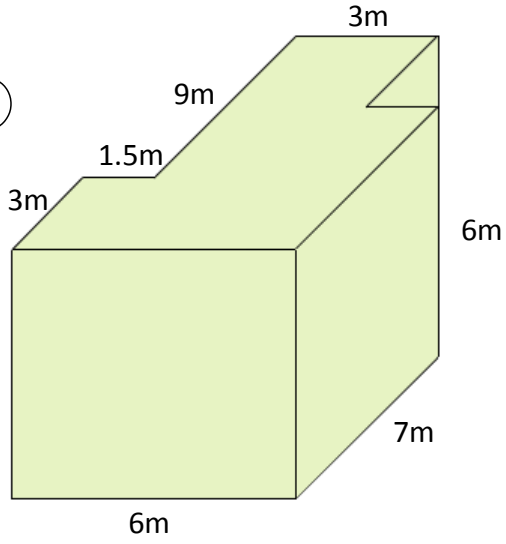
C



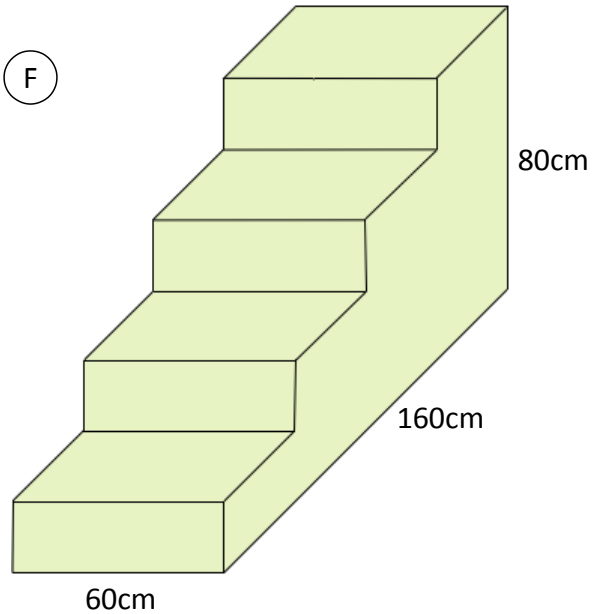
D



E



F



2. Find the surface area of each shape.

Let's think about estimating the volume of a room ...



Mr T

So far we have been finding the volume of fairly small cubes and cuboids. Today's activity is about measuring the volume of larger things such as our classroom.

9

Which units shall we use … do you think cubic centimetres will be appropriate?



Evie

A cubic centimetre would be too small.

Could we use cubic metres?



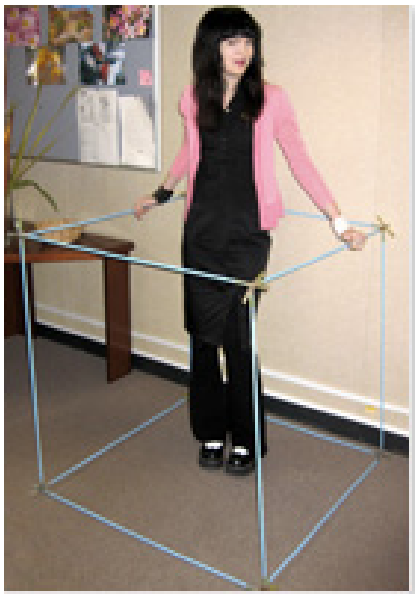
Alice



Mr T

To help you to visualise a cubic metre, using metre sticks, tape and wooden sticks, make a cube with a volume of $1m^3$





10

Now try to estimate the size of your classroom by visualising how many cubic metres would fit into the room.

Let's think about estimating the volume of a room ...



Jon

The floor of our classroom measures 8m by 7m.
So the area of the floor is $56m^2$.

The classroom could be modelled as a cube.
The height of the classroom is about 4m.

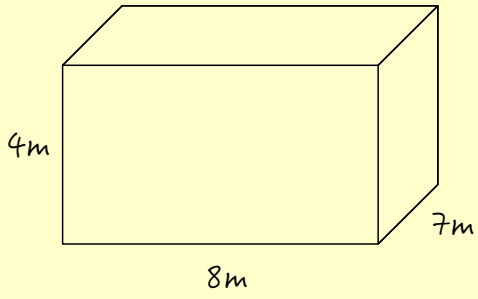


Amber



Matthew

Matthew's work



The volume of our classroom is roughly
$56 \times 4 = 224m^3$.



Mr T

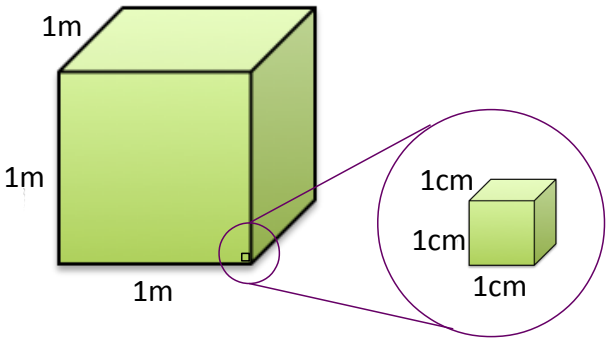
When we express the volume of large objects, we use cubes with 1m edges as the unit.



Evie

So how many centimetre cubes would fit into a cubic metre?

11 Can you work out the answer to Evie's question.
The diagram below might help.

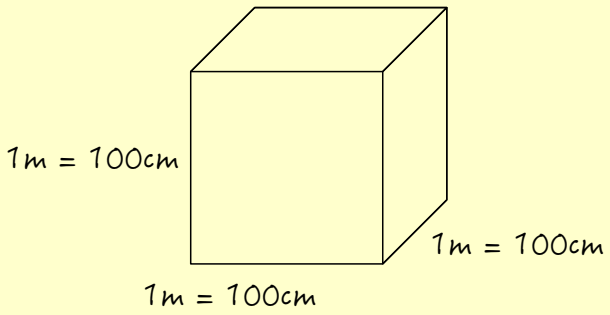


Let's think about using different units ...



Sarah

Sarah's working

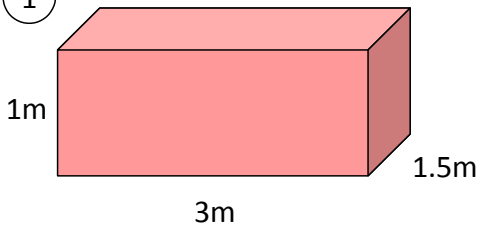


The volume of this cube is
100 x 100 x 100 =
1000000cm^3
So 1m^3 = 1000000cm^3

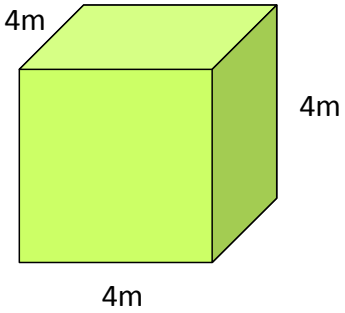
Fitness check

Calculate the volumes of these cubes and cuboids in both m^3 and cm^3.

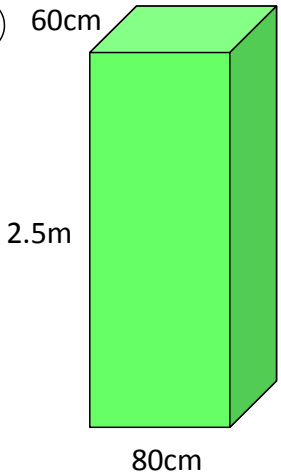
1



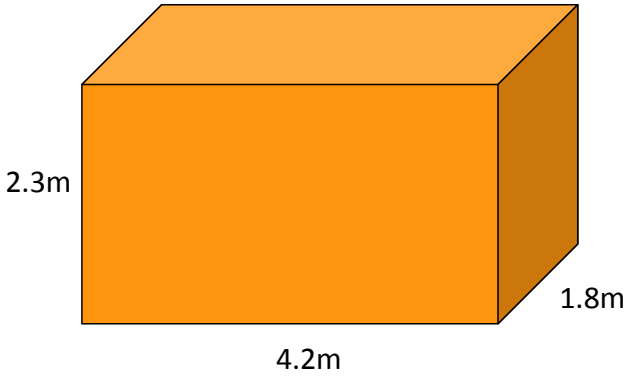
2



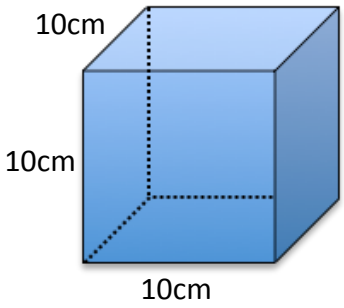
3



4



12 The picture on the right show a 1L cubic measuring cup, with side lengths of 10cm.
What is the volume of the water in the cup measured in cm^3?



1. How many $1cm^3$ cubes will fit inside a $1m^3$ cube?

☐ x ☐ x ☐ = ☐

Answer = ☐ cm^3

Measuring capacity

The amount of water or other liquids a container can hold is called its **capacity**. It is often measured in litres (L).

Smaller quantities are measured in millilitres (mL) where 1L = 1000mL.

But from our calculations above we can see that 1L is also equal to $1000cm^3$.

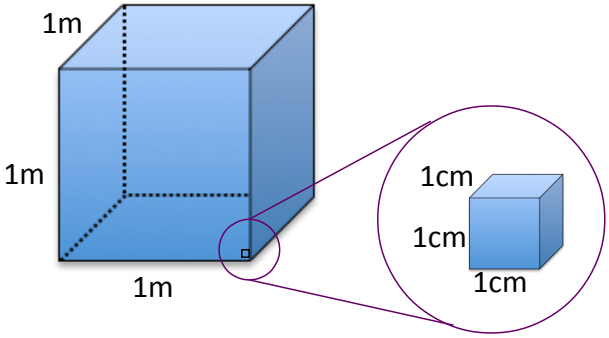
And that means that **1mL ʙ $1cm^3$** (ʙ is the **equivalent** sign which means it is the same as).

2. What is the capacity of the water tank on the right in cm^3?

   What is the capacity in litres?

3. Can you design a cubic or cuboid shaped container that would have a capacity of 0.1L?

4. Estimate the number of litres it would take to fill a rectangular swimming pool if the length is 50m, the width 25m and the depth of water is 2m.



A useful Summary

1L ʙ 1000mL ʙ $1000cm^3$

1mL ʙ $1cm^3$

1 000 $000cm^3$ ʙ $1m^3$

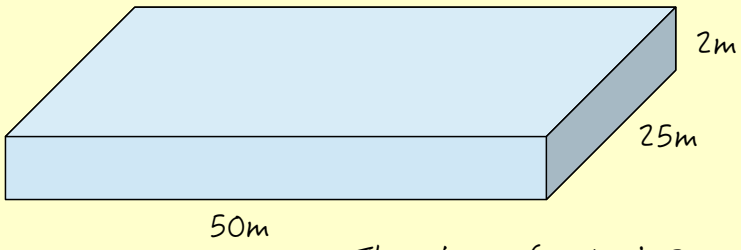
1 000 000mL ʙ $1m^3$

1000L ʙ $1m^3$



Alice

Alice's working for Q4



The volume of water is 50 x 25 x 2 = 2500m^3

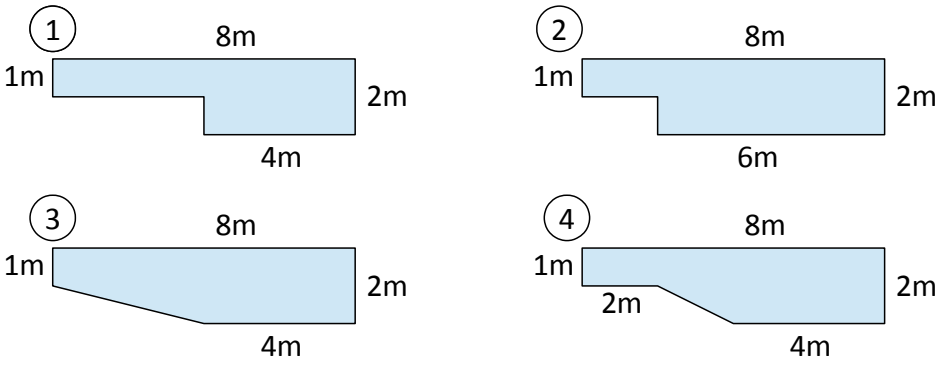
1m^3 ʙ 1000L

So the volume of water in the pool is 2500000L

Let's think about planning a swimming pool.



A hotel is planning to build a new swimming pool on their rear lawn. The swimming pool will be 8m long and 5m wide. The depth will vary to suit all ages. The designer has given them 4 possible side elevations.



Calculate

a) The volume of each pool in m^3.

b) The capacity of each pool in litres.

c) The time to fill each pool if water is pumped in at a rate of 100 litres per minute.

Let's think about rainfall ...



"There is a warning of very high rainfall over parts of the south and east of England today. Some areas will see 60 to 80mm of rain through the day.
There is a danger of flash flooding in many places."



Mr T

Our soccer pitch measures 90m by 60m.
Can you work out how much rain fell on the pitch?

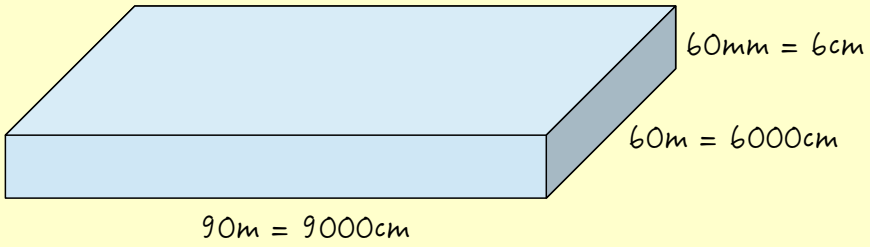


13 Work out how much rain fell on the soccer pitch if the rainfall was a) 60mm, b) 70mm, c) 80mm. What do you notice about your results?



Evie

Evie's working



If I work in cm, the rainfall would be $9000 \times 6000 \times 6 = 324000000cm^3$
So that is 324000L.
If the rainfall was 70mm (7cm), then the rainfall would be
$9000 \times 6000 \times 7 = 378000000cm^3$ or 378000L.
If the rainfall was 80mm (8cm), then the rainfall would be
$9000 \times 6000 \times 8 = 432000000cm^3$ or 432000L.
The amount of water goes up by 54000L for every extra 10mm of rain.

14 Can you explain why the amount of rain goes up by 54 000L for every extra 10mm of rainfall?



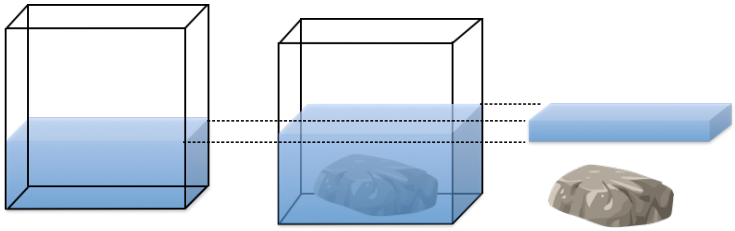
Mr T

Apparently the volume of a raindrop is approximately 1ml.
Can you estimate how many raindrops would have landed on you if you stood in the middle of the soccer pitch for every 10mm of rain? You must explain your thinking.

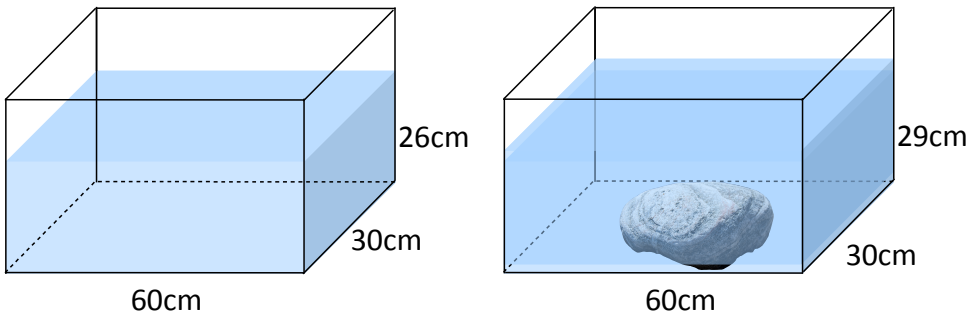
Maths Story: How to find the volume of a rock...

We can determine the volume of irregular shapes like rocks and eggs using the following method.

Submerge the rock in a tank of water. When the rock is submerged, the water level goes up in proportion to the volume of the rock. Therefore, if we use the new level to calculate the volume of the tank that has now been filled up, we can find out the volume of the rock.



1. For example, suppose you have a fish tank as shown below, filled to a depth of 26cm.



   After placing the rock in the tank, the depth of the water rose to 29cm. What is the volume of the rock?

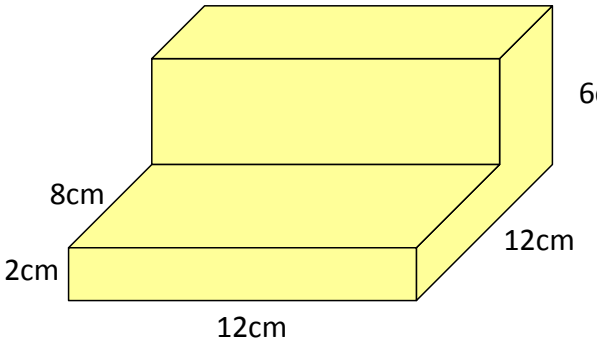
2. What difference would it make in the previous question if the depth of water had risen by 5cm instead?

3. If the total height of the tank is 48cm, how much water would the tank hold in litres?

4. Going back to Q1, how many similar shaped rocks could be put in the tank before it overflowed?

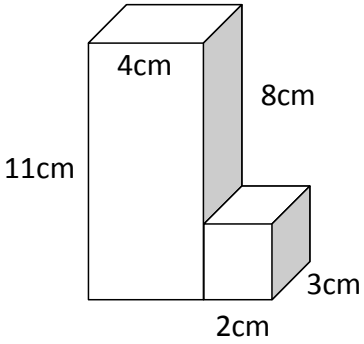
Geometry 3c: Mastery Questions (volume)

1. What is the volume of this compound shape made from various cuboids?



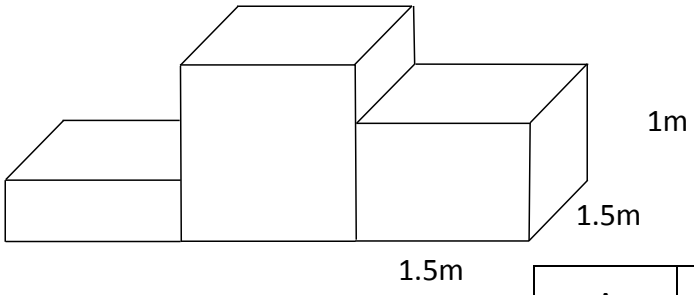
A	B	C	D
$40cm^3$	$480cm^3$	$576cm^3$	$864cm^3$

2. Which of these calculations is not correct to calculate the volume of this compound shape made from two cuboids?



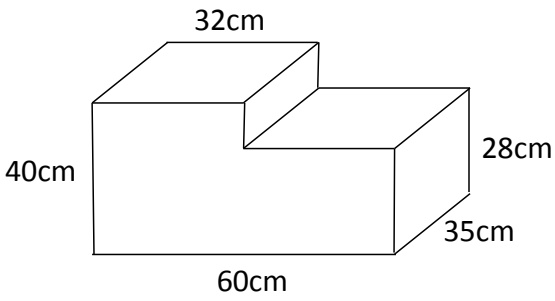
A	4 x 11 x 3 + 2 x 3 x 3
B	6 x 3 x 3 + 8 x 3 x 4
C	11 x 6 x 3 – 8 x 2 x 3
D	6 x 3 x 8 + 2 x 2 x 3

3. The rostrum at the school sports is made up of three square based cuboids of height 0.5m, 1m and 1.5m. What is the volume of the rostrum?



A	B	C	D
$2.25m^3$	$4.5m^3$	$6.75m^3$	$10.125m^3$

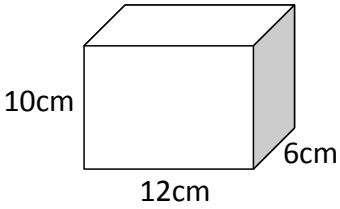
4. A fuel storage tank is made up of two cuboids. What is the capacity of the tank in litres?



A	B	C	D
7.24L	72.24L	722.4L	7224L

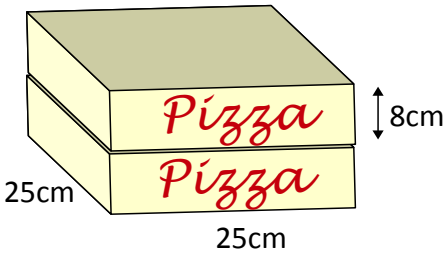
Geometry 3c: Mastery Questions (volume)

5. Evie's mum stores her homemade lemonade in cuboid shaped stone containers as shown below. If she has made 20L of lemonade, how many containers can she fill completely?



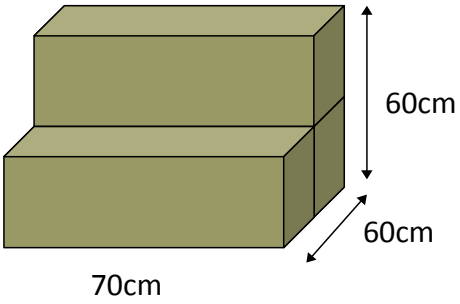
A	B	C	D
20	25	27	28

6. Two pizza boxes are stacked together as shown. What is the surface area of the shape formed?



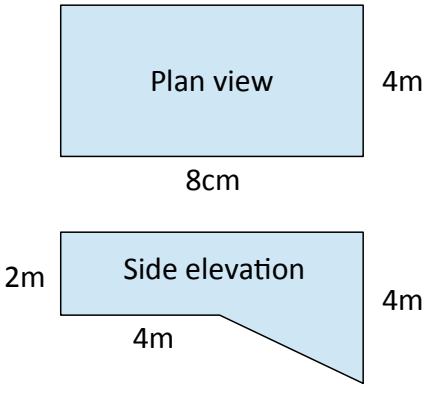
A	B	C	D
2050cm^2	2850cm^2	4100cm^2	5000cm^2

7. What is the surface area of this step made from 3 identical cuboids?



A	B	C	D
22 200cm^2	13 800cm^2	18 000cm^2	36 000cm^2

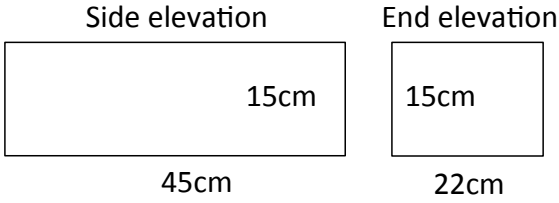
8. What is the capacity of this aquarium in litres?



A	B	C	D
80L	96L	8000L	80000L

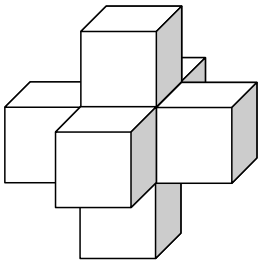
Geometry 3c: Mastery Questions (volume)

9. A cuboid has these two faces shown below.
   What is the surface area of the cuboid?



A	B	C	D
1995cm^2	2010cm^2	3990cm^2	14 850cm^2

10. A 3 dimensional cross is made out of identical cubes as shown.
    The volume of the cross is 448cm^3
    What is the surface area of the cross?



A	B	C	D
448cm^2	480cm^2	560cm^2	672cm^2

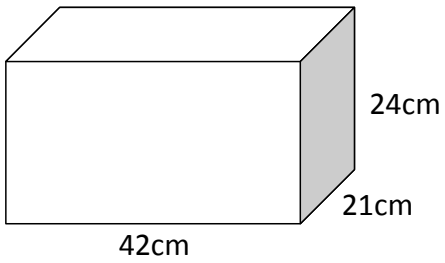
In Q11 – 12, you must show all of your working.

11. The tank shown below is filled to $\frac{3}{4}$ of its capacity.

    How deep is the water in the tank?

    A large stone is then put into the tank and the level of water goes up by 2cm.

    What is the volume of the stone?



12. A cuboid is cut away from a cube of side 8cm as shown.
    By what fraction does the total surface area of the solid decrease as a result?

