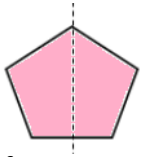
Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	9A	Ch 9 Transformations

Lines of symmetry



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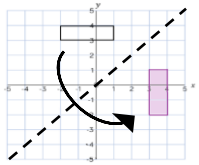
This regular polygon (a regular pentagon has 5 lines of symmetry)

Rhombus two lines of symmetry

Parallelogram No lines of symmetry

Or A **circle** has an infinite amount of lines of symmetry

Reflect Diagonally



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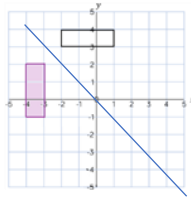

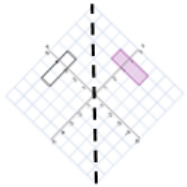

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Rotational Symmetry

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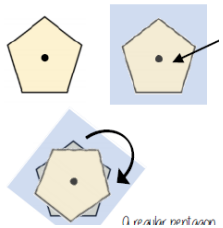
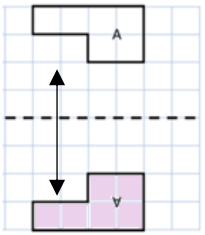
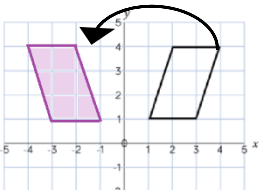


Reflect horizontally or vertically



All points need to be the same distance away from the line of reflection.

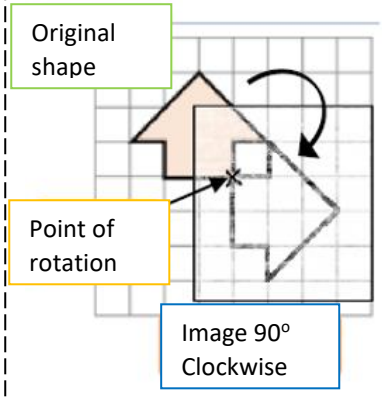


Reflection in the line y axis – this is also a reflection in the line x = 0

Lines parallel to the x and y axis

Remember Lines parallel to the x axis are of the form y = _____
Lines Parallel to the y axis are in the form x = ____

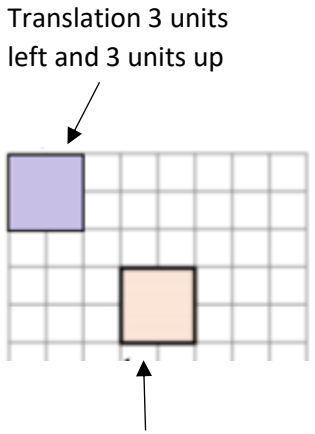
Rotation from a point (in the shape)



1. Trace the shape and mark the point of rotation
2. Keep the point in the same place and turn the tracing paper
3. Draw the new shape

Translation

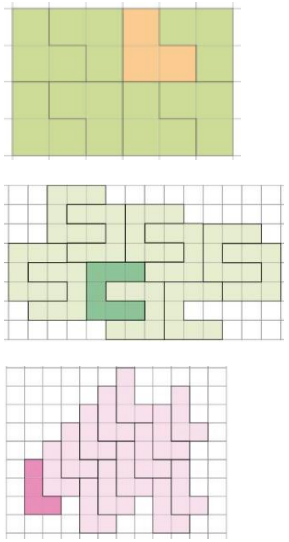
Every **vertex** (corner) has been (moved) by the same amount in the same direction



Tessellation

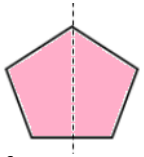
A tiling pattern with no gaps or overlaps

These shapes are all congruent in these diagrams



Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	9B	Ch 9 Transformations

Lines of symmetry



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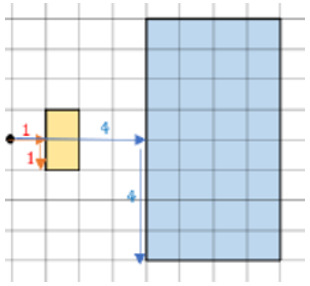
Method 1: Scale the distance between the point of enlargement and each corresponding vertex.



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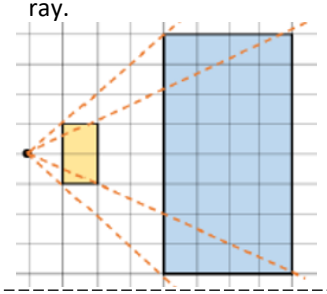

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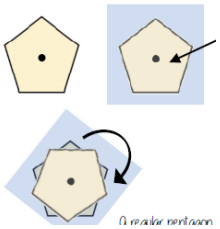

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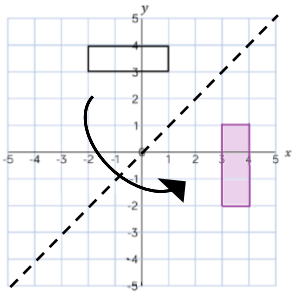

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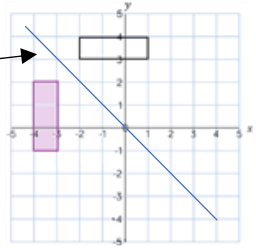

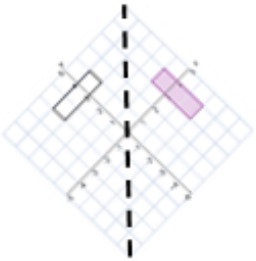

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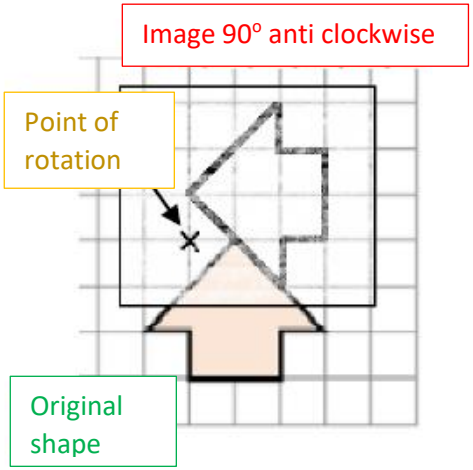
Rotation from a point (outside the shape)



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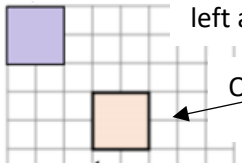

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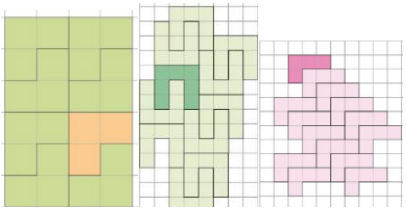

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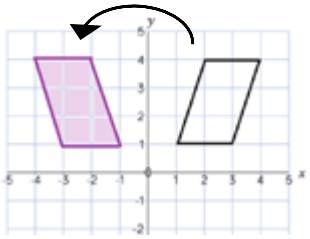

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Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
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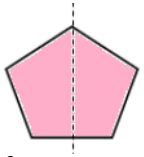

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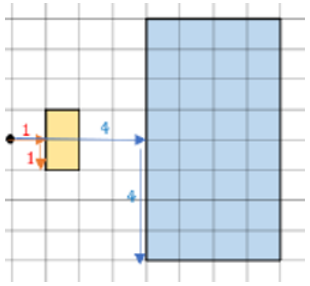

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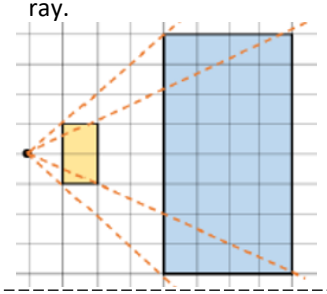

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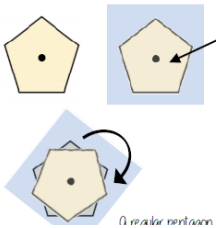

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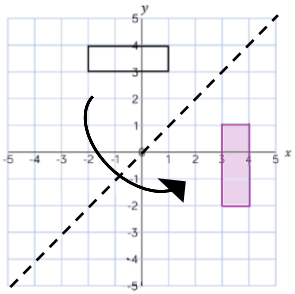

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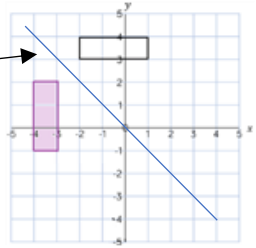

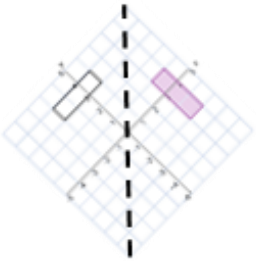

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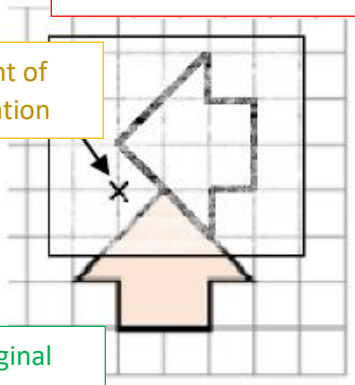
Rotation from a point (outside the shape)

Image 90° anti clockwise

Point of rotation



Original shape

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Translation:

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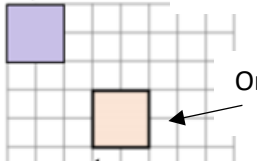
Translation 3 units left and 3 units up



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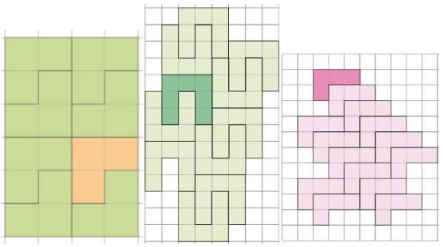
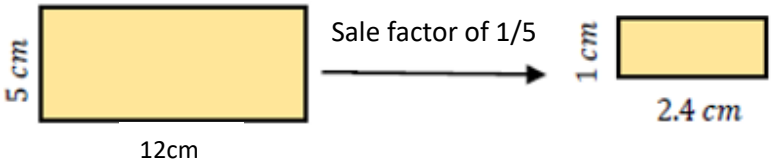


Positive fractional scale Factor

With a scale factor between 0 and 1 it makes the shape smaller.



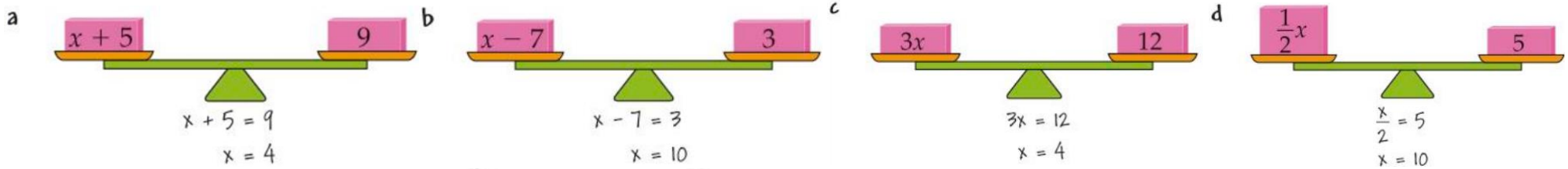
Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	10A	Ch 10 Equations

Solving 1 step equations

Solving equations is where you find the value of the **unknown**.

Solve these equations.

a $x + 5 = 9$ **b** $x - 7 = 3$ **c** $3x = 12$ **d** $\frac{1}{2}x = 5$



The **inverse** of +5 is −5, so subtract 5 from both sides.

The inverse of −7 is +7, so add 7 to both sides.

The inverse of ×3 is ÷3, so divide both sides by 3.

The inverse of ÷2 is ×2, so multiply both sides by 2.

Vocabulary

Solution – The values of the unknown that the equation is true for

Operation – A rule for processing numbers or letters

Equation – Expressions on both sides of an equal sign.

Solve – Finding an unknown value.

Solving 2 step Equations

Solving 2 step equations is where you find the value of the **unknown** using two stages to do so.

Solve these equations.

a $\frac{m}{2} + 7 = 10$ **b** $5y - 3 = 7$

a

$$\frac{m}{2} + 7 = 10$$
$$\frac{m}{2} + 7 - 7 = 10 - 7$$
$$\frac{m}{2} = 3$$
$$\frac{m}{2} \times 2 = 3 \times 2$$
$$m = 6$$

b

$$5y - 3 = 7$$
$$5y - 3 + 3 = 7 + 3$$
$$5y = 10$$
$$5y \div 5 = 10 \div 5$$
$$y = 2$$

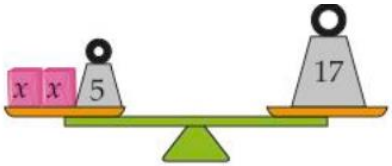
Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	10B	Ch 10 Equations

Solving 2 step equations

Solving equations is where you find the value of the unknown.

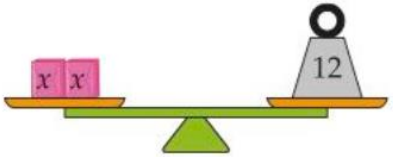
Solve $2x + 5 = 17$

$2x + 5 = 17$



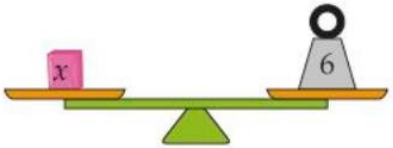
The inverse of +5 is −5.
Subtract 5 from both sides.

$2x = 12$



The inverse of ×2 is ÷2.
Divide both sides by 2.

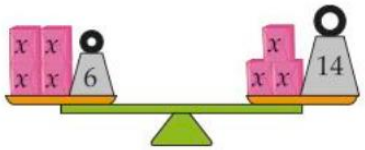
$x = 6$



The **solution** of the equation is $x = 6$.

Unknowns on both sides

To be able to solve with unknown on both sides you must first rearrange to collect the unknown on one side. This balance has the unknown on both sides of the balance.



The balance shows the equation

$$\begin{aligned} 4x + 6 &= 3x + 14 \\ x + 6 &= 14 \\ x &= 8 \end{aligned}$$

Subtract 3x from both sides
Subtract 6 from both sides

Vocabulary

Equation – In an equation each letter stands for a missing number. Both sides of the equation represents the same value.

Solution – The values of the unknown that the equation is true for.

Inverse – A second operation which undoes the effect of the first operation.

Expand - To multiply out all brackets and then collect like terms

Equations with brackets

Solve the equation $3(2x - 1) = 5(x + 2)$

$3(2x - 1) = 5(x + 2)$

Expand the brackets
$6x - 3 = 5x + 10$
Add 3 to both sides
$6x = 5x + 13$
Subtract 5x from both sides
$x = 13$

Real life Equations

A taxi company charges £2.00 per journey plus 30 pence per mile.

a Write down an equation for £T, the total cost of a journey of m miles.

b How much would it cost to travel 5 miles?

c If I am charged £4.70 for my journey, how far did I travel?

a) Total cost is £2 + £0.30 per mile so T = 2 + 0.3m
b) T = 2 + 0.3 x 5 = 2 + 1.50 so Cost = £3.50
c) 4.70 = 2 + 0.3 x m 2.70 = 0.3m m = 9

Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	10C	Ch 10 Equations

Solving equations with fractions

Solve these equations.

a $\frac{3x+4}{5} = 2$ **b** $\frac{x}{3} - 6 = 1$

a
$\frac{3x+4}{5} = 2$ × 5 on both sides
$3x + 4 = 10$ − 4
$3x = 6$ ÷ 3
$x = 2$

b
$\frac{x}{3} - 6 = 1$ + 6 to both sides.
$\frac{x}{3} = 7$ × 3
$x = 21$

Solve this equation.

$\frac{3x-4}{5} = \frac{x+4}{3}$

$\frac{3x-4}{5} = \frac{x+4}{3}$ × 5 on both sides.

$3x - 4 = \frac{5(x+4)}{3}$ × 3 on both sides.

$3(3x - 4) = 5(x + 4)$ expand the brackets.
$9x - 12 = 5x + 20$ − 5x
$4x - 12 = 20$ + 12
$4x = 32$ ÷ 4
$x = 8$

Unknowns on both sides

To be able to solve with unknown on both sides you must first rearrange to collect the unknown on one side.

Solve these equations.

a $8x + 3 = 2x + 9$

a
$8x + 3 = 2x + 9$
$6x + 3 = 9$ Subtract 2x from both sides.
$6x = 6$ Subtract 3 from both sides.
$x = 1$ Divide both sides by 6.

b $2(5n + 3) = 4(2n - 1)$

b
$2(5n + 3) = 4(2n - 1)$ expand the brackets.
$10n + 6 = 8n - 4$ − 8n from both sides.
$2n + 6 = -4$ − 6 from both sides.
$2n = -10$ ÷ 2 on both sides.
$n = -5$

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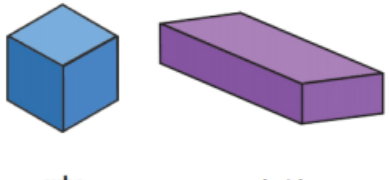
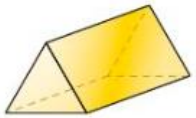
Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	14A	Ch 14 3D shapes

3D shapes

Cubes: All 6 faces are the same size.
Cuboids: Opposite faces are equal sized rectangles.
Prisms: Are the same shape all the way through.
Pyramids: Taper to a point.


cube

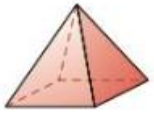
cuboid


Triangular prism


Cylinder, or circular prism


Tetrahedron, or triangular-based pyramid

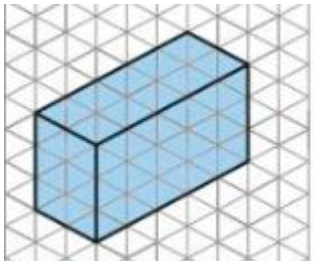

Sphere

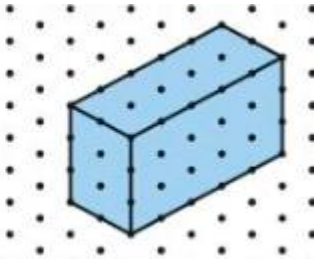

Square-based pyramid


Cone, or circular-based pyramid

Isometric Drawing

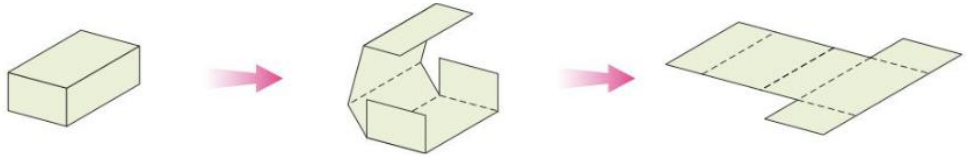
You can use Isometric paper or dots to draw 3D shapes.





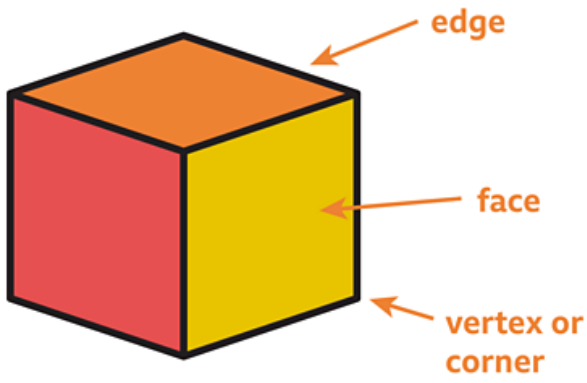
Nets

When a 3D shape is unfolded the flat shape is called a net.



Describing 3D Shapes

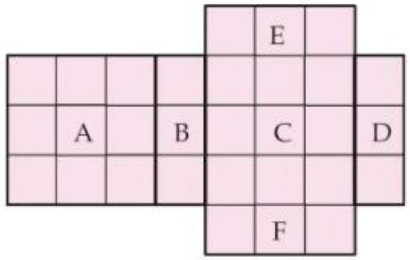
You can describe a 3D shape by its **faces**, **edges** and **vertices.**



Surface Area

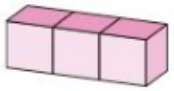
The **surface area** is the total area of all the shapes faces.

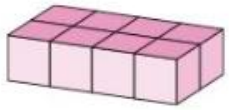
Surface area = A + B + C + D + E + F
= 9 + 3 + 9 + 3 + 3 + 3
= 30 cm^2



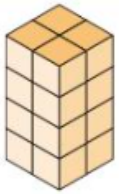
Volume

Volume is a measure of how space a 3D shape occupies.


It has a volume of 3 centimetre cubes ($3\,cm^3$).


It has a volume of 8 centimetre cubes ($8\,cm^3$).


The total volume is $12\,cm^3$.



This cuboid has a volume of $16cm^3$

Each layer is 4 cm^2 and there are 4 layers so 4 x 4 = 16

Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	14B	Ch 14 3D shapes

3D shapes

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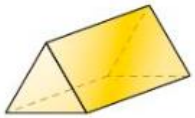
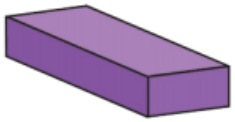
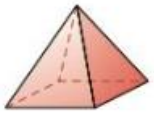

Triangular prism


Cylinder, or circular prism


cube


cuboid


Square-based pyramid


Cone, or circular-based pyramid

Plans and Elevations

A **Front elevation** is the view from the front.
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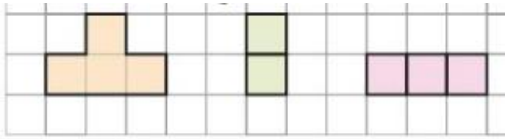

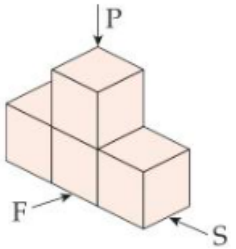

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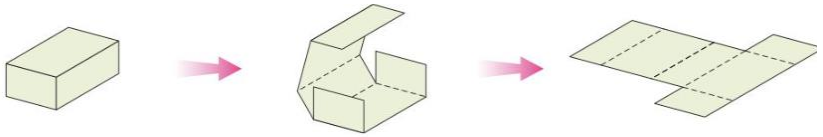


Volume of Prisms

To calculate the volume of a prism you multiply the cross sectional area by the length

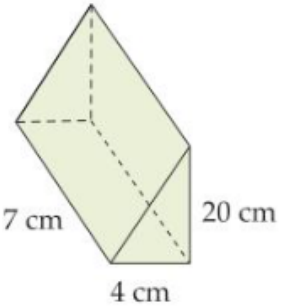
Volume = Cross sectional area x length

Volume =

(½ x 4 x 20) x 7

= 40 x 7

= 280cm^3



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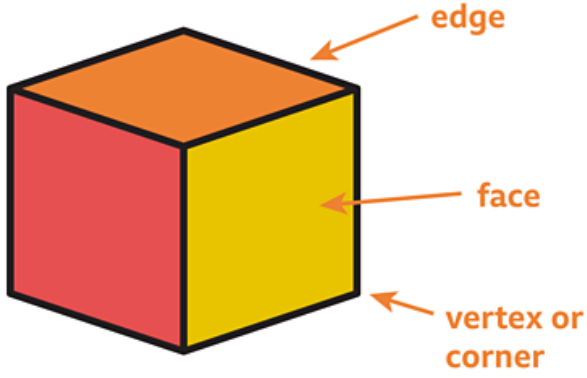
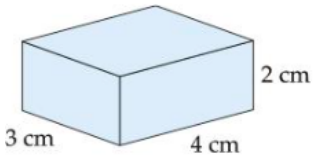


Surface Area of Cuboids

A cuboid measures 4cm by 3 cm by 2 cm.
Calculate the surface area of the cuboid.



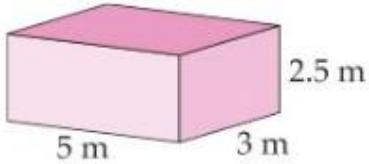
Area of top is 3 x 4 = 12 cm^2
Area of side = 4 x 2 = 8 cm^2
Area of front = 3 x 2 = 6 cm^2
Total = 2 x (12 + 8 + 6) = 52cm^2

Volume

Volume is a measure of how space a 3D shape occupies.

It can be calculated by volume = length x width x height

Calculate the volume of this cuboid.



Volume = 5 x 3 x 2.5 = 37.5 cm^3

Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	14C	Ch 14 3D shapes

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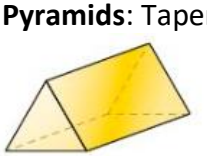
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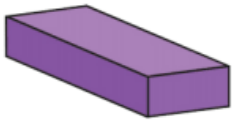
Cylinder, or circular prism


cube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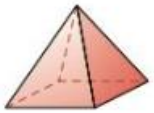
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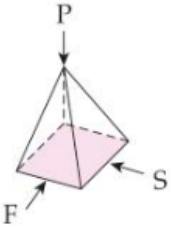

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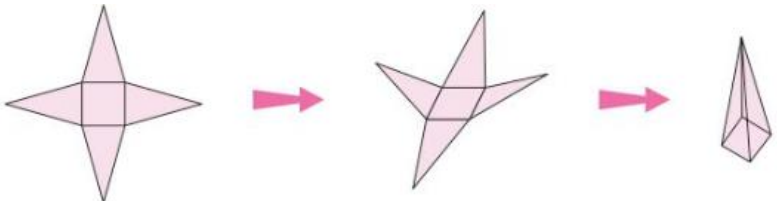
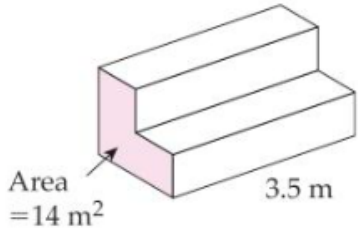


Volume of Prisms

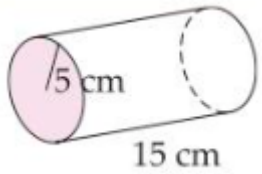
To calculate the volume of a prism you multiply the cross-sectional area by the length

Volume = Cross sectional area x length



Volume = 14 x 3.5 = 49 m^2

Volume = Cross sectional area x length

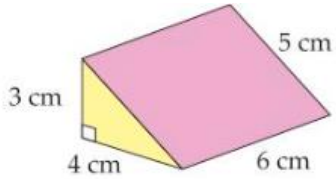


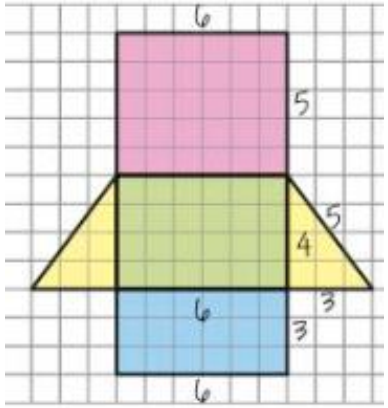
Volume = Area of circle x length

= πr^2 x 15
= π x 5^2 x 15
= 375π = 1178.097245 cm^3

Surface Area of Cuboids

A cuboid measures 4cm by 3 cm by 2 cm. Calculate the surface area of the cuboid.





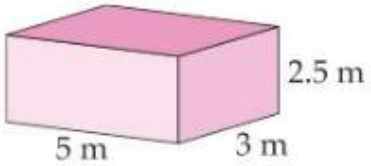
6 x 5 = 30cm^2
6 x 4 = 24 cm^2
6 x 3 = 18cm^2
½ x 3 x 4 = 6cm^2
½ x 3 x 4 = 6cm^2
Total = 84 cm^2

Volume

Volume is a measure of how space a 3D shape occupies.

It can be calculated by volume = length x width x height

Calculate the volume of this cuboid.

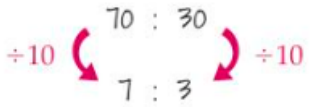


Volume = 5 x 3 x 2.5 = 37.5 cm^3

Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	15A	Ch 15 Ratio and Proportion

Ratio

You can compare the size of two quantities by writing them as a **ratio**. They can be simplified by dividing both sides by the same number.



You can make an equivalent ratio by multiplying both sides of the **ratio** by the same number

For every 3 boys there are 2 girls.

boys : girls

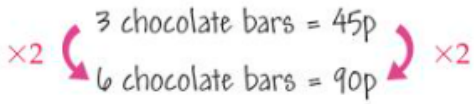
Multiply both parts by 5.

There are 10 girls in the class.

Direct proportion

Two quantities are in **direct proportion**, if one increases the other increases by the same proportion.

Three Chocolate bars cost 45p. What is the cost of 6 bars?

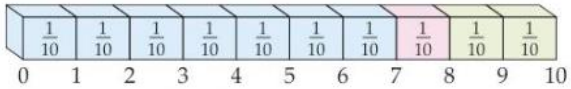


So 6 bars cost 90p

Proportion

A **proportion** tells you what part of the whole something is. It can be written as a fraction, decimal or percentage.

The bar has been divided into 10 equal sections.



a As a fraction, what proportion of the bar is shaded blue?

b As a decimal, what proportion of the bar is pink?

c As a percentage, what proportion of the bar is not pink?

a 7 sections are blue so $\frac{7}{10}$ of the bar is blue.

b 1 section is pink so 0.1 of the bar is pink.

c 9 sections are not pink, so 90% of the bar is not pink.

Dividing Into Ratios

To share an amount into **ratios** you need to add the parts together to find the total number of parts.
Divide the amount by the total parts.
This value is then multiplied by the number in each grouping.

Alex and Charlie divide £12 in the ratio 3 : 1.
How much will they receive?

3 : 1 is 4 parts total.

£12 ÷ 4 = £3

Alex → 3 × £3 = £9

Charlie → 1 × £3 = £3

Comparing Proportions

You can compare proportions by converting them to **percentages**. Or find the fractions of the amounts to compare.

Molly scored 42 out of 50 in a German test, and in a French test she scored 64 out of 80. In which test did she do best?

German: 42/50 = 84/100 = 84 %

French: 64/80 = 4/5 = 80/100 = 80%

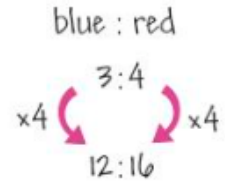
So Molly did better in her German test.

Ratio and Proportion Problems

A **proportion** compares the size of the part to the whole.
A **ratio** compares the size of 2 or more parts.
You simplify ratios where possible.

Dominique is an artist.
She can make purple paint by mixing blue and red paint in the ratio 3 : 4.
Dominique has 12 tubes of blue paint.
How many tubes of red paint will she need?

So Dominque will need 16 tubes of red paint



Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	15B	Ch 15 Ratio and Proportion

Ratio

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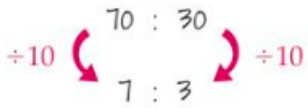

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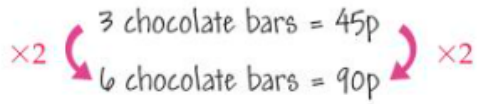

So 6 bars cost 90p

Percentage Increase and Decrease

You can calculate a percentage increase or decrease in one calculation.

In the sale the prices decrease by 15%.

Sale price = (100 – 15)% of the old price

After the sale, the prices increase by 15%.

New price = (100 + 15)% of the sale price

Or you can find the percentage and add it or subtract it from the original amount accordingly.

100% + 20 % = 120% of original

100% - 20 % = 80% of original

Dividing Into Ratios

To share an amount into **ratios** you need to add the parts together to find the total number of parts.
Divide the amount by the total parts.
This value is then multiplied by the number in each grouping.

Jermaine and Gina share £150 in the ratio 3 : 2.
How much money do they each receive?

Jermaine receives $\frac{3}{5}$ of £150 = £90

Gina receives $\frac{2}{5}$ of £150 = £60

Comparing Proportions

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Molly scored 42 out of 50 in a German test, and in a French test she scored 64 out of 80. In which test did she do best?

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Ratio and Proportion

A **proportion** compares the size of the part to the whole.
A **ratio** compares the size of 2 or more parts.
You simplify ratios where possible.

This is the national flag of Nigeria.

The ratio green : white = 2 : 1

The proportion of green = $\frac{2}{3}$

The proportion of white = $\frac{1}{3}$

Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	15C	Ch 15 Ratio and Proportion

Ratio

You can compare the size of two quantities by writing them as a **ratio**. They can be simplified by dividing both sides by the same number.

$$70 : 30 \quad (\div 10) \quad 7 : 3$$

You can make an equivalent ratio by multiplying both sides of the **ratio** by the same number

For every 3 boys there are 2 girls.

boys : girls

$$3 : 2 \quad (\times 5) \quad 15 : 10$$

Multiply both parts by 5.

There are 10 girls in the class.

Direct proportion

Two quantities are in **direct proportion**, if one increases the other increases by the same proportion.

Three Chocolate bars cost 45p. What is the cost of 6 bars?

$$3 \text{ chocolate bars} = 45p \quad (\times 2) \quad 6 \text{ chocolate bars} = 90p$$

So, 6 bars cost 90p

Algebra and Proportion

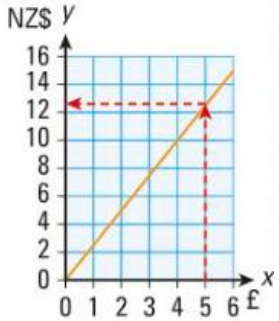
Two quantities A and B are in **direct proportion** if, as they vary, they remain in the same ratio.

You can write $A \propto B$

Or

A = KB where K is a constant

The graph of two quantities that are in direct proportion is a straight line that passes through the origin.



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Comparing Proportions

You can compare proportions by converting them to **percentages**. Or find the fractions of the amounts to compare. You can express the change in an amount as a **percentage** of the **original amount.**

A packet of biscuits increases in weight from 180g to 210g. What is the percentage increase in weight?

$$\frac{(210 - 180)}{180} \times 100 = \frac{\cancel{30}^{1}}{\cancel{180}_{6}} \times 100$$

$$= 16.7\% \text{ (1 dp)}$$

Ratio and Proportion

You can compare two or more parts of the same quantity using ratio or **proportion**.

- The ratio compares the size of the parts.
- The proportion compares the size of the part with the whole.

In a ski club there are 20 beginners, 16 intermediate and 8 advanced skiers.

a) What proportion of the club are intermediate skiers?

b) What is the ratio of beginners to advanced skiers?

a Total number of skiers = 20 + 16 + 8 = 44

Proportion of intermediates = $\frac{16}{44}$

$= \frac{4}{11}$ (= 36.4% to 1 dp)

b beginners : advanced = 20 : 8

= 5 : 2

Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	16A	Ch 16 Probability

Probability Introduction

Some things are certain, some impossible and some are uncertain. **Probability** describes how likely a future event is. Every **probability** is a number between **0 and 1.**

An **event** is certain if it **always** happen.

An **event** is **likely** if it happens quite often.

An **event** has an **evens** chance if you would expect it to happen half the time.

An **event** is **unlikely** if it does not happen very often.

An **event** is **impossible** if it cannot happen.

An event is **random** if its outcomes are **uncertain**

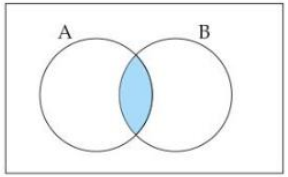
Ven Diagrams

A **set** is a collection of **elements**. To identify a , use curly brackets.

In Venn Diagrams circles are used to sort into sets. The numbers show how many objects are ina **set**.

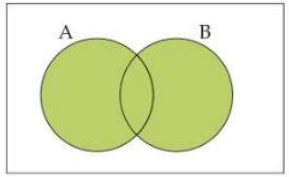
You can describe the **regions** on a **Venn Diagram** in words.

The **intersection** is where two sets overlap.



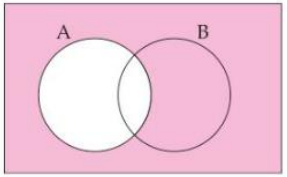
'A and B'

If you put two sets together, you get the **union**.



'A or B'

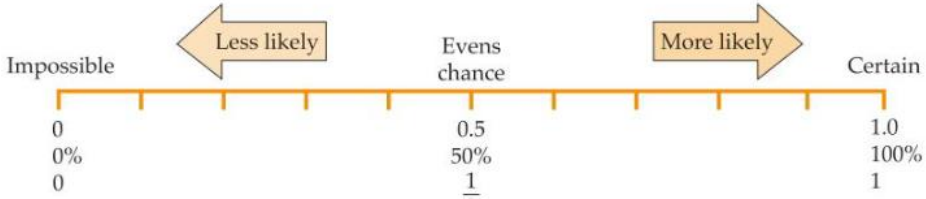
The **complement of A** is the region that is not A.



'not A'

More Probability

Probabilities can be shown as **fractions, decimals or percentages**.



Experimental Probability

We can often use an **experiment** to **estimate** probability. An experiment is a set of **trials**. The more trials the **more reliable** the estimation is. If you repeat an experiment, you will probably get different outcomes.

$$\text{Experimental proability} = \frac{\text{Number of successful trials}}{\text{Total number of trials}}$$

Sam watched 20 cars approaching a junction and recorded the direction they turned. 8 turned left and 12 right. Estimate the probability the next car will turn left.

Probability of turning left = 8/20 = 4/ 10 = 0.4

Theoretical Probability

$$\text{Probability of an event} = \frac{\text{Number of equally likely outcomes}}{\text{Total number of outcomes}}$$

If you roll an ordinary dice, what is the probability of getting

a a score of 5 **b** an even number?

a) There is 1 5 on the dice with 6 outcomes so probability is 1/6
b) There are 3 even numbers out of the 6 outcomes so probability of even is 3/6 = 1/2

Knowledge Organiser	Subject	Year	Term	KO n.o.	Title
	Mathematics	8	2	16B	Ch 16 Probability

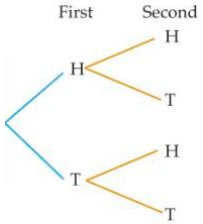
Listing outcomes

A **trial** is a statistical experiment, like throwing a dice.

An **outcome** is a possible result of a trial, like throwing a 5.

An **event** is a collection of outcomes, like throwing an odd number (1, 3 or 5)

A tree diagram shows possible outcomes.



A sample space diagram shows outcomes.

		Second coin	
		Heads	**Tails**
First coin	**Heads**	(H, H)	(H, T)
	Tails	(T, H)	(T, T)

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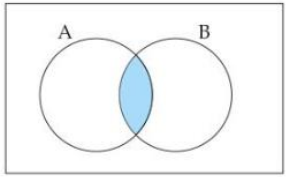

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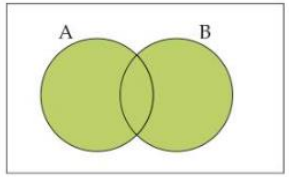

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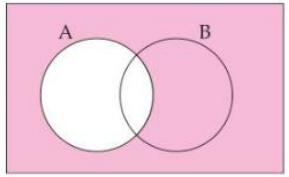

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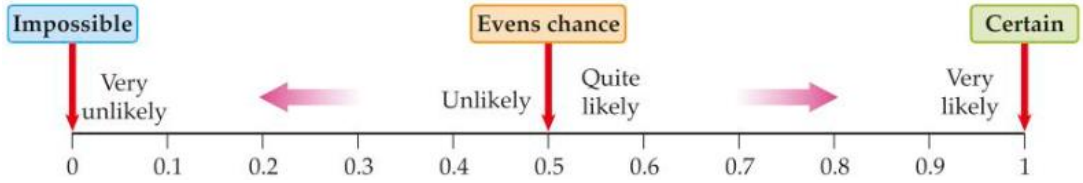
Theoretical Probability

Probability describes how likely an event is. It can be shown on a scale 0 to 1.



$$\text{Probability of an event} = \frac{\text{Number of } \textbf{outcomes} \text{ that belong to the event}}{\text{Total number of outcomes}}$$

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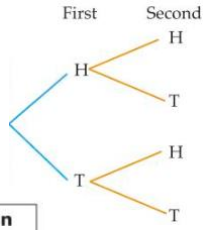

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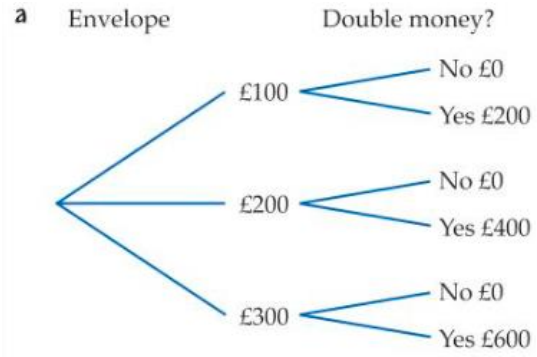
Tree Diagrams

Archie wins a competition and gets to pick one of three identical envelopes which contain £100, £200 or £300. He then must flip a coin. If it lands on heads, he doubles his prize money. If it lands on tails, he wins nothing.

a Show all the possible outcomes in a tree diagram.
b **i** What is the probability that he wins a least £300?
ii What is the probability that he wins nothing?

a



b **i** $P(\text{wins} \geq £300) = \frac{2}{6} = \frac{1}{3}$

ii $P(\text{wins nothing}) = \frac{3}{6} = \frac{1}{2}$

Mutually Exclusive

Two outcomes are **mutually exclusive** if they cannot happen at the same time.

If a set of **mutually exclusive** events covers all possible outcomes, then their sum of probabilities is 1.

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Venn Diagram Language

The **universal set**, Ω, is the set containing all the elements.
A ∩ B means the elements in A **and** B
A U B means the elements in A **or** B
A' **U** B' means the elements not in A or not in B

Ω = {2, 3, 6, 7, 11, 15}, P = {prime numbers} and E = {even numbers}

a Write the elements of P ∩ E. — **a** P ∩ E = {2}
b Write the elements of P ∪ E. — **b** P ∪ E = {2, 3, 6, 7, 11}
c Which element is in P' ∩ E'? — **c** 15