YEAR 8 - ALGEBRAIC TECHNIQUES...
Sequences

What do I need to be able to do?

By the end of this unit you should be able to:

- Generate a sequence from term to term or position to term rules
- Recognise arithmetic sequences and find the nth term
- Recognise geometric sequences and other sequences that arise

Keywords

Sequence: items or numbers put in a pre-decided order
Term: a single number or variable
Position: the place something is located
Linear: the difference between terms increases or decreases (+ or -) by a constant value each time
Non-linear: the difference between terms increases or decreases in different amounts, or by x or ÷
Difference: the gap between two terms
Arithmetic: a sequence where the difference between the terms is constant
Geometric: a sequence where each term is found by multiplying the previous one by a fixed non zero number

Linear and Non Linear Sequences

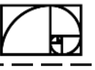
Linear Sequences – increase by addition or subtraction and the same amount each time
Non-linear Sequences – do not increase by a constant amount – quadratic, geometric and Fibonacci

- Do not plot as straight lines when modelled graphically
- The differences between terms can be found by addition, subtraction, multiplication or division

Fibonacci Sequence – look out for this type of sequence

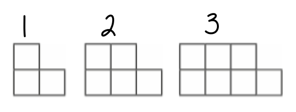
0 1 1 2 3 5 8 ...

Each term is the sum of the previous two terms.



Sequence in a table and graphically

Position: the place in the sequence



3 5 7

Term: the number or variable
(the number of squares in each image)

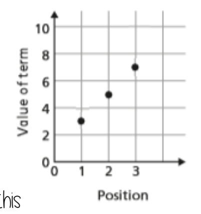
"The **term** in **position** 3 has 7 squares"

In a table

Position	1	2	3
Term	3	5	7

+2 +2

Graphically



Because the terms increase by the same addition each time this is **linear** – as seen in the graph

Sequences from algebraic rules

This is substitution!

$3n + 7$

This will be linear - note the single power of n. The values increase at a constant rate

$3n^2 + 7$

This is not linear as there is a power for n

$2n - 5$ → Substitute the number of the term you are looking for in place of 'n'

eg
1^{st} term = 2 (1) – 5 = -3
2^{nd} term = 2 (2) – 5 = -1
100^{th} term = 2 (100) – 5 = 195

Complex algebraic rules

Misconceptions and comparisons

$2n^2$

2 times whatever n squared is

eg
1^{st} term = 2 x 1^2 = 2
2^{st} term = 2 x 2^2 = 8
100^{th} term = 2 x 100^2 = 2000

$(2n)^2$

2 times n then square the answer

eg
1^{st} term = $(2 \times 1)^2$ = 4
2^{st} term = $(2 \times 2)^2$ = 16
100^{th} term = $(2 \times 100)^2$ = 40000

$n(n + 5)$ ←

eg
1^{st} term = 1 (1 + 5) = 6
2^{st} term = 2 (2 + 5) = 14
100^{th} term = 100 (100 + 5) = 10500

You don't need to expand the expression

Checking for a term in a sequence

Form an equation

Is 201 in the sequence 3n – 4?

$3n - 4 = 201$

Algebraic rule
Term to check

Solving this will find the position of the term in the sequence.
ONLY an integer solution can be in the sequence.

H Finding the algebraic rule

This is the 4 times table → 4, 8, 12, 16, 20...

4n

7, 11, 15, 19, 22 ← This has the same constant difference – but is 3 more than the original sequence

4n + 3

$4n + 3$

This is the constant difference between the terms in the sequence

This is the comparison (difference) between the original and new sequence

YEAR 8 - REASONING WITH ALGEBRA...

Straight Line Graphs

What do I need to be able to do?

By the end of this unit you should be able to:

- Compare gradients
- Compare intercepts
- Understand and use y= mx + c
- Find the equation of a line from a graph
- Interpret gradient and intercepts of real-life graphs

Keywords

Gradient: the steepness of a line

Intercept: where two lines cross. The y-intercept: where the line meets the y-axis.

Parallel: two lines that never meet with the same gradient.

Co-ordinate: a set of values that show an exact position on a graph.

Linear: linear graphs (straight line) – linear common difference by addition/ subtraction

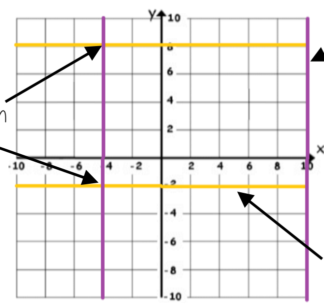
Asymptote: a straight line that a graph will never meet.

Reciprocal: a pair of numbers that multiply together to give 1.

Perpendicular: two lines that meet at a right angle.

Lines parallel to the axes R

Intersection points



All the points on this line have a x coordinate of 10

'a' can be ANY positive or negative value including 0

Lines parallel to the **y axis** take the form **x = a** and are **vertical**

Lines parallel to the **x axis** take the form **y = a** and are **horizontal**

All the points on this line have a y coordinate of -2

eg (3, -2) (7, -2) (-2, -2) all lay on this line because the y coordinate is -2

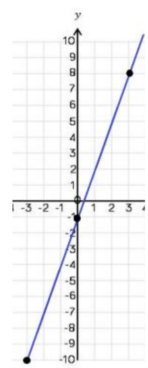
Plotting y = mx + c graphs R

$y = 3x - 1$ → 3 x the x coordinate then – 1

x	−3	0	3
y	-10	-1	8

Draw a table to display this information

This represents a coordinate pair (-3, -10)



You only need two points to form a straight line

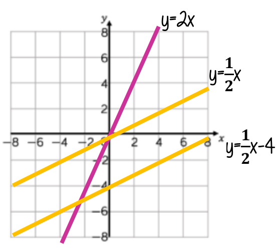
Plotting more points helps you decide if your calculations are correct (if they do make a straight line)

Remember to join the points to make a line

Compare Gradients

$y = mx + c$

The **coefficient** of x (the number in front of x) tells us the gradient of the line



The **greater** the gradient – the **steeper** the line

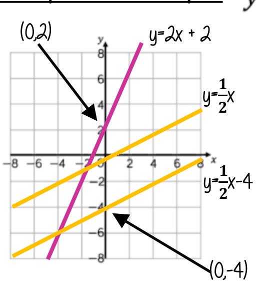
Parallel lines have the **same** gradient

Positive gradients

Negative gradients

Compare Intercepts

$y = mx + c$ ← The value of **c** is the point at which the line crosses the y-axis. **Y intercept**



The coordinate of a y intercept will always be (0,c)

Lines with the **same** y-intercept cross in the **same** place

y = mx + c

The **coefficient** of x (the number in front of x) tells us the gradient of the line

$y = mx + c$ ← The value of **c** is the point at which the line crosses the y-axis. **Y intercept**

y and x are **coordinates**

The equation of a line can be rearranged. Eg:

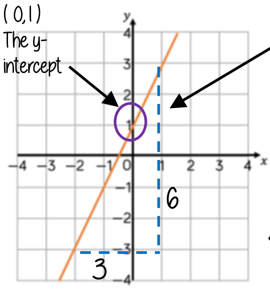
y = c + mx

c = y – mx

Identify which coefficient you are identifying or comparing

Find the equation from a graph

(0,1) The y-intercept



The Gradient $\frac{6}{3} = 2$

$y = 2x + 1$

The direction of the line indicates a positive gradient

Positive gradients

Negative gradients

Real life graphs

A plumber charges a £25 callout fee, and then £12.50 for every hour. Complete the table of values to show the cost of hiring the plumber.

Time (h)	0	1	2	3	8
Cost (£)	£25				£125

The y-intercept shows the minimum charge. The gradient represents the price per mile

In real life graphs like this values will always be positive because they measure distances or objects which cannot be negative.

Direct Proportion graphs To represent direct proportion the graph must start at the origin.

When you have 0 pens this has 0 cost. The gradient shows the price per pen

A box of pens costs £2.30
Complete the table of values to show the cost of buying boxes of pens.

Boxes	0	1	2	3	8
Cost (£)		£2.30			

YEAR 8 - REPRESENTATIONS...

Working in the Cartesian plane

What do I need to be able to do?

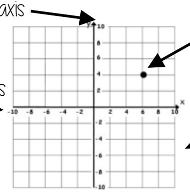
By the end of this unit you should be able to:

- Label and identify lines parallel to the axes
- Recognise and use basic straight lines
- Identify positive and negative gradients
- Link linear graphs to sequences
- Plot y = mx + c graphs

Keywords

Quadrant: four quarters of the coordinate plane.
Coordinate: a set of values that show an exact position.
Horizontal: a straight line from left to right (parallel to the x axis)
Vertical: a straight line from top to bottom (parallel to the y axis)
Origin: (0,0) on a graph. The point the two axes cross
Parallel: Lines that never meet
Gradient: The steepness of a line
Intercept: Where lines cross

Coordinates in four quadrants



From the origin this coordinate is 6 places along the positive x axis and 4 places up the positive y axis.

(x, y)

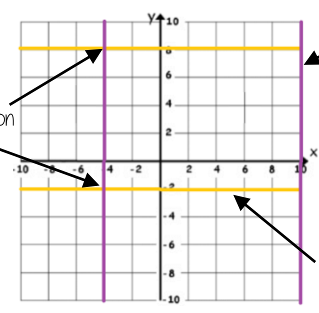
Always the position on the x axis first

Always the position on the y axis second

(0, a) Will be always be a point on the y axis (a can be any number)

(a, 0) Will be always be a point on the x axis (a can be any number)

Lines parallel to the axes



All the points on this line have a x coordinate of 10

'a' can be ANY positive or negative value including 0

Lines parallel to the **y axis** take the form **x = a** and are **vertical**

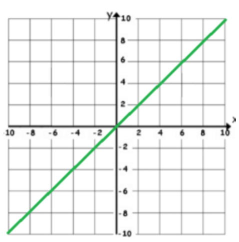
Lines parallel to the **x axis** take the form **y = a** and are **horizontal**

All the points on this line have a y coordinate of -2

e.g (3, -2) (7, -2) (-2, -2) all lay on this line because the y coordinate is -2

Recognise and use the line y=x

This means the x and the y coordinate have the same value

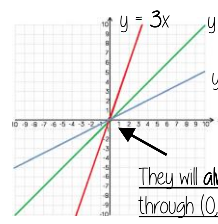


Examples of coordinates on this line: (0, 0) (-3, -3) (8, 8)

The axes **scale is important** – if the scale is the same y = x will be a straight line at 45°

Recognise and use the lines y=kx

The value of **k** changes the steepness of the line



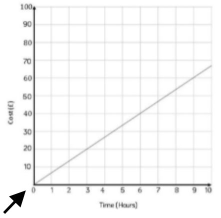
Note: y = x is the same as y = 1x

The bigger the value of k the **steeper** the line will be.

The closer to 0 the value of k the closer the line will be to the x axis.

They will **always** go through (0,0)

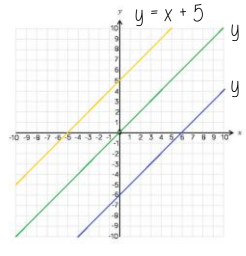
Direct Proportion using y=kx



The line must be straight to be directly proportional – variables increase at the same rate **k**

Direct proportion graphs always start at (0,0) as they are describing relationships between two variables

Lines in the form y = x + a



All the lines are **parallel** because the gradients are the same

y = x + a

This is the line y=x when the y and x coordinate are the same

This shows the translation of that line.
e.g y = x + 5
Is the line y=x moved 5 places up the graph

5 has been added to each of the x coordinates

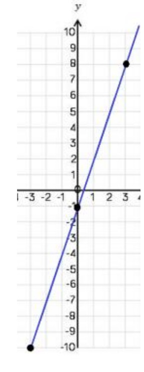
Plotting y = mx + c graphs

$y = 3x - 1$ → 3 x the x coordinate then – 1

x	-3	0	3
y	-10	-1	8

Draw a table to display this information

This represents a coordinate pair (-3, -10)

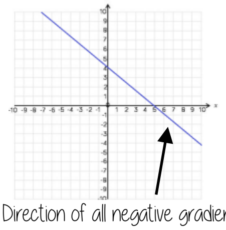


You only need two points to form a straight line

Plotting more points helps you decide if your calculations are correct (if they do make a straight line)

Remember to join the points to make a line

Lines with negative gradients



Any straight-line graph with a negative x value has a negative gradient.

Eg y = -2x
y = -x   y + x = 12

Direction of all negative gradients

YEAR 8 - DEVELOPING GEOMETRY...

Angles in parallel lines and polygons

What do I need to be able to do?

By the end of this unit you should be able to:

- Identify alternate angles
- Identify corresponding angles
- Identify co-interior angles
- Find the sum of interior angles in polygons
- Find the sum of exterior angles in polygons
- Find interior angles in regular polygons

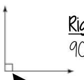
Keywords

Parallel: Straight lines that never meet
Angle: The figure formed by two straight lines meeting (measured in degrees)
Transversal: A line that cuts across two or more other (normally parallel) lines
Isosceles: Two equal size lines and equal size angles (in a triangle or trapezium)
Polygon: A 2D shape made with straight lines
Sum: Addition (total of all the interior angles added together)
Regular polygon: All the sides have equal length; all the interior angles have equal size.

Basic angle rules and notation

R

Acute Angles
0°< angle <90°

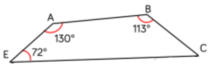


Right Angles
90°

Right angle notation

Obtuse
90°< angle <180°

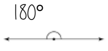
The letter in the middle is the angle
The arc represents the part of the angle



Angle Notation: three letters ABC
This is the angle at B = 113 °
Line Notation: two letters EC
The line that joins E to C.

Reflex
180°< angle <360°

Straight Line
180°



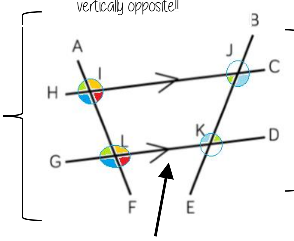
Vertically opposite angles
Equal
Angles around a point
360 °

Parallel lines

Still remember to look for angles on straight lines, around a point and vertically opposite!!

Lines AF and BE are **transversals** (lines that bisect the parallel lines)

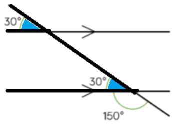
Corresponding angles often identified by their "F shape" in position



Alternate angles often identified by their "Z shape" in position

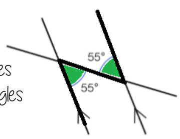
This notation identifies parallel lines

Alternate/ Corresponding angles

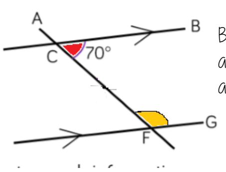


Because alternate angles are equal the highlighted angles are the same size

Because corresponding angles are equal the highlighted angles are the same size



Co-interior angles



Because co-interior angles have a sum of 180° the highlighted angle is 110°

As angles on a line add up to 180° co-interior angles can also be calculated from applying alternate/ corresponding rules first

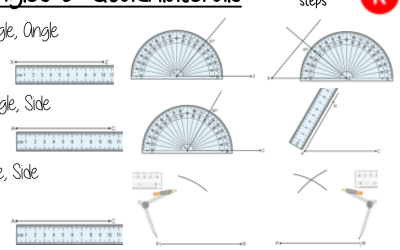
Triangles & Quadrilaterals

Link to steps R

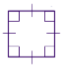
Side, Angle, Angle

Side, Angle, Side

Side, Side, Side



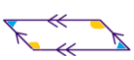
Properties of Quadrilaterals



Square
All sides equal size
All angles 90°
Opposite sides are parallel

Rectangle
All angles 90°
Opposite sides are parallel

Rhombus
All sides equal size
Opposite angles are equal



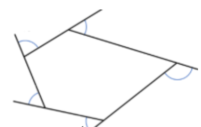
Parallelogram
Opposite sides are parallel
Opposite angles are equal
Co-interior angles

Trapezium
One pair of parallel lines

Kite
No parallel lines
Equal lengths on top sides
Equal lengths on bottom sides
One pair of equal angles

Sum of exterior angles

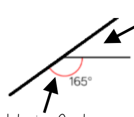
Exterior angles all add up to 360°



Exterior Angles
Are the angle formed from the straight-line extension at the side of the shape

Using exterior angles

Exterior Angle



Interior Angle

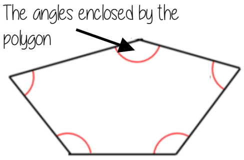
Interior angle + Exterior angle = straight line = 180°
Exterior angle = 180 – 165 = 15°

Number of sides = 360° ÷ exterior angle
Number of sides = 360 ÷ 15 = 24 sides

Sum of interior angles

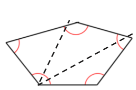
(number of sides – 2) x 180

Interior Angles
The angles enclosed by the polygon



This is an **irregular** polygon – the sides and angles are different sizes

Sum of the interior angles = (5 – 2) x 180

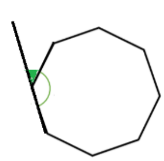


This shape can be made from three triangles
Each triangle has 180°

Sum of the interior angles = 3 x 180
= 540°

Remember this is **all** of the interior angles added together

Missing angles in regular polygons



Exterior angle = 360 ÷ 8 = 45°

Interior angle = $\frac{(8-2) \times 180}{8} = \frac{6 \times 180}{8} = 135°$

Exterior angles in regular polygons = 360° ÷ number of sides

Interior angles in regular polygons = $\frac{\text{(number of sides – 2) x 180}}{\text{number of sides}}$

YEAR 8 - LINES AND ANGLES

Constructing, measuring and using geometric notation

What do I need to be able to do?

By the end of this unit you should be able to:

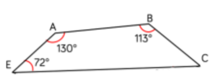
- Use letter and labelling conventions
- Draw and measure line segments and angles
- Identify parallel and perpendicular lines
- Recognise types of triangle
- Recognise types of quadrilateral
- Identify polygons
- Construct triangles (SAS, SSS, ASA)
- Draw Pie charts

Keywords

Polygon: A 2D shape made with straight lines
Scalene triangle: a triangle with all different sides and angles
Isosceles triangle: a triangle with two angles the same size and two angles the same size
Right-angled triangle: a triangle with a right angle
Frequency: the number of times a data value occurs
Sector: part of a circle made by two radii touching the centre
Rotation: turn in a given direction
Protractor: equipment used to measure angles
Compass: equipment used to draw arcs and circles.

Letter and labelling convention

The letter in the middle is the angle
The arc represents the angle



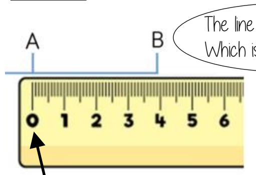
Angle Notation: three letters ABC
This is the angle at B = 113 °

Line Notation: two letters EC
The line that joins E to C.

Draw and measure line segments

Conversions 1cm = 10mm, 1m = 100cm

The line segment is 3.9cm
Which is 39mm



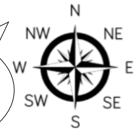
AB is a line segment (part of the line)

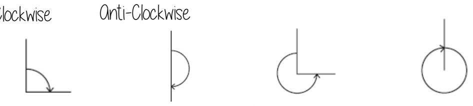
Make sure the start of the line is at 0.

Angles as measures of turn

Clockwise
Anti-Clockwise

East to South is a quarter turn clockwise





Quarter Turn
90°
Clockwise

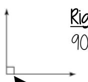
Half Turn
180°

Three-quarter Turn
270°
Anti-Clockwise

Full Turn
360°

Classify angles

Acute Angles
0°< angle <90°



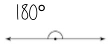
Right Angles
90°

Right angle notation

Obtuse
90°< angle <180°

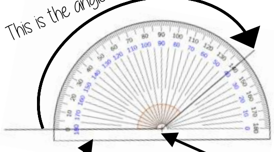
Reflex
180°< angle <360°

Straight Line
180°



Measure angles to 180°

This is the angle being measured



Read from 0° on the base line.
Remember to use estimation.
This is an obtuse angle so between 90 ° and 180 °

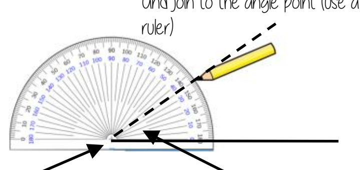
The base line follows the line segment

Make sure the cross is at the point the two lines meet

Draw angles up to 180°

Draw a 35° angle

Make a mark at 35° with a pencil
And join to the angle point (use a ruler)

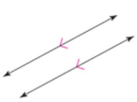


Make sure the cross is at the end of the line (where you want the angle)

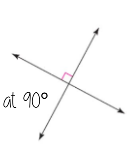
The angle

Parallel and Perpendicular lines

Parallel lines
Straight lines that never meet
(Have the same gradient)



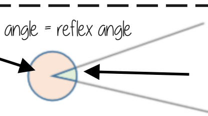
Perpendicular lines
Straight lines that meet at 90°



Angles over 180°

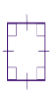
360 ° - smaller angle = reflex angle

Use your knowledge of straight lines 180 ° and angles around a point 360 °

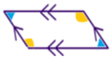


Measure the smaller angle first (less than 180 °)

Properties of Quadrilaterals

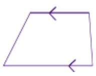


Square
All sides equal size
All angles 90°
Opposite sides are parallel



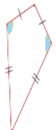
Parallelogram
Opposite sides are parallel
Opposite angles are equal
Co-interior angles

Rectangle
All angles 90°
Opposite sides are parallel



Trapezium
One pair of parallel lines

Rhombus
All sides equal size
Opposite angles are equal



Kite
No parallel lines
Equal lengths on top sides
Equal lengths on bottom sides
One pair of equal angles

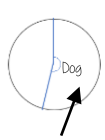
Draw Pie Charts

Type of pet	Dog	Cat	Hamster
Frequency	32	25	3

$\frac{32}{60}$ "32 out of 60 people had a dog"

This fraction of the 360 degrees represents dogs

$\frac{32}{60} \times 360 = 192°$



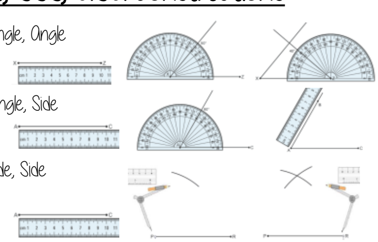
Use a protractor to draw
This is 192°

SAS, SSS, ASA constructions

Side, Angle, Angle

Side, Angle, Side

Side, Side, Side



Polygons

3 - Triangle
4 - Quadrilateral
5 - Pentagon
6 - Hexagon
7 - Heptagon
8 - Octagon
9 - Nonagon
10 - Decagon

If all the sides and angles are the same, it is a **regular** polygon

YEAR 8 - APPLICATION OF NUMBER

Solving problems with multiplication and division

What do I need to be able to do?

By the end of this unit you should be able to:

- Understand and use factors
- Understand and use multiples
- Multiply/ Divide integers and decimals by powers of 10
- Use formal methods to multiply
- Use formal methods to divide
- Understand and use order of operations
- Solve area problems
- Solve problems using the mean

Keywords

Array: an arrangement of items to represent concepts in rows or columns
Multiples: found by multiplying any number by positive integers
Factor: integers that multiply together to get another number.
Mili: prefix meaning one thousandth
Centi: prefix meaning one hundredth
Kilo: prefix meaning multiply by 1000
Quotient: the result of a division
Dividend: the number being divided
Divisor: the number we divide by

Factors

Arrays can help represent factors

5 x 2 or 2 x 5

Factors of 10
1, 2, 5, 10

10 x 1 or 1 x 10

The number itself is always a factor

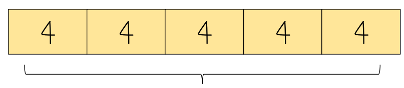
Square numbers have an ODD number of factors

Factors of 4
1, 2, 4

Factors of 36
1, 2, 3, 4, 6, 9, 12, 18, 36

Be strategic
- Lay factors out in pairs can help you not to miss any

Multiples



Bar models can represent by something is a multiple. Eg 20 is a multiple of 4

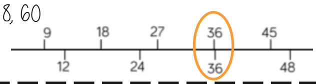
Lowest Common Multiples

LCM of 9 and 12

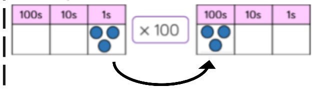
The first time their multiples match

9: 9, 18, 27, 36, 45, 54
12: 12, 24, 36, 48, 60

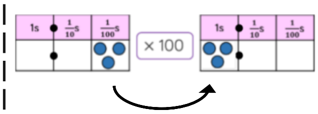
LCM = 36



Multiply/ Divide by powers of 10



3 x 100 = 300



0.03 x 100 = 3

Repeated multiplication and division by powers of 10 is commutative

÷ 10 then ÷ 10 ⟶ ÷ 100

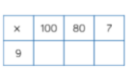
Metric conversions

Useful Conversions

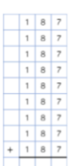
mm → cm (÷ 10), cm → mm (× 10)
cm → m (÷ 100), m → cm (× 100)
m → km (÷ 1000), km → m (× 1000)
g → kg (÷ 1000), kg → g (× 1000)
ml → L (÷ 1000), L → ml (× 1000)

Multiplication methods

Long multiplication (column)



Grid method



Repeated addition

Less effective method especially for bigger multiplication

Estimations: Using estimations allows a 'check' if your answer is reasonable

Multiplication with decimals

Perform multiplications as integers
eg 0.2 x 0.3 ⟶ 2 x 3

Make **adjustments** to your answer to match the question: 0.2 x 10 = 2
0.3 x 10 = 3

Therefore 6 ÷ 100 = 0.06

Division methods

Short division

3584 ÷ 7 = 512

```
    5  1  2
7 | 3 ³5  8 ¹4
```

Complex division

÷ 24 = ÷ 6 ÷ 4

Break up the divisor using factors

Division with decimals

The placeholder in division methods is essential – the decimal lines up on the dividend and the quotient

24 ÷ 0.02 ⟶ 24 ÷ 0.2 ⟶ 240 ÷ 2

All give the same solution as represent the same proportion
Multiply the values in proportion until the divisor becomes an integer

Order of operations

Brackets
Indices or roots
Multiplication or division
Addition or subtraction

If you have multiple operations from the same tier work from left to right

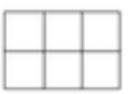
eg 10 – 3 + 5 ⟶ 10 - 3 ⟶ 7 + 5

6 x 4 + 8 x 2

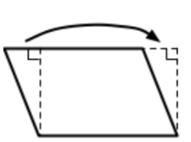
24 + 16 = 40

Area problems

Rectangle
Base x Perpendicular height

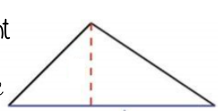


Parallelogram/ Rhombus
Base x Perpendicular height



Triangle
½ x Base x Perpendicular height

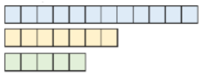
A triangle is half the size of the rectangle it would fit in



Mean problems

Mean – a measure of average
It gives an idea of the central value

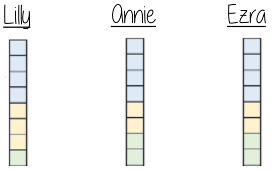
Lilly, Annie and Ezra have the following cubes



24 in total

Finding the mean amount is the average amount each person would have if shared out equally

Lilly Annie Ezra



The mean number of blocks would be 8 each

YEAR 8 – DIRECTED NUMBER

Operations with equations and directed numbers

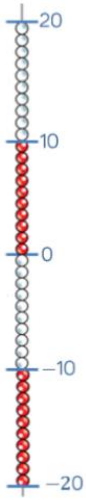
What do I need to be able to do?

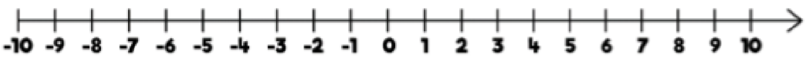
By the end of this unit you should be able to:

- Perform calculations that cross zero
- Add/ Subtract directed numbers
- Multiply/ Divide directed numbers
- Evaluate algebraic expressions
- Solve two-step equations
- Use order of operations with directed number

Keywords

Subtract: taking away one number from another.
Negative: a value less than zero.
Commutative: changing the order of the operations does not change the result
Product: multiply terms
Inverse: the opposite function
Square root: a square root of a number is a number when multiplied by itself gives the value (symbol $\sqrt{\ }$)
Square: a term multiplied by itself.
Expression: a maths sentence with a minimum of two numbers and at least one math operation (no equals sign)

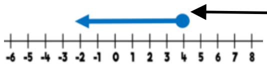




Perform calculations that cross zero

Number lines are useful to help you visualise the calculation crossing 0

$4 - 6 = -2$

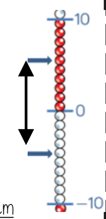


Use the number line to guide subtraction of 6

Start at 4

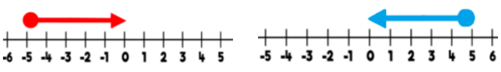
Find the difference between 6 and -4

From 6 to 0
6
From 0 to -4
4



10 beads between them

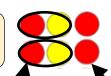
$-5 + 5 = 0$ Rearrangements of the same equation $5 - 5 = 0$



Add directed numbers

(red counter) = –1
(yellow counter) = 1
Representations

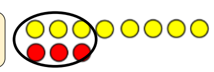
$2 + -4 = -2$



Zero pair ($-1 + 1 = 0$)

Two "– 1" left = -2

$8 + -3 = 5$



Partitioning

$8 + -3 = 5$

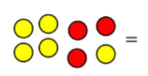
$5 + 3 + -3 = 5$

Partition the value to create a zero pair calculation

Generalisation
$+ - = -$

Subtract directed numbers

(red counter) = –1
(yellow counter) = 1
Representations



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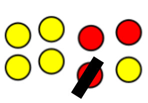
Representation for calculation

2 "Subtract" – means take away or remove

$2 - -1 = 3$

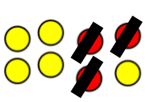


= 3

Take away one (red counter)

Start with the representation of 2

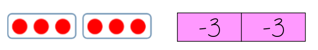
$2 - -3 = 5$



= 5

Generalisation
$- - = +$

Multiply/ Divide directed numbers



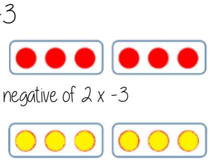
Two representations of the same calculation

$2 \times -3 = -6$

Negative, Negative calculation

-2×-3

This is the negative of 2×-3



The act of making counters into their negative is turning them over

$-2 \times -3 = 6$

Divisions are the inverse operations

Evaluate algebraic expressions

$a = 5$

$b = -4$

$a^2 = 5^2$
$a^2 = 25$

$b^2 = (-4)^2$
$b^2 = 16$

With negative numbers the brackets are important so that it performs -4×-4.

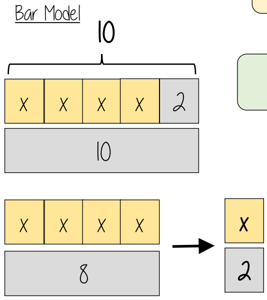
Brackets around negative substitutions helps remove calculation errors

$2a - b = 2 \times 5 - (-4) = 10 + 4 = \underline{14}$

$3b - 2a = 3(-4) - 2(5) = -12 - 10 = \underline{-22}$

Two-step equations

Bar Model



$4x + 2 = 10$

$10 - 4x = 2$

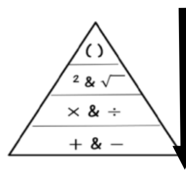
Representing the same question (use fact families)

Function machine

$x \rightarrow \boxed{\times 4} \rightarrow \boxed{+2} \rightarrow 10$

Inverse operations to find x

Use order or operations



Brackets
Indices or roots
Multiplication or division
Addition or subtraction

Brackets around negative substitutions helps remove calculation errors

Remember square roots have a positive and negative value

×	−3	−2	−1	0	1	2	3
−3	9	6	3	0	−3	−6	−9
−2	6	4	2	0	−2	−4	−6
−1	3	2	1	0	−1	−2	−3
0	0	0	0	0	0	0	0
1	−3	−2	−1	0	1	2	3
2	−6	−4	−2	0	2	4	6
3	−9	−6	−3	0	3	6	9

YEAR 8 - PROPORTIONAL REASONING...

Multiplying and Dividing Fractions

What do I need to be able to do?

By the end of this unit you should be able to:

- Carry out any multiplication or division using fractions and integers.
- Solutions can be modelled, described and reasoned

Keywords

Numerator : the number above the line on a fraction. The top number. Represents how many parts are taken

Denominator: the number below the line on a fraction. The number represent the total number of parts.

Whole: a positive number including zero without any decimal or fractional parts.

Commutative: an operation is commutative if changing the order does not change the result.

Unit Fraction: a fraction where the numerator is one and denominator a positive integer.

Non-unit Fraction: a fraction where the numerator is larger than one.

Dividend : the amount you want to divide up.

Divisor: the number that divides another number.

Quotient: the answer after we divide one number by another. e.g. dividend ÷ divisor = quotient

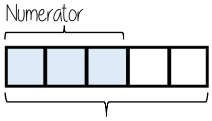
Reciprocal: a pair of numbers that multiply together to give 1.

Representing a fraction

$\frac{\text{Numerator}}{\text{Denominator}}$

$\frac{3}{5}$

Number of parts represented
Numerator



Number of parts to make up the whole
Denominator

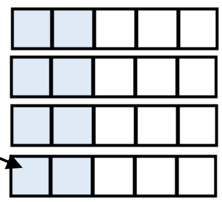
ALL PARTS of a fraction are of equal size

Repeated addition = multiplication by an integer

$4 \times \frac{2}{5} \rightarrow \frac{2}{5} + \frac{2}{5} + \frac{2}{5} + \frac{2}{5}$

Integer (Whole number)

Each part represents $\frac{1}{5}$

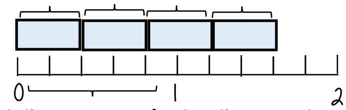


How many parts are shaded?
What each part represents

Revisit
When adding fractions with the same denominator = add the numerators

$= \frac{8}{5} \leftarrow \frac{2}{5} + \frac{2}{5} + \frac{2}{5} + \frac{2}{5}$

$= 1\frac{3}{5}$



Each whole is split into the same number of parts as the denominator

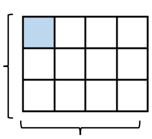
Multiplying unit fractions

$\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$

Parts shaded

Total number of parts in the diagram

Modelled:



Multiplying non-unit fractions

$\frac{3}{4} \times \frac{2}{3}$

Shade in 3 parts

Repeat it on this many rows

This many columns

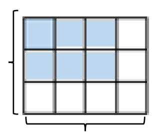
This many rows

$\frac{3}{4} \times \frac{2}{3} = \frac{6}{12}$

Parts shaded

Total number of parts in the diagram

Modelled:



Quick Multiplying and Cancelling down

$\frac{\cancel{3}^{\,1}}{5} \times \frac{4}{\cancel{9}_{\,3}}$

The 3 and the 9 have a common factor and can be simplified

Quick Solving
Multiply the numerators
Multiply the denominators

$\frac{1 \times 4}{5 \times 3} = \frac{4}{15}$

The reciprocal

When you multiply a number by its reciprocal the answer is always 1

$3 \times \frac{1}{3} = 1$

$\frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1$

The reciprocal of 3 is $\frac{1}{3}$ and vice versa

Reciprocals for division

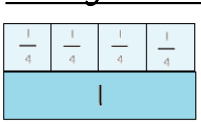
e.g.

$5 \div \frac{1}{4} = 20$

$5 \times 4 = 20$

Multiplying by a reciprocal gives the same outcome

Dividing an integer by an unit fraction



$1 \div \frac{1}{4} = 4$

How many quarters are in 1?

"There are 4 quarters in 1 whole. Therefore, there are 20 quarters in 5 wholes"

$5 \div \frac{1}{4} = 20$

Dividing any fractions

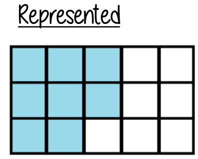
Remember to use reciprocals

$\frac{2}{5} \div \frac{3}{4}$

$\frac{2}{5} \times \frac{4}{3}$

Multiplying by a reciprocal gives the same outcome

Represented



$= \frac{8}{15}$

YEAR 8 - ALGEBRAIC TECHNIQUES...

Brackets, Equations & Inequalities

What do I need to be able to do?

By the end of this unit you should be able to:

- Form Expressions
- Expand and factorise single brackets
- Form and solve equations
- Solve equations with brackets
- Represent inequalities
- Form and solve inequalities

Keywords

Simplify: grouping and combining similar terms
Substitute: replace a variable with a numerical value
Equivalent: something of equal value
Coefficient: a number used to multiply a variable
Product: multiply terms
Highest Common Factor (HCF): the biggest factor (or number that multiplies to give a term)
Inequality: an inequality compares who values showing if one is greater than, less than or equal to another

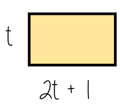
Form expressions

For unknown variables, a letter is normally used in its place

More than – ADD
Less than/ difference – SUBTRACT

eg 4 more than t ⟶ $t + 4$
8 less than k ⟶ $k - 8$

Only similar terms can be grouped together



eg Find the perimeter of this shape
(Perimeter = length around outside of shape)

$t + 2t + 1 + t + 2t + 1 \longrightarrow 6t + 2$

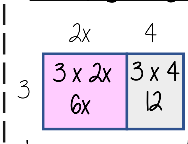
Directed numbers

+ + ⟶ +
− − ⟶ +
+ − ⟶ −
− + ⟶ −

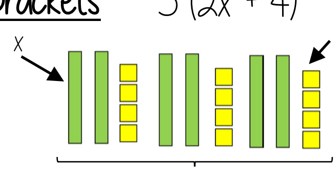
eg $a = -5$ and $b = 2$
$a^2 = a \times a = -5 \times -5 = 25$
$b + a = 2 + -5 = -3$

Multiply single brackets

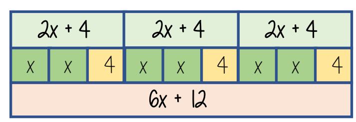
$3(2x + 4)$



$6x + 12$



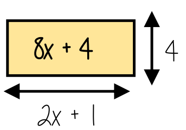
$6x + 12$



Different representations of $3(2x+4) = 6x + 12$

Factorise into a single bracket

$8x + 4$



⟵ Try and make this the **highest common factor**

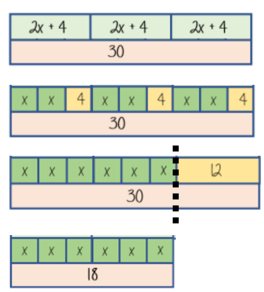
The two values **multiply** together (also the area) of the rectangle

$8x + 4 \equiv 4(2x + 1)$

Note:
$8x + 4 \equiv 2(4x + 2)$
This is factorised but the HCF has not been used

Solve equations with brackets

$3(2x + 4) = 30$



$3(2x + 4) = 30$

Expand the brackets

$6x + 12 = 30$
$-12 \qquad -12$

Substitute to check your answer. This could be negative or a fraction or decimal

$6x = 18$
$\div 6 \qquad \div 6$

$x = 3$

Simple Inequalities

< less than
≤ Less than or equal to
> More than
≥ More than or equal to

$x < 10$
Say this out loud
"x is a value less than 10"

$10 > x$
Say this out loud
"10 is more than the value"

Note:
$x < 10$ and $10 > x$ represent the same values

$x + 2 \leq 20$
"my value + 2 is less than or equal to 20"
$x \leq 18$
The biggest the value can be is 18

Form and solve inequalities

Two more than treble my number is greater than 11

Find the possible range of values

Form

$x \longrightarrow \times 3 \longrightarrow +2 \longrightarrow 11$

$3x + 2 > 11$

Solve

$x \longleftarrow \div 3 \longleftarrow -2 \longleftarrow 11$

$x > 3$

Check

This would suggest any value bigger than 3 satisfies the statement

$3 \times 3 + 2 = 11$ ✓ $\qquad 10 \times 3 + 2 = 32$ ✓

Algebraic constructs

Expression
A sentence with a minimum of two numbers and one maths operation

Equation
A statement that two things are equal

Term
A single number or variable

Identity
An equation where both sides have variables that cause the same answer includes ≡

Formula
A rule written with all mathematical symbols
eg area of a rectangle $A = b \times h$

YEAR 8 - REASONING WITH ALGEBRA...
Forming and Solving Equations

What do I need to be able to do?

By the end of this unit you should be able to:

- Solve inequalities with negative numbers
- Solve equations with unknowns on both sides
- Solve inequalities with unknowns on both sides
- Substitute into formulae and equations
- Rearrange formulae

Keywords

Inequality: an inequality compares who values showing if one is greater than, less than or equal to another

Variable: a quantity that may change within the context of the problem

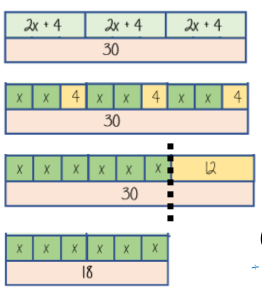
Rearrange: Change the order

Inverse operation: the operation that reverses the action

Substitute: replace a variable with a numerical value

Solve: find a numerical value that satisfies an equation

Solve equations with brackets (R)



$3(2x + 4) = 30$

Expand the brackets

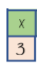
$6x + 12 = 30$

$-12 \quad -12$

$6x = 18$

$\div 6 \quad \div 6$

$x = 3$



Form and solve inequalities (R)

Find the possible range of values

$3x + 2 > 11$

Solve

$x \leftarrow -3 \leftarrow -2 \leftarrow 11$

$x > 3$

Inequalities with negatives

Method 1 Make x positive first

$2 - 3x > 17$

$+3x \quad +3x$

$2 > 17 + 3x$

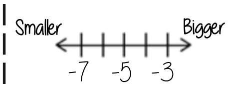
$-17 \quad -17$

$-15 > 3x$

$\div 3 \quad \div 3$

$-5 > x$

x is true for any value smaller than -5



CHECK IT!
$2 - 3(-6) = 20$
TRUE/ CORRECT

Method 2 Keep the negative x

$2 - 3x > 17$

$-2 \quad -2$

$-3x > 15$

$\div -3 \quad \div -3$

$x > -5$

x is true for any value bigger than -5

This cannot be true...

$x < -5$

When you multiply or divide x by a negative you need to reverse the inequality

Equations with unknown on both sides

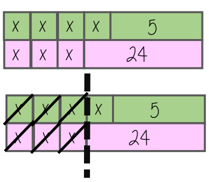
$4x + 5 = 3x + 24$

$-3x \quad -3x$

$x + 5 = 24$

$-5 \quad -5$

$x = 19$



Inequalities with unknown on both sides

Solving inequalities has the same method as equations

$5(x + 4) < 3(x + 2)$

$5x + 20 < 3x + 6$

$2x + 20 < 6$

$2x < -14$

$x < -7$

Check it!

$5(-8 + 4) < 3(-8 + 2)$

$5(-4) < 3(-6)$

$-20 < -18$

✓ -20 IS smaller than -18

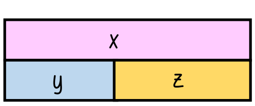
Formulae and Equations

Formulae – all expressed in symbols

Substitute in values

Equations – include numbers and can be solved

Rearranging Formulae (one step)



$x = y + z$

Rearrange to make y the subject.

$y = x - z$

$y \rightarrow +z \rightarrow x$

$y \leftarrow -z \leftarrow x$

Using inverse operations or fact families will guide you through rearranging formulae

Rearranging can also be checked by substitution.

Language of rearranging...

Make XXX the subject

Change the subject

Rearrange

Rearranging Formulae (two step)

In an equation (find x)

$4x - 3 = 9$

$+3 \quad +3$

$4x = 12$

$\div 4 \quad \div 4$

$x = 3$

In a formula (make x the subject)

$xy - s = a$

$+s \quad +s$

$xy = a + s$

$\div y \quad \div y$

$x = \frac{a + s}{y}$

The steps are the same for solving and rearranging

Rearranging is often needed when using $y = mx + c$

e.g. Find the gradient of the line $2y - 4x = 9$

Make y the subject first $y = \frac{4x + 9}{2}$ Gradient $= \frac{4}{2} = 2$

YEAR 8 - DEVELOPING GEOMETRY...
Area of trapezia and Circles

What do I need to be able to do?

By the end of this unit you should be able to:

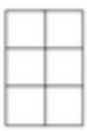
- Recall area of basic 2D shapes
- Find the area of a trapezium
- Find the area of a circle
- Find the area of compound shapes
- Find the perimeter of compound shapes

Keywords

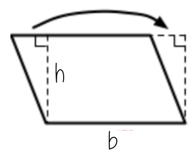
Congruent: The same
Area: Space inside a 2D object
Perimeter: Length around the outside of a 2D object
Pi (π): The ratio of a circle's circumference to its diameter.
Perpendicular: At an angle of 90° to a given surface
Formula: A mathematical relationship/ rule given in symbols. E.g. b x h = area of rectangle/ square
Infinity (∞): A number without a given ending (too great to count to the end of the number) – never ends
Sector: A part of the circle enclosed by two radii and an arc.

Area – rectangles, triangles, parallelograms

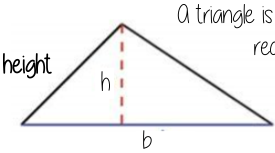
Rectangle
Base x Height



Parallelogram/ Rhombus
Base x Perpendicular height



Triangle
½ x Base x Perpendicular height

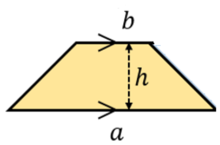


A triangle is half the size of the rectangle it would fit in

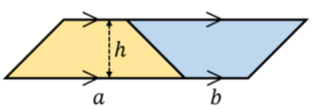
Area of a trapezium

Area of a trapezium

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



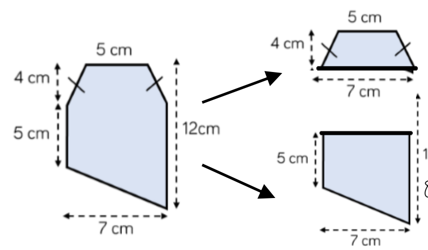
Why?



- Two congruent trapeziums make a parallelogram
- New length (a + b) x height
- Divide by 2 to find area of one

Compound shapes

To find the area compound shapes often need splitting into more manageable shapes first. Identify the shapes and missing sides etc. first.



Units

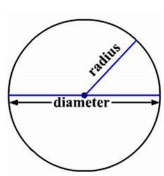
Shape A + Shape B = total area

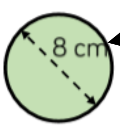
$\frac{(5+7) \times 4}{2}$ + $\frac{(5+8) \times 7}{2}$ = 24 + 45.5 = 69.5cm²

Area of a circle (Non-Calculator)

Read the question – leave in terms of π or if $\pi \approx 3$ (provides an estimate for answers)

Area of a circle
π x radius²



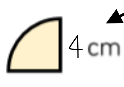


Diameter = 8cm
∴ **Radius** = 4cm

π x radius²
= π x 4²
= π x 16
= 16π cm²

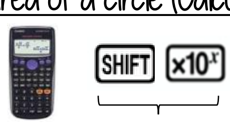
Find the area of one quarter of the circle

Radius = 4cm



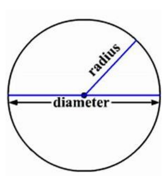
Circle Area = 16π cm²
Quarter= 4π cm²

Area of a circle (Calculator)



How to get π symbol on the calculator

Area of a circle
π x radius²



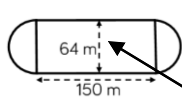
It is important to round your answer suitably – to significant figures or decimal places. This will give you a decimal solution that will go on forever!

Compound shapes including circles

Circumference
π x diameter

Compound shapes are not always area questions. For Perimeter you will need to use the circumference

Spotting diameters and radii



This dimension is also the diameter of the semi circles.

Arc lengths = π x 64
= 64 π

Don't need to halve this because there are 2 ends which make the whole circle

Arc lengths + Straight lengths = total perimeter

= 64 π + 150 + 150
= (300 + 64 π) m
OR = 501.1 m

Still remember to split up the compound shape into smaller more manageable individual shapes first

YEAR 8 - CONSTRUCTING IN 2D/3D...
3D Shapes

What do I need to be able to do?

By the end of this unit you should be able to:

- Name 2D & 3D shapes
- Recognise Prisms
- Sketch and recognise nets
- Draw plans and elevations
- Find areas of 2D shapes
- Find Surface area for cubes, cuboids, triangular prisms and cylinders
- Find the volume of 3D shapes

Keywords

2D: two dimensions to the shape e.g. length and width

3D: three dimensions to the shape e.g. length, width and height

Vertex: a point where two or more line segments meet

Edge a line on the boundary joining two vertex

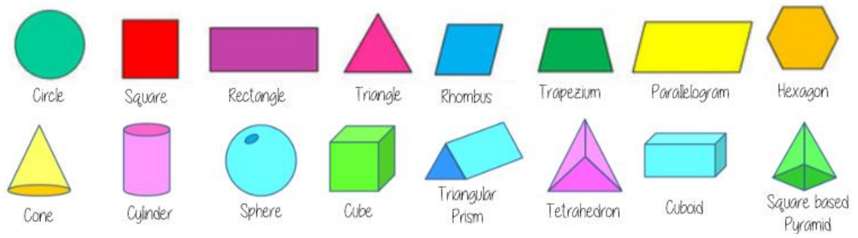
Face: a flat surface on a solid object

Cross-section: a view inside a solid shape made by cutting through it

Plan: a drawing of something when drawn from above (sometimes birds eye view)

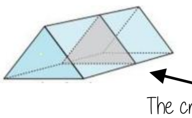
Perspective: a way to give illustration of a 3D shape when drawn on a flat surface.

Name 2D & 3D shapes



Recognise prisms

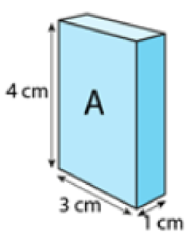
A solid object with two identical ends and flat sides

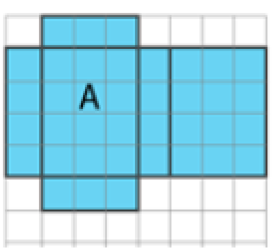


The cross section will also be identical to the end faces.

A cylinder although with very similar properties does not have flat faces so is not categorised as a prism

Nets of cuboids

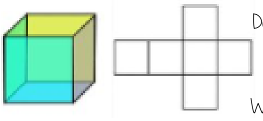




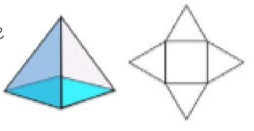
1cm grids help to draw accurately

Visualise the folding of the net. Will it make the cuboid with all sides touching

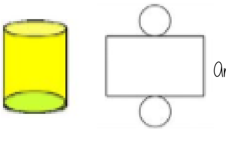
Sketch and recognise nets



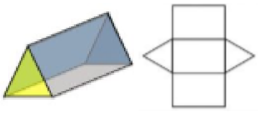
Do they have the same number of faces?



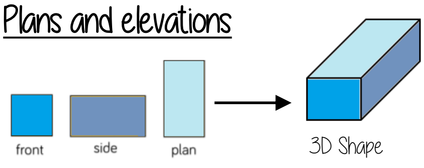
Where do the edges join?



Are the shapes of the faces correct?



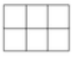
Plans and elevations



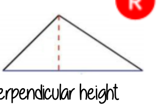
The direction you are considering the shape from determines the front and side views

Area of 2D shapes

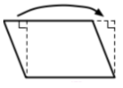
Rectangle
Base x Height



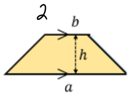
Triangle
½ x Base x Perpendicular height



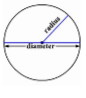
Parallelogram/ Rhombus
Base x Perpendicular height



Area of a trapezium
$\frac{(a+b) \times h}{2}$

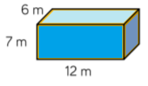


Area of a circle
π x radius²

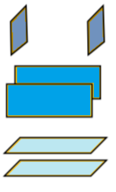


Surface area

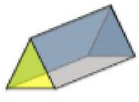
Sketching nets first helps you visualise all the sides that will form the overall surface area



For cubes and cuboids you can also find one of each face and double it

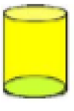


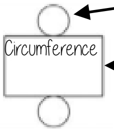
Sides	6 x 7	
	6 x 7	
Front and back	12 x 7	
	12 x 7	
Top and Bottom	12 x 6	
	12 x 6	Sum of all sides is surface area



For other shapes – not all the sides are the same, so calculate the individually

Surface area - cylinders





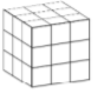
The area of the circle
π x radius²

The width of this face is the same as the circumference
π x diameter x height

2 x π x radius² + π x diameter x height

Volumes

Volume is the 3D space it takes up – also known as capacity if using liquids to fill the space

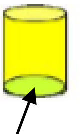


Counting cubes

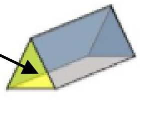
Some 3D shape volumes can be calculated by counting the number of cubes that fit inside the shape

Cubes/ Cuboids = base x width x height

Remember multiplication is commutative



Cross section



Cross section

Prisms and cylinders = area cross section x height

Height can also be described as depth

Areas – square units
Volumes – cube units

Areas and volumes can be left in terms of pi π

YEAR 8 - DEVELOPING NUMBER...

Fractions & Percentages

What do I need to be able to do?

By the end of this unit you should be able to:

- Convert between FDP less than and more than 100.
- Increase or decrease using multipliers.
- Express an amount as a percentage.
- Find percentage change.

Keywords

Percent: parts per 100 – written using the % symbol

Decimal: a number in our base 10 number system. Numbers to the right of the decimal place are called decimals.

Fraction: a fraction represents how many parts of a whole value you have.

Equivalent: of equal value.

Reduce: to make smaller in value.

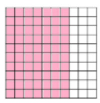
Growth: to increase/ to grow.

Integer: whole number, can be positive, negative or zero.

Invest: use money with the goal of it increasing in value over time (usually in a bank).

Convert FDP (R)

$\frac{70}{100}$ → This also means 70 ÷ 100 → 70 out of 100 squares, 70 "hundredths" = 7 "tenths", 0.7 →



→ 70 hundredths = 70%

Using a calculator: ■/□ → S⇌D → Convert to a decimal → × 100 converts to a percentage

This will give you the answer in the simplest form

Be careful of recurring decimals
e.g. $\frac{1}{3} = 0.3333333 = 0.\dot{3}$
The dot above the 3

Fraction/ Percentage of amount (R)

Find $\frac{3}{5}$ of £60

£60: | £12 | £12 | £12 | £12 | £12 |

£36

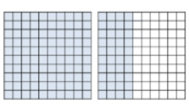
Remember $\frac{3}{5} = 60\%$

10% of £60 = £6
50% of £60 = £30
60% of £60 = £36

Remember
$\frac{3}{5} = 60\% = 0.6$
60% of £60
= 0.6 x 60
= £36

Convert FDP < and > 100%

100 hundredths, 10 tenths, 100%



40 hundredths, 4 tenths, 40%

140 hundredths, 14 tenths, 140%

100%+40%
1 + 0.40
= 1.40

Percentage decrease: Multipliers

100%

Decrease by 58%

42%

100% - 58% = 42%
1.00 – 0.58 = 0.42 ← Multiplier Less than 1

Percentage increase: Multipliers

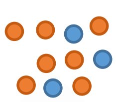
100% | 12%

Increase by 12%

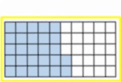
100% + 12% = 112%
1.00 + 0.12 = 1.12 ← Multiplier More than 1

Express as a % - Non-calculator

Percent – per hundred



7 per every 10 are orange: $\frac{7}{10}$ → This means that 70 per every 100 are orange: $\frac{70}{100}$ → 70%



27 per every 50 shaded: $\frac{27}{50}$ → 54 per every 100 shaded: $\frac{54}{100}$ → 54%

Denominator 100 | Equivalent fractions

Express as a % - Calculator

$\frac{13}{30}$ → ■/□ → $\frac{13}{30}$ → × 100 → 43.3333...% → 43%

This the same as 13 ÷ 30

Can't use equivalence easily to find 'per hundred'

Decimal percentages are still a percentage

Percentage change

"I bought a phone for £200. A year later sold it for £125"

100%: £200 / £125

All values of change compare to the ORIGINAL value

Percentage loss
$\frac{75}{200} \times 100 = 37.5\%$

$\frac{\text{Difference in value}}{\text{Original value}} \times 100$

"I bought a house for £180,000, I later sold it for £216,000"

100%: £180,000

Percentage profit

Money made (profit value) → $\frac{36000}{180000} \times 100 = 20\%$

Choose appropriate method

The language and wording of the question is the key

Have you represented the question in a bar model?
Can you use a calculator?

YEAR 8 – REASONING WITH GEOMETRY...

Solving ratio & proportion problems

What do I need to be able to do?

By the end of this unit you should be able to:

- Solve problems with direct proportion
- Use conversion graphs
- Solve problems with inverse proportion
- Solve ratio problems
- Solve 'best buy' problems

Keywords

Proportion: a comparison between two numbers
Ratio: a ratio shows the relative size of two variables
Direct proportion: as one variable is multiplied by a scale factor the other variable is multiplied by the same scale factor.
Inverse proportion:: as one variable is multiplied by a scale factor the other is divided by the same scale factor.

Direct Proportion

As one variable changes the other changes at the same rate.

4 cans of pop = £2.40

This is a multiplicative change

4 cans of pop = £2.40 (x 0.5)
2 cans of pop = £1.20 (x 0.5)

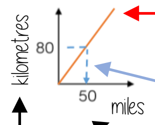
This multiplier is the same In the same way that this would be for ratio

4 cans of pop = £2.40 (x 3)
12 cans of pop = £7.20 (x 3)

Sometimes this is easiest if you work out how much one unit is worth first
eg. 1 can of pop = £0.60

Conversion Graphs

Compare two variables



This is always a straight line because as one variable increases so does the other at the same rate

Labelling of both axes is vital

To make conversions between units you need to find the point to compare – then find the associated point by using your graph.
Using a ruler helps for accuracy
Showing your conversion lines help as a "check" for solutions

Inverse Proportion

As one variable is multiplied by a scale factor the other is divided by the same scale factor

Examples of inversely proportional relationships

Time taken to fill a pool and the number of taps running

Time taken to paint a room and the number of workers

T is inversely proportional to G. When T=2 then G=20

÷ 2 (from 2 to 1), × 4 (from 2 to 8)

T	1	2	8
G	40	20	5

× 2 (from 20 to 40), ÷ 4 (from 20 to 5)

Best Buys

Have a directly proportional relationship

To calculate best buys you need to be able to compare the cost of one unit or units of equal amounts

Shop A
4 cans for £1.20
£1.20 ÷ 4
1 can is £0.30
Or 30p

Shop B
3 cans for 93p
£0.93 ÷ 3
1 can is £0.31
Or 31p

Cost per item

Shop A is the best value as it is 1p cheaper per can of pop

Shop A
4 cans for £1.20
4 ÷ £1.20
£1 buys 3.333 cans of pop

3 cans for 93p
3 ÷ £0.93
£1 buys 3.23 cans of pop

Cost per pound

Shop A is still shown as being the best value but pay attention to the unit you are calculating, per item or per pound

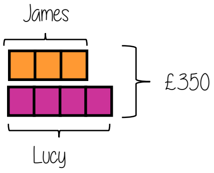
Best value is the most product for the lowest price per unit

Sharing a whole into a given ratio

James and Lucy share £350 in the ratio 3:4.
Work out how much each person earns

Model the Question

James: Lucy
3 : 4



Find the value of one part

Whole: £350
7 parts to share between
(3 James, 4 Lucy)

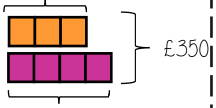
£350 ÷ 7 = £50

□ = one part = £50

Put back into the question

James: Lucy
3 : 4 (x 50)
£150:£200

James = 3 x £50 = £150



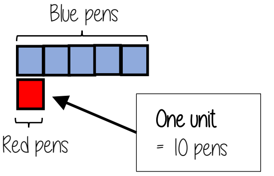
Lucy = 4 x £50 = £200

Finding a value given 1:n (or n:1)

Inside a box are blue and red pens in the ratio 5:1
If there are 10 red pens how many blue pens are there?

Model the Question

Blue : Red
5 : 1



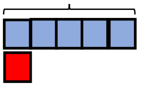
One unit = 10 pens

□ = one part = 10 pens

Put back into the question

Blue : Red
5 : 1 (x 10)
50: 10

Blue pens = 5 x 10 = 50 pens



Red pens = 1 x 10 = 10 pens

There are 50 Blue Pens

YEAR 8 - REASONING WITH DATA...

The data handling cycle

What do I need to be able to do?

By the end of this unit you should be able to:

- Set up a statistical enquiry
- Design and criticise questionnaires
- Draw and interpret multiple bar charts
- Draw and interpret line graphs
- Represent and interpret grouped quantitative data
- Find and interpret the range
- Compare distributions

Keywords

Hypothesis: an idea or question you want to test
Sampling: the group of things you want to use to check your hypothesis
Primary Data: data you collect yourself
Secondary Data: data you source from elsewhere e.g the internet/ newspapers/ local statistics
Discrete Data: numerical data that can only take set values
Continuous Data: numerical data that has an infinite number of values (often seen with height, distance, time)
Spread: the distance/ how spread out/ variation of data
Average: a measure of central tendency – or the typical value of all the data together
Proportion: numerical relationship that compares two things

Set up a statistical enquiry

Write a suitable hypothesis → Design a data collection sheet → Pros/ Cons of sampling → Pros/ Cons primary or secondary data → Discrete or continuous data?

Features of a data collection sheet

Data Title	Tally	Frequency
	𝍸	

Grouped or ungrouped categories

Total number of that group observed

Design and criticise a questionnaire

The Question - be clear with the question - don't be too leading/ judgemental

e.g How much pocket money do you get a week?

Responses – do you want closed or open responses? – do any options overlap? – Have you an option for all responses?

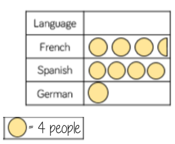
Zero option → ☐ £0 ☐ £0.01 - £2 ☐ £2.01 - £4 ☐ more than £4 ← More option

NOTE: For responses about continuous data include inequalities $<$ x $\leq$

Pictograms, bar and line charts (R)

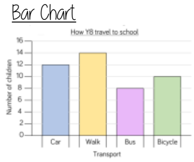
Represents quantitative data

Pictogram



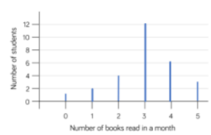
- Need to remember a key
- Visually able to identify mode

Bar Chart



- Gaps between the bars
- Clearly labelled axes
- Scale for the axes
- Title for the bar chart
- Discrete Data

Line Chart



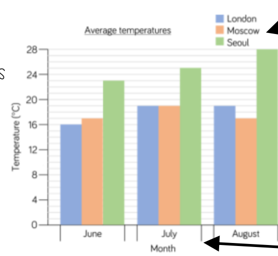
- Gaps between the lines
- Clearly labelled axes
- Scale for the axes
- Discrete Data

Multiple Bar chart

Compares multiple groups of data

- Clearly labelled axes
- Scale for axes
- Comparable data bars drawn next to each other

Key/ Colour code for separate groups of information



Gap between different categories of data

Draw and interpret Pie Charts (R)

Remember a circle has 360°

Type of pet	Dog	Cat	Hamster
Frequency	32	25	3

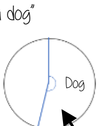
There were 60 people asked in this survey (Total frequency)

$\frac{32}{60}$ "32 out of 60 people had a dog"

This fraction of the 360 degrees represents dogs

$\frac{32}{60} \times 360 = 192°$

Multiple method
As 60 goes into 360 – 6 times.
Each frequency can be multiplied by 6 to find the degrees (proportion of 360)



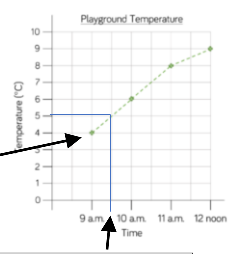
Use a protractor to draw
This is 192°

Represents quantitative, discrete data

Draw and interpret line graphs

- Commonly used to show changing over time
- The points are the recorded information and the lines join the points.

Line graphs do not need to start from 0



More than one piece of data can be plotted on the same graph to compare data

It is possible to make estimates from the line e.g temperature at 9.30am is 5°C

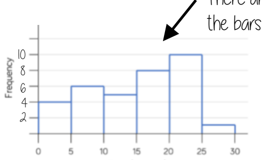
Grouped quantitative data

Time (minutes)	Frequency
$0 \leq t < 5$	4
$5 \leq t < 10$	6
$10 \leq t < 15$	5
$15 \leq t < 20$	8
$20 \leq t < 25$	10
$25 \leq t < 30$	1

"More than or equal to 25 and less than 30 minutes"

The use of inequalities shows that this will be a frequency diagram

This is a frequency diagram
There are no gaps between the bars



Grouping the data is useful if there is a large spread of data to begin with

Find and interpret the range

The range is a measure of **spread**

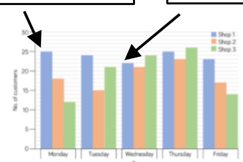
Difference between the biggest and smallest values

A smaller range means there is less variation in the results – it is more consistent data

A range of 0 means all the data is the same value

Shop 1 highest value

Shop 1 lowest value



Shop 1 has the smallest range – this indicates it has a more consistent flow of customers each week

Range of customers = 25 – 22 = 3 (Shop 1)

YEAR 8 - REASONING WITH GEOMETRY...
Pythagoras' theorem

What do I need to be able to do?

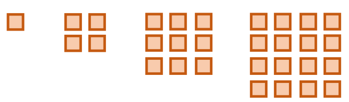
By the end of this unit you should be able to:

- Use square and cube roots
- Identify the hypotenuse
- Calculate the hypotenuse
- Find a missing side in a Right angled triangle
- Use Pythagoras' theorem on axes
- Explore proofs of Pythagoras' theorem

Keywords

Square number: the output of a number multiplied by itself
Square root: a value that can be multiplied by itself to give a square number
Hypotenuse: the largest side on a right angled triangle. Always opposite the right angle.
Opposite: the side opposite the angle of interest
Adjacent: the side next to the angle of interest

Squares and square roots R



This can also be written as 6^2

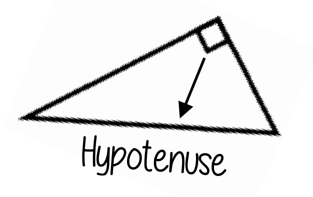
$\sqrt{\ }$ is the square root symbol

eg $\sqrt{64} = 8$
Because 8 × 8 = 64

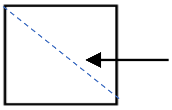
1 × 1	2 × 2	3 × 3	4 × 4	5 × 5	6 × 6	7 × 7	8 × 8	9 × 9	10 × 10
1	4	9	16	25	36	49	64	81	100

Square numbers

Identify the hypotenuse

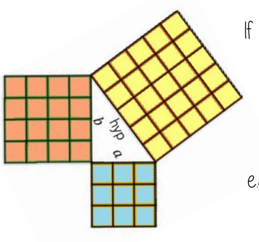


The hypotenuse is always the longest side on a triangle because it is opposite the biggest angle.



Polygons can still have a hypotenuse if it is split up into triangles and opposite a right angle

Determine if a triangle is right-angled



a = 3 b = 4 c = 5

If a triangle is right-angled, the sum of the squares of the shorter sides will equal the square of the hypotenuse.

$a^2 + b^2 = \text{hypotenuse}^2$

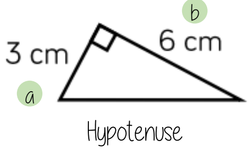
eg $a^2 + b^2 = \text{hypotenuse}^2$

$3^2 + 4^2 = 5^2$

$9 + 16 = 25$

Substituting the numbers into the theorem shows that this is a right-angled triangle

Calculate the hypotenuse



Either of the short sides can be labelled a or b

$a^2 + b^2 = \text{hypotenuse}^2$

1. Substitute in the values for a and b

$3^2 + 6^2 = \text{hypotenuse}^2$

$9 + 36 = \text{hypotenuse}^2$

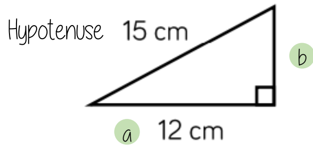
$45 = \text{hypotenuse}^2$

2. To find the hypotenuse square root the sum of the squares of the shorter sides.

$\sqrt{45} = \text{hypotenuse}$

$6.71cm = \text{hypotenuse}$

Calculate missing sides



Either of the short sides can be labelled a or b

$a^2 + b^2 = \text{hypotenuse}^2$

$12^2 + b^2 = 15^2$

1. Substitute in the values you are given

$144 + b^2 = 225$

$-144 \qquad -144$

Rearrange the equation by subtracting the shorter square from the hypotenuse squared

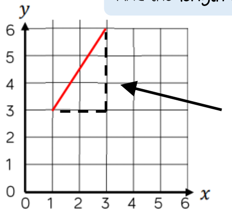
Square root to find the length of the side

$b^2 = 111$

$b = \sqrt{111} = 10.54\ cm$

Pythagoras' theorem on a coordinate axis

Find the **length** of the line segment



The segment can be made into a right-angled triangle by adding the sides on the diagram.

The line segment is the **hypotenuse**

$a^2 + b^2 = \text{hypotenuse}^2$

The lengths of a and b are the sides of the triangle.

Be careful to check the scale on the axes