

YEAR 8

KNOWLEDGE ORGANISERS



BLOCK: PROPORTIONAL REASONING

Ratio and Scale

Multiplicative Change

Multiplying and Dividing Fractions

YEAR 8 - PROPORTIONAL REASONING...

Ratio and Scale

@whisto_maths

What do I need to be able to do?

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

- Simplify any given ratio
- Share an amount in a given ratio
- Solve ratio problems given a part

Solutions should be modelled, explained and solved

Keywords

Ratio: a statement of how two numbers compare

Equal Parts: all parts in the same proportion, or a whole shared equally

Proportion: a statement that links two ratios

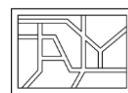
Order: to place a number in a determined sequence

Part: a section of a whole

Equivalent: of equal value

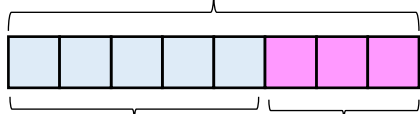
Factors: integers that multiply together to get the original value

Scale: the comparison of something drawn to its actual size.



Representing a ratio

This is the "whole" — boys and girls together



This represents the 5 boys

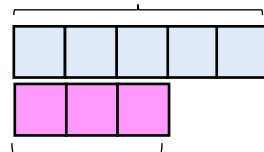
This represents the 3 girls

"For every 5 boys there are 3 girls"

5:3

This represents the 5 boys

Double Number Line



This is the "whole" — boys and girls together

This represents the 3 girls

Order is Important

"For every dog there are 2 cats"



Dogs: Cats



1:2

The ratio has to be written in the same order as the information is given

e.g. 2:1 would represent 2 dogs for every 1 cat ✗

Simplifying a ratio

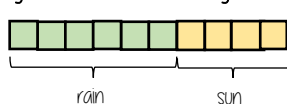
Cancel down the ratio to its lowest form

"For every 6 days of rain there are 4 days of sun"

6:4

+ by 2 ↓

3:2



rain

sun



Find the biggest common factor that goes into all parts of the ratio

For 6 and 4 the biggest factor (number that multiplies into them is 2)

"For every 3 days of rain there are 2 days of sun" — when this happens twice the ratio becomes 6:4.

Ratio In (or n:1)

This is asking you to cancel down until the part indicated represents 1

Show the ratio 4:20 in the ratio of 1:n

The question states that this part has to be 1 unit.

Therefore Divide by 4

4 : 20
1 : 5

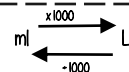
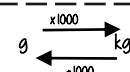
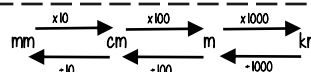
This side has to be divided by 4 too — to keep in proportion

*The n part does not have to be an integer for this type of question

Units are important:

When using a ratio — all parts should be in the same units

Useful Conversions



Sharing a whole into a given ratio

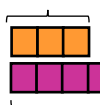
James and Lucy share £350 in the ratio 3:4.
Work out how much each person earns

Model the Question

James: Lucy

3:4

James



£350

Lucy

£350 ÷ 7 = £50

□ = one part = £50

Find the value of one part

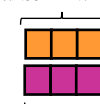
Whole: £350
7 parts to share between
(3 James, 4 Lucy)

Put back into the question

James: Lucy

(x 50) 3:4 (x 50)
£150:£200

James = 3 x £50 = £150



£350

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 part = 10 pens

Blue pens



Red pens

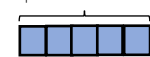
One unit = 10 pens

Put back into the question

Blue: Red

(x 10) 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

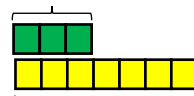


Ratio as a fraction

Trees: Flowers

3:7

Trees



Ratio

Flowers

Fraction of trees

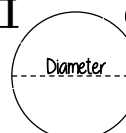
There are 3 parts for trees
Number of parts of in group
Total number of parts

3
10

Fraction

Tree parts 3 + Flower parts 7 = 10

π



Circumference

Diameter

The ratio of a circles circumference to its diameter

YEAR 8 - PROPORTIONAL REASONING...

Multiplicative Change

@whisto_maths

What do I need to be able to do?

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

- Solve problems and explain direct proportion
- Use conversion graphs to make statements, comparisons and form conclusions
- Understand and use scale factors for length

Keywords

Proportion: a statement that links two ratios

Variable: a part that the value can be changed

Axes: horizontal and vertical lines that a graph is plotted around

Approximation: an estimate for a value

Scale Factor: the multiple that increases/ decreases a shape in size

Currency: the system of money used in a particular country

Conversion: the process of changing one variable to another

Scale: the comparison of something drawn to its actual size.

Direct Proportion

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



4 cans of pop = £2.40

$\times 0.5$
4 cans of pop = £2.40
 $\rightarrow$ 2 cans of pop = £1.20

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

This is a multiplicative change

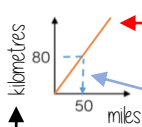
4 cans of pop = £2.40

$\times 3$
12 cans of pop = £7.20

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

Conversion Graphs

Compare two variables



Labelling of both axes is vital

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

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

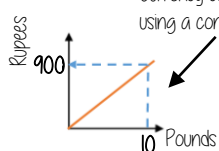
Conversion between currencies



£1 = 90 Rupees

Currency is directly proportional

For every £1 I have 90 Rupees



Currency can be converted using a conversion graph

Convert 630 Rupees into Pounds

$\times 10$
£1 = 90 Rupees
 $\rightarrow$ £10 = 900 Rupees
 $\times 7$
£7 = 630 Rupees
 $\leftarrow 630 \div 90 = 7$

Ratio between similar shapes



Angles in similar shapes do not change
e.g. if a triangle gets bigger the angles can not go above 180°

The two rectangles are similar.

3m 8m

4.5m ?m

Corresponding sides

$\times 5$
3m : 4.5m
 $\rightarrow$ 8m : 12m
 $\times 1.5$
1m : 1.5m

$\times 8$
8m : 12m
 $\rightarrow$ 1m : 1.5m
 $\times 1.5$

Note
Simplify to the same ratio

Understand Scale Factor

The two rectangles are similar.

3m 8m

4.5m ?m

$$3 \times 1.5 = 4.5$$

This is a multiplicative change.

Use corresponding sides to calculate a scale factor

Scale factor can also be calculated by:

Bigger corresponding side
Smaller corresponding side

Small corresponding side $\times$ SF Big corresponding side
Big corresponding side $\div$ SF Small corresponding side

Draw and interpret scale diagrams

A picture of a car is drawn with a scale of 1:30

For every 1cm on my image is 30cm in real life

The car image is 10cm

Image : Real life
1cm : 30cm
 $\times 10$
 $\rightarrow$ 10cm : 300cm

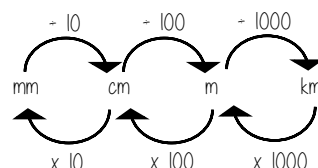


The car in real life is 210cm

Image : Real life
1cm : 30cm
 $\times 7$
 $\rightarrow$ 7cm : 210cm



Interpret maps with scale factors



1 cm : 250 m

Ratios need to be in the same units

1 cm : 250m

1 cm : 25000cm

$$250 \times 100 = 25000$$

For every 1cm on my map is 25000cm in real life



YEAR 8 - PROPORTIONAL REASONING...

Multiplying and Dividing Fractions

@whisto_maths

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.

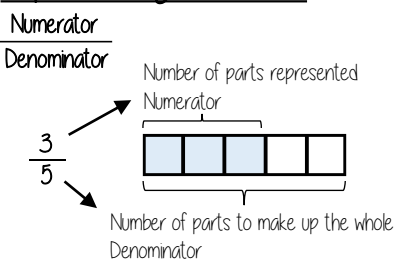
Divisor: the number that divides another number.

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

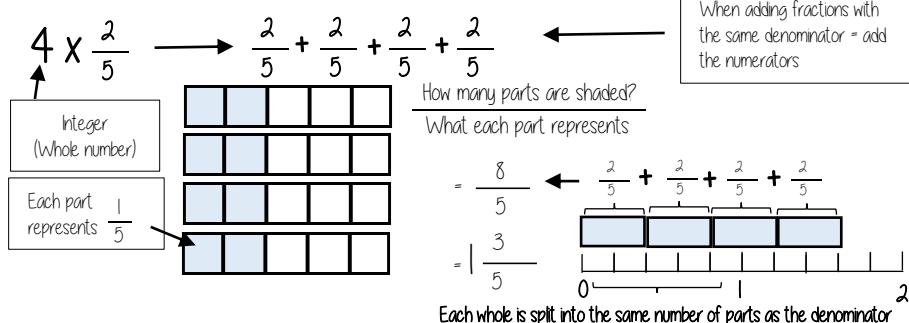
Reciprocal: a pair of numbers that multiply together to give 1.



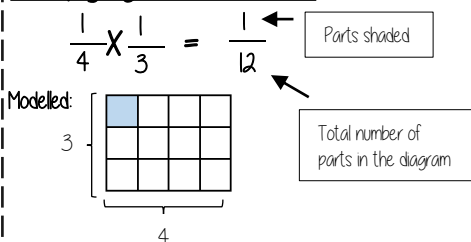
Representing a fraction



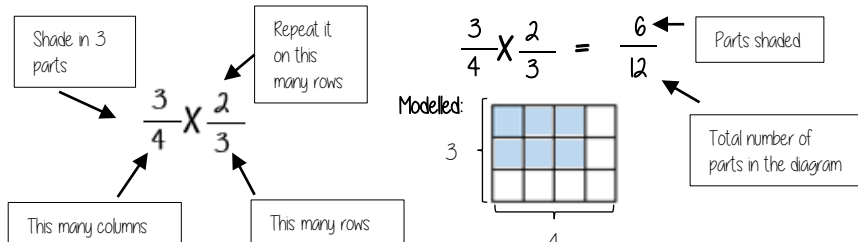
Repeated addition = multiplication by an integer



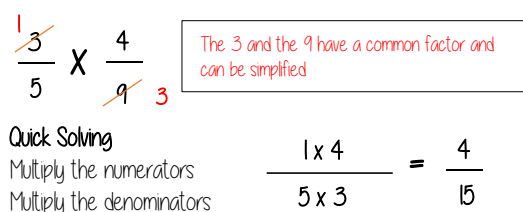
Multiplying unit fractions



Multiplying non-unit fractions

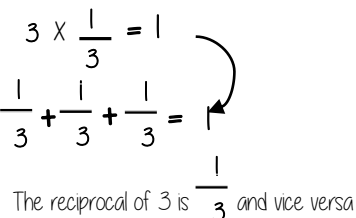


Quick Multiplying and Cancelling down

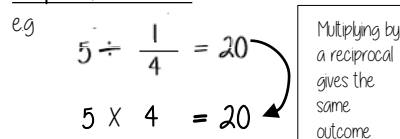


The reciprocal

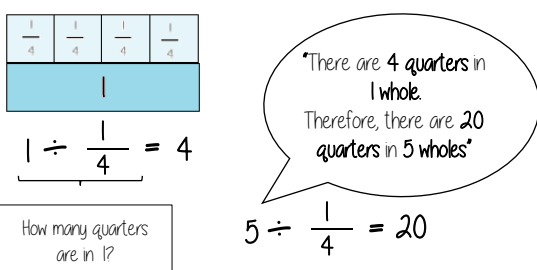
When you multiply a number by its reciprocal the answer is always 1



Reciprocals for division

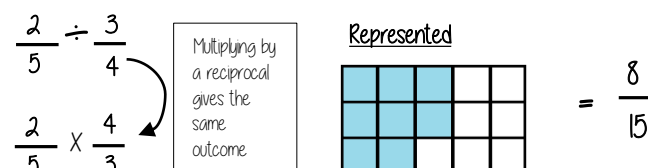


Dividing an integer by an unit fraction



Dividing any fractions

Remember to use reciprocals



YEAR 8
KNOWLEDGE ORGANISERS



BLOCK: REPRESENTATIONS

Working in the Cartesian plane

Representing data

Tables

YEAR 8 - REPRESENTATIONS...

Working in the Cartesian plane

@whisto_maths

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)

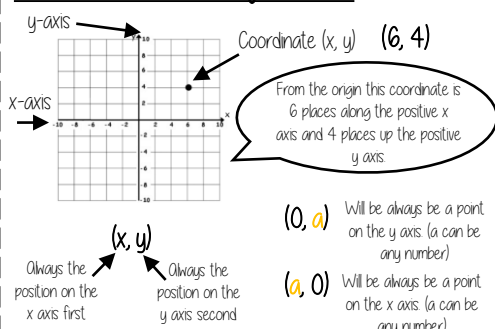
Origin: (0,0) on a graph. The point the two axes cross

Parallel: Lines that never meet

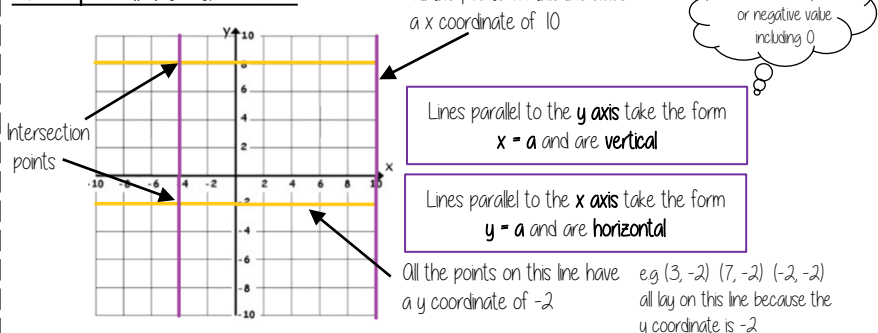
Gradient: The steepness of a line

Intercept: Where lines cross

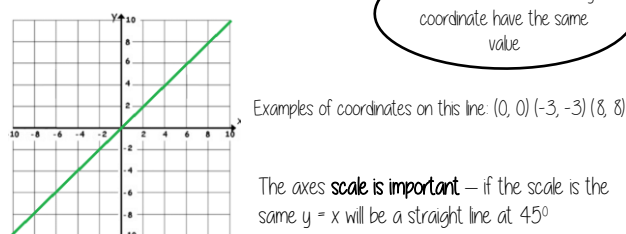
Coordinates in four quadrants



Lines parallel to the axes

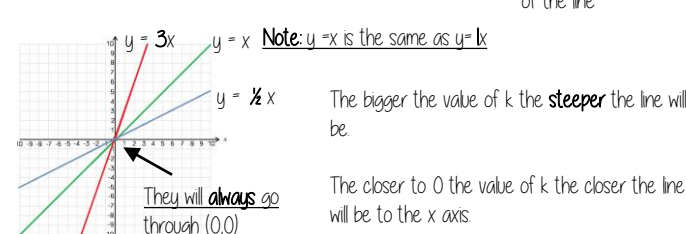


Recognise and use the line $y = x$

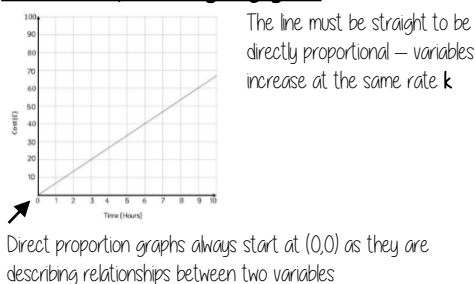


Recognise and use the lines $y = kx$

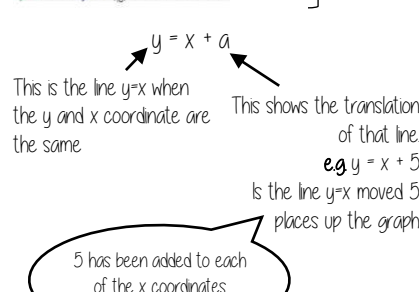
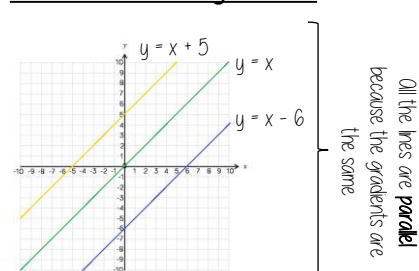
The value of k changes the steepness of the line



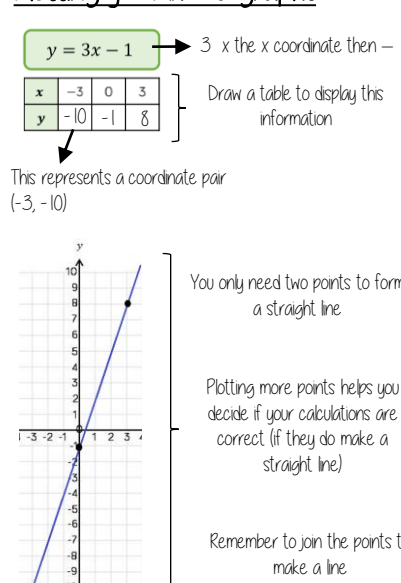
Direct Proportion using $y = kx$



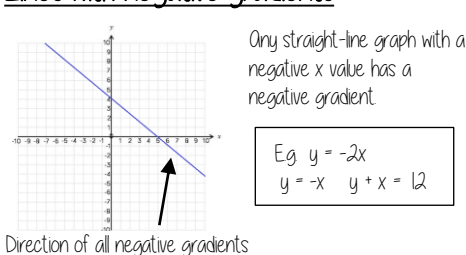
Lines in the form $y = x + a$



Plotting $y = mx + c$ graphs



Lines with negative gradients



Representing Data

What do I need to be able to do?

- Draw and interpret scatter graphs
- Describe correlation and relationships
- Identify different types of non-linear relationships
- Design and complete an ungrouped frequency table
- Read and interpret grouped tables (discrete and continuous data)
- Represent data in two way tables

Frequency: the number of times a particular data value occurs.

The axis should fit all the values
on and be equally spread out

There is no relationship between the two variables

Interleaving: Use your fraction, decimal percentage equivalence knowledge

YEAR 8 - REPRESENTATIONS...

Tables and Probability

@whisto_maths

What do I need to be able to do?

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

- Construct a sample space diagram
- Systematically list outcomes
- Find the probability from two-way tables
- Find the probability from Venn diagrams

Keywords

Outcomes: the result of an event that depends on probability

Probability: the chance that something will happen

Set: a collection of objects

Chance: the likelihood of a particular outcome

Event: the outcome of a probability — a set of possible outcomes

Biased: a built in error that makes all values wrong by a certain amount

Union: Notation 'U' meaning the set made by comparing the elements of two sets

Construct sample space diagrams



Sample space diagrams provide a systematic way to display outcomes from events

The possible outcomes from tossing a coin

The possible outcomes from rolling a dice

	1	2	3	4	5	6
H	1H	2H	3H	4H	5H	6H
T	1T	2T	3T	4T	5T	6T

This is the set notation to list the outcomes $S =$

$$S = \{1H, 2H, 3H, 4H, 5H, 6H, 1T, 2T, 3T, 4T, 5T, 6T\}$$

In between the $\{ \}$ are a_i the possible outcomes

Probability from sample space

The possible outcomes from rolling a dice

The possible outcomes from tossing a coin

	1	2	3	4	5	6
H	1H	2H	3H	4H	5H	6H
T	1T	2T	3T	4T	5T	6T

This is the set notation that represents the question P

What is the probability that an outcome has an even number and a tails?

$$P(\text{Even number and Tails}) = \frac{3}{12}$$

In between the $()$ is the event asked for

There are three even numbers with tails

Numerator: the event

Denominator: the total number of outcomes

There are twelve possible outcomes

Probability from two-way tables

	Car	Bus	Walk	Total
Boys	15	24	14	53
Girls	6	20	21	47
Total	21	44	35	100

$$P(\text{Girl walk to school}) = \frac{21}{100}$$

The total number of items

The event

The total in the set

Product Rule

The number of items in event a

x

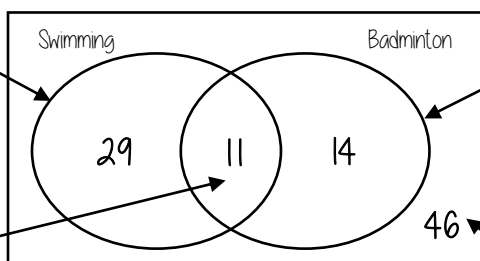
The number of items in event b

Probability from Venn diagrams

This whole curve includes everyone that went swimming

Because 11 did both we calculate just swimming by $40 - 11$

The intersection represents both Swimming AND badminton



100 students were questioned if they played badminton or went to swimming club
40 went swimming, 25 went to badminton and 11 went to both

This whole curve includes everyone that went to badminton

Because 11 did both we calculate just badminton by $25 - 11$

The number outside represents those that did neither badminton or swimming

$$P(\text{Just swimming}) = \frac{29}{100}$$

$$100 - 29 - 11 = 14$$

YEAR 8
KNOWLEDGE ORGANISERS



BLOCK: ALGEBRAIC TECHNIQUES

Brackets, Equations & Inequalities

Sequences

Indices

YEAR 8 - ALGEBRAIC TECHNIQUES...

Brackets, Equations & Inequalities

@whisto_maths

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 two 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

e.g. 4 more than $t \longrightarrow t + 4$

8 less than $k \longrightarrow k - 8$

Only similar terms can be grouped together

e.g. Find the perimeter of this shape

(Perimeter = length around outside of shape)

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

Directed numbers

$++ \longrightarrow +$

$-- \longrightarrow +$

$+ - \longrightarrow -$

$- + \longrightarrow -$

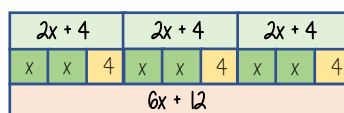
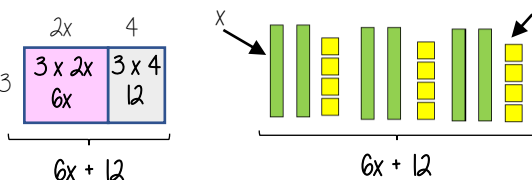
e.g. $a = -5$ and $b = 2$

$a^2 = a \times a = -5 \times -5 = 25$

$b + a = 2 + -5 = -3$

Multiply single brackets

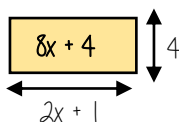
$3(2x + 4)$



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

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

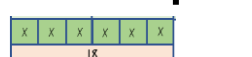
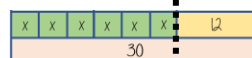
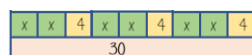
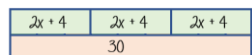
Note:

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

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

-12

$$6x = 18$$

-6

-6

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



$$x = 3$$

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"

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

$$10 > x$$

Say this out loud "10 is more than the value"

Form and solve inequalities



Two more than treble my number is greater than 11

Find the possible range of values

Form

$$x \longrightarrow x3 \longrightarrow +2 \longrightarrow 11$$

$$3x + 2 > 11$$

Solve

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

$$x > 3$$

Check

This would suggest any value bigger than 3 satisfies the statement

$$3 \times 3 + 2 = 11 \checkmark$$

$$10 \times 3 + 2 = 32 \checkmark$$

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 $\equiv$

Formula

A rule written with all mathematical symbols e.g. area of a rectangle $A = b \times h$

YEAR 8 - ALGEBRAIC TECHNIQUES...

Sequences

@whisto_maths

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 n th 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 $\times$ or $\div$

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

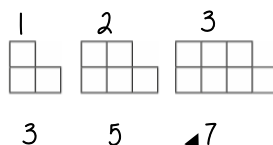
0 1 1 2 3 5 8 ...

Each term is the sum of the previous two terms



Sequence in a table and graphically

Position: the place in the sequence



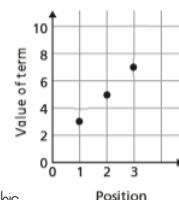
Term: the number or variable (the number of squares in each image)

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!

$$3n + 7$$

$$3n^2 + 7$$

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

$$2n - 5 \longrightarrow$$

Substitute the number of the term you are looking for in place of 'n'

eg

$$1^{\text{st}} \text{ term} = 2(1) - 5 = -3$$

$$2^{\text{nd}} \text{ term} = 2(2) - 5 = -1$$

$$100^{\text{th}} \text{ term} = 2(100) - 5 = 195$$

This is not linear as there is a power for n

Checking for a term in a sequence

Form an equation

Is 201 in the sequence $3n - 4$?

Algebraic rule

$$3n - 4 = 201$$

Term to check

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

Complex algebraic rules

Misconceptions and comparisons

$$2n^2$$

2 times whatever n squared is

eg

$$1^{\text{st}} \text{ term} = 2 \times 1^2 = 2$$

$$2^{\text{st}} \text{ term} = 2 \times 2^2 = 8$$

$$100^{\text{th}} \text{ term} = 2 \times 100^2 = 20000$$

$$(2n)^2$$

2 times n then square the answer

eg

$$1^{\text{st}} \text{ term} = (2 \times 1)^2 = 4$$

$$2^{\text{st}} \text{ term} = (2 \times 2)^2 = 16$$

$$100^{\text{th}} \text{ term} = (2 \times 100)^2 = 40000$$

$$n(n + 5)$$

eg

$$1^{\text{st}} \text{ term} = 1(1 + 5) = 6$$

$$2^{\text{st}} \text{ term} = 2(2 + 5) = 14$$

$$100^{\text{th}} \text{ term} = 100(100 + 5) = 10500$$

You don't need to expand the expression

H Finding the algebraic rule

This is the 4 times table

→ 4, 8, 12, 16, 20....

$$4n$$

$$\downarrow \downarrow \downarrow$$

7, 11, 15, 19, 22

This has the same constant difference – but is 3 more than the original sequence

$$4n + 3$$

This is the constant difference between the terms in the sequence

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

YEAR 8 - ALGEBRAIC TECHNIQUES...

@whisto_maths

Indices

What do I need to be able to do?

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

- Add/ Subtract expressions with indices
- Multiply expressions with indices
- Divide expressions with indices
- Know the addition law for indices
- Know the subtraction law for indices

Keywords

Base: The number that gets multiplied by a power

Power: The exponent — or the number that tells you how many times to use the number in multiplication

Exponent: The power — or the number that tells you how many times to use the number in multiplication

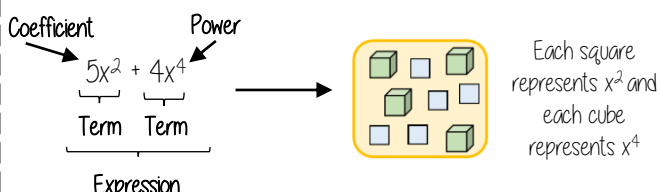
Indices: The power or the exponent

Coefficient: The number used to multiply a variable

Simplify: To reduce a power to its lowest term

Product: Multiply

Addition/ Subtraction with indices



Only similar terms can be simplified
If they have different powers, they are unlike terms

$5x^2 + 2x^2 \rightarrow$ [Visual representation of 7 squares] $\rightarrow 7x^2$

$5x^2 + 6x^4 - 3x^2 + x^4 \rightarrow$ [Visual representation of 2 squares and 7 cubes] $\rightarrow 2x^2 + 7x^4$

Multiply expressions with indices

$4b \times 3a$
 $\equiv 4 \times b \times 3 \times a$
 $\equiv 4 \times 3 \times b \times a$
 $\equiv 12ab$

$5t \times 9t$
 $\equiv 5 \times t \times 9 \times t$
 $\equiv 5 \times 9 \times t \times t$
 $\equiv 45t^2$

$2b^4 \times 3b^2$
 $\equiv 2 \times b \times b \times b \times b \times 3 \times b \times b$
 $\equiv 2 \times 3 \times b \times b \times b \times b \times b \times b$
 $\equiv 6b^6$

There are often misconceptions with this calculation but break down the powers

Addition/ Subtraction laws for indices

$3^5 \times 3^2 \rightarrow 3^7$
 $= (3 \times 3 \times 3 \times 3 \times 3) \times (3 \times 3)$

The base number is all the same so the terms can be simplified

Addition law for indices

$a^m \times a^n = a^{m+n}$

$3^5 \div 3^2 \rightarrow 3^3$

$\frac{3 \times 3 \times 3 \times \cancel{3} \times \cancel{3}}{\cancel{3} \times \cancel{3}} \rightarrow \frac{3^3}{3^0} \rightarrow \frac{3^3}{1}$

Subtraction law for indices

$a^m \div a^n = a^{m-n}$

Divide expressions with indices

$\frac{24}{36} \rightarrow \frac{\cancel{2} \times \cancel{2} \times 2 \times \cancel{3}}{\cancel{2} \times \cancel{3} \times 2 \times \cancel{3}} \rightarrow \frac{2}{3}$

$\frac{5a^3b^2}{15ab^6} \rightarrow \frac{\cancel{5} \times \cancel{a} \times a \times a \times \cancel{b} \times \cancel{b}}{3 \times \cancel{5} \times \cancel{a} \times \cancel{b} \times \cancel{b} \times b \times b \times b \times b} \rightarrow \frac{a^2}{3b^4}$

Cross cancelling factors shows cancels the expression

$\frac{23a^7y^2}{5db^6}$ } This expression cannot be divided (cancelled down) because there are no common factors or similar terms

YEAR 8
KNOWLEDGE ORGANISERS



BLOCK: DEVELOPING NUMBER

Fractions and Percentages

Standard Index Form

Number Sense

YEAR 8 - DEVELOPING NUMBER...

Fractions & Percentages

@whisto_maths

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.

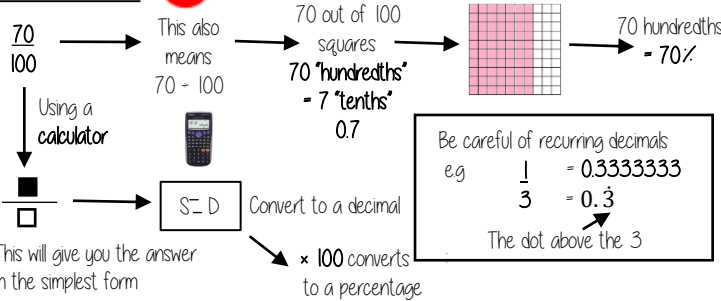
Growth: to increase/ to grow.

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).

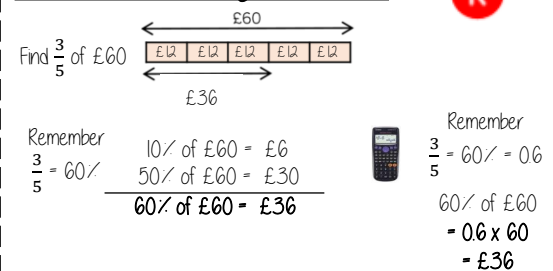
Convert FDP

R

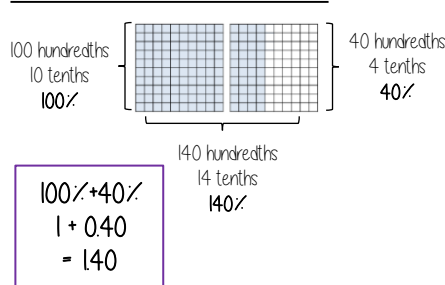


Fraction/ Percentage of amount

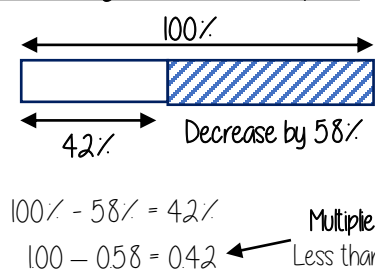
R



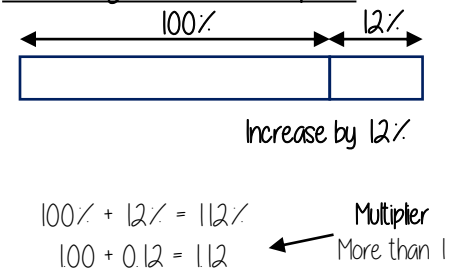
Convert FDP < and > 100%



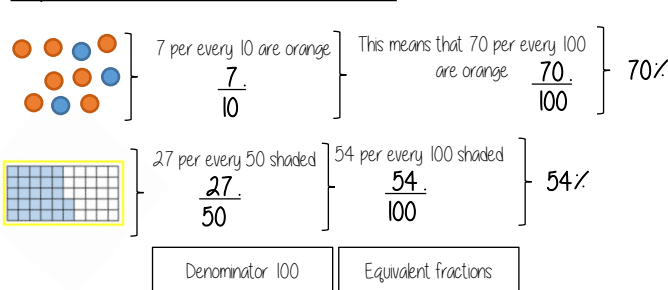
Percentage decrease: Multipliers



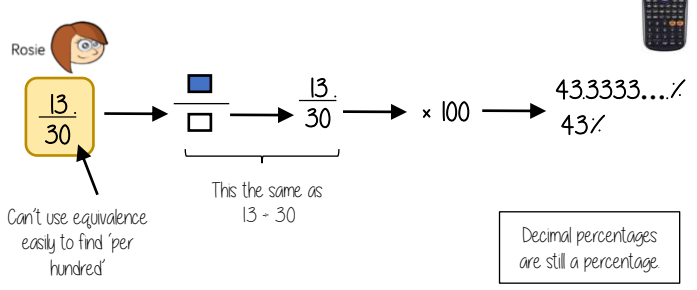
Percentage increase: Multipliers



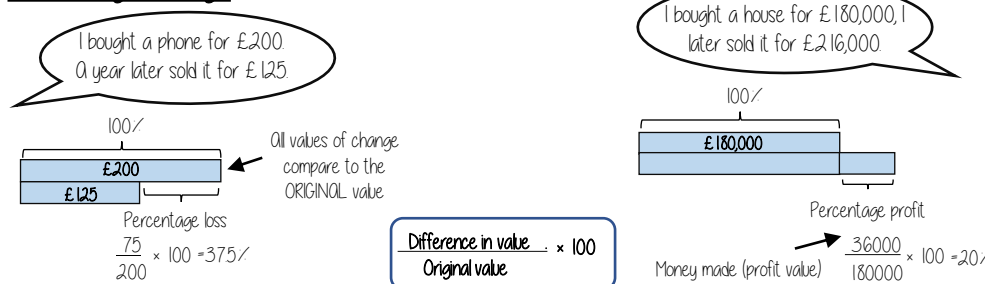
Express as a % - Non-calculator



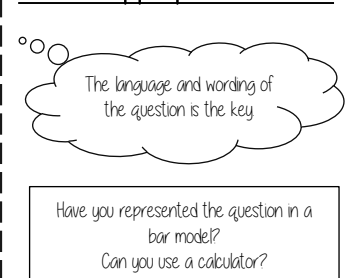
Express as a % - Calculator



Percentage change



Choose appropriate method



YEAR 8 - DEVELOPING NUMBER...

Standard Form

@whisto_maths

What do I need to be able to do?

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

- Write numbers in standard form and as ordinary numbers
- Order numbers in standard form
- Add/ Subtract with standard form
- Multiply/ Divide with standard form
- Use a calculator with standard form

Keywords

Standard (index) Form: A system of writing very big or very small numbers

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

Base: The number that gets multiplied by a power

Power: The exponent — or the number that tells you how many times to use the number in multiplication

Exponent: The power — or the number that tells you how many times to use the number in multiplication

Indices: The power or the exponent

Negative: A value below zero.

Positive powers of 10

1 billion = 1 000 000 000

$$10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^9$$

Addition rule for indices $10^a \times 10^b = 10^{a+b}$

Subtraction rule for indices $10^a \div 10^b = 10^{a-b}$

Standard form with numbers > 1

Any number between 1 and less than 10 $\rightarrow A \times 10^n$ $\leftarrow$ Any integer

Example

$$\begin{aligned} 3.2 \times 10^4 \\ = 3.2 \times 10 \times 10 \times 10 \times 10 \\ = 32000 \end{aligned}$$

Non-example

$$\begin{aligned} (0.8) \times 10^4 \\ 5.3 \times 10^{07} \end{aligned}$$

Negative powers of 10

0.001	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
$1 \times \frac{1}{1000}$	10^1	10^0	10^{-1}	10^{-2}	10^{-3}
1×10^{-3}	0	0	0	0	1

Any value to the power 0 always = 1

Negative powers do not indicate negative solutions

Numbers between 0 and 1

0.054	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
$= 5.4 \times 10^{-2}$	10^0	10^{-1}	10^{-2}	10^{-3}
	0	0	5	4

A negative power does not mean a negative answer — it means a number closer to 0

Order numbers in standard form

6.4×10^{-2}	2.4×10^2	3.3×10^0	1.3×10^{-1}
0.064	240	1	0.13

Look at the power first will the number be = > or < than 1

Use a place value grid to compare the numbers for ordering

Mental calculations

$$6.4 \times 10^2 \times 1000 \text{ Not in Standard Form}$$

$$= 6.4 \times 10^2 \times 10^3$$

$$= 6.4 \times 10^5 \text{ Use addition for indices rule}$$

$$(2 \times 10^3) \div 4$$

$$= (2 \div 4) \times 10^3$$

$$= 0.5 \times 10^3$$

Divide the values

$$(8) \times 10^5 \times (3)$$

$$= 24 \times 10^5 \text{ Not in Standard Form}$$

$$\begin{aligned} &= 2.4 \times 10^1 \times 10^5 \text{ Use addition for indices rule} \\ &= 2.4 \times 10^6 \end{aligned}$$

Remember the layout for standard form

Any number between 1 and less than 10 $\rightarrow A \times 10^n$ $\leftarrow$ Any integer

Addition and Subtraction

Tip: Convert into ordinary numbers first and back to standard form at the end

$$6 \times 10^5 + 8 \times 10^5$$

Method 1

$$= 600000 + 800000$$

$$= 1400000$$

$$= 1.4 \times 10^6$$

Method 2

$$= (6 + 8) \times 10^5$$

$$= 14 \times 10^5$$

$$= 1.4 \times 10^1 \times 10^5$$

$$= 1.4 \times 10^6$$

This is not the final answer

Only works if the powers are the same

More robust method
Less room for misconceptions
Easier to do calculations with negative indices
Can use for different powers

Multiplication and division

For multiplication and division you can look at the values for A and the powers of 10 as two separate calculations

$$\frac{1.5 \times 10^5}{0.3 \times 10^3} \leftarrow \text{Division questions can look like this}$$

$$(1.5 \times 10^5) \div (0.3 \times 10^3)$$

$$15 \div 0.3 \times 10^5 \div 10^3$$

$$= 5 \times 10^2$$

Addition law for indices

$$a^m \times a^n = a^{m+n}$$

Subtraction law for indices

$$a^m \div a^n = a^{m-n}$$

Revisit addition and subtraction laws for indices — they are needed for the calculations

Using a calculator

$$14 \times 10^5 \times 3.9 \times 10^3$$

Use a calculator to work out this question to a suitable degree of accuracy

Input 14 and press $\times 10^1$ Then press 5 (for the power)

Press $\times$

Input 3.9 and press $\times 10^3$ Then press 3 (for the power)

Press $=$

This gives you the solution



Click calculator for video tutorial

To put into standard form and a suitable degree of accuracy

Press **SHIFT** **SETUP** and then press 7 for sci mode

Choose a degree of accuracy so in most cases press 2

$$\text{Answer: } 5.5 \times 10^6$$

YEAR 8 - DEVELOPING NUMBER...

Number Sense

@whisto_maths

What do I need to be able to do?

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

- Round numbers to powers of 10 and 1 sf
- Round numbers to any dp
- Estimate solutions
- Calculate using order of operations
- Calculate with money, units of measurement and time

Keywords

Significant: Place value of importance

Round: Making a number simpler but keeping its value close to what it was

Decimal: Place holders after the decimal point

Overestimate: Rounding up — gives a solution higher than the actual value

Underestimate: Rounding down — gives a solution lower than the actual value

Metric: A system of measurement

Balance: The amount of money in a bank account

Deposit: Putting money into a bank account

Round to powers of 10 and 1 sig figure



If the number is halfway between we "round up"

5495 to the nearest 1000



5475 to the nearest 100



5475 to the nearest 10



370 to 1 significant figure is 400

37 to 1 significant figure is 40

3.7 to 1 significant figure is 4

0.37 to 1 significant figure is 0.4

0.00037 to 1 significant figure is 0.0004

Round to the first non-zero number

Round to decimal places

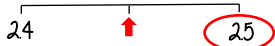
2.46192

Focus on the numbers after the decimal point

"To 1dp" — to one number after the decimal

"To 2dp" — to two numbers after the decimal

2.46192 (to 1dp) — Is this closer to 2.4 or 2.5



2.46192 This shows the number is closer to 2.5

2.46192 (to 2dp) — Is this closer to 2.46 or 2.47

2.46192 This shows the number is closer to 2.46



Estimate the calculation

Round to 1 significant figure to estimate

$$4.2 + 6.7 \approx 4 + 7 \approx 11$$

This is an **overestimate** because the 6.7 was rounded up more

The equal sign changes to show it is an estimation

$$214 \times 3.1 \approx 20 \times 3 \approx 60$$

This is an **underestimate** because both values were rounded down

It is good to check all calculations with an estimate in all aspects of maths — it helps you identify calculation errors

Order of operations



Brackets Operations in brackets are calculated first

Other operations e.g powers, roots,

Multiplication/ Division

They are carried out in the order from left to right in the question

Addition/ Subtraction

They are carried out in the order from left to right in the question

Calculations with money

Debit — You have £0 or more in an account

Credit — You have less than £0 in an account

Money calculations are to 2dp



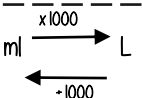
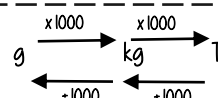
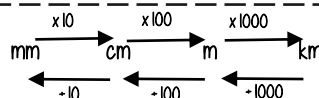
Using a calculator — ensure you are working in the correct units

$$\begin{aligned} \text{£ } 1.30 + 50\text{p} &= 1.30 + 0.50 \quad (\text{in pence}) \\ &= 1.30 + 0.50 \quad (\text{in pounds}) \end{aligned}$$

$$\text{£ } 1 = 100\text{p}$$



Units are important: Useful Conversions



Metric measures of length

$$\text{Kilo} = 1000 \times \text{meter}$$

$$\text{Centi} = \frac{1}{100} \times \text{meter}$$

$$\text{Milli} = \frac{1}{1000} \times \text{meter}$$

Units of weight/ capacity

$$\text{Weight} = \text{g, kg, t}$$

$$\text{Capacity (volume of liquid)} = \text{ml, L}$$

Time and the calendar



1 Year — the amount of time it takes Earth to go around the sun **365** (and a quarter) days

Leap Year — 366 days (every 4 years)



12 Months — one year = 52 weeks

31 days — Jan, March, May, July

Aug, Oct, Dec

30 days — April, June, Sept, Nov

28 days — Feb (29 leap year)

1 week — 7 days

Monday, Tuesday, Wednesday,

Thursday, Friday, Saturday, Sunday

1 day — 24 hours

1 hour — 60 minutes

1 minute — 60 seconds

Use a number line for time calculations!

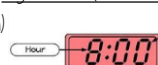
Analogue Clock



12-hour clock

- Use am (morning) and pm (afternoon)
- Only use hour times up to 12

Digital Clock (24-hour times)



24-hour clock

- 0-11 (morning hours)
- 12-23 (afternoon hours)

YEAR 8
KNOWLEDGE ORGANISERS



BLOCK: DEVELOPING GEOMETRY

Angles in parallel lines and polygons

Area of trapezia and circles

Line symmetry and reflection

YEAR 8 - DEVELOPING GEOMETRY...

Angles in parallel lines and polygons

@whisto_maths

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

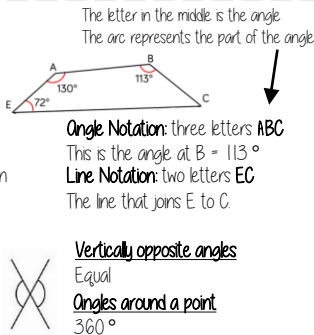
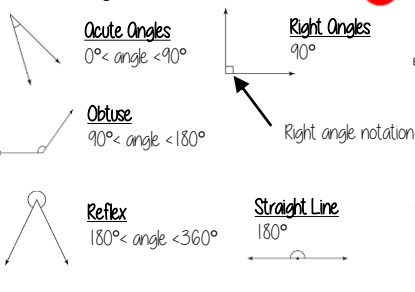
Isosceles: Two equal size lines and equal size angles (in a triangle or trapezium)

Polygon: A 2D shape made with straight lines

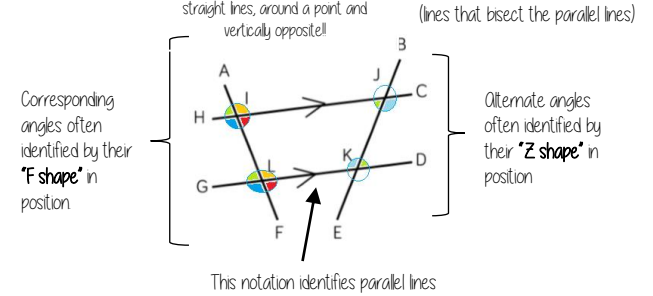
Sum: Addition (total of all the interior angles added together)

Regular polygon: All the sides have equal length; all the interior angles have equal size

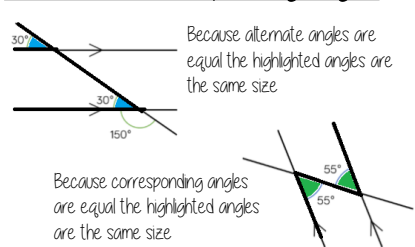
Basic angle rules and notation



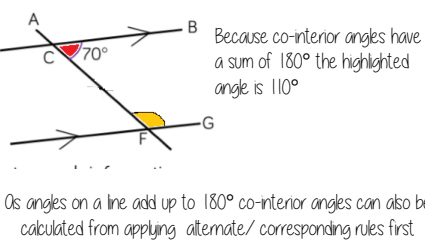
Parallel lines



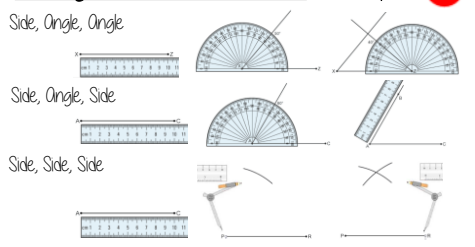
Alternate/Corresponding angles



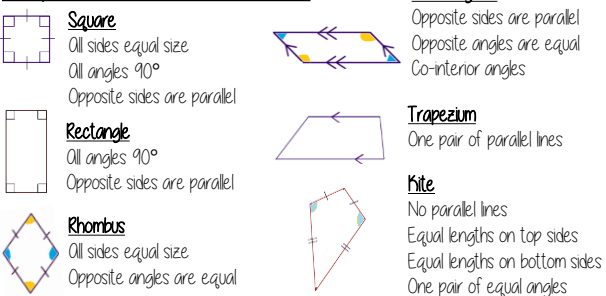
Co-interior angles



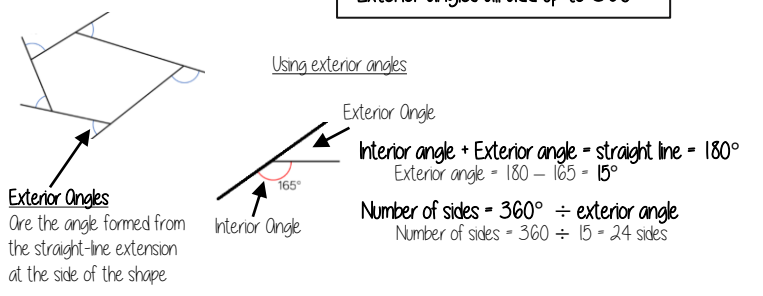
Triangles & Quadrilaterals



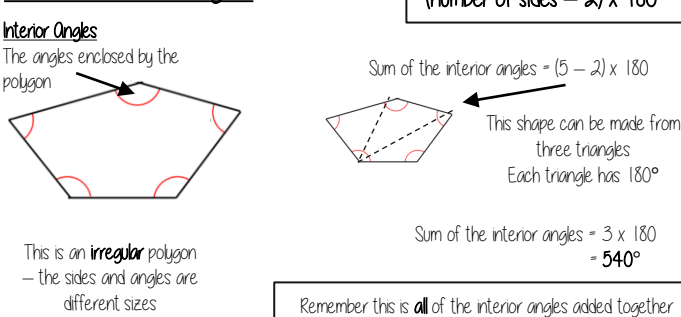
Properties of Quadrilaterals



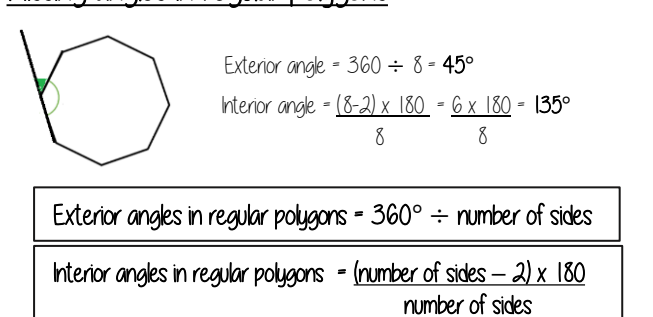
Sum of exterior angles



Sum of interior angles



Missing angles in regular polygons



YEAR 8 - DEVELOPING GEOMETRY...

Area of trapezia and Circles

@whisto_maths

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

π (π): The ratio of a circle's circumference to its diameter.

Perpendicular: At an angle of 90° to a given surface

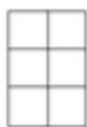
Formula: A mathematical relationship/ rule given in symbols. Eg $b \times h$ = area of rectangle/ square

Infinity (∞): A number without a given ending (too great to count to the end of the number) – never ends

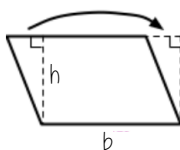
Sector: A part of the circle enclosed by two radii and an arc.

Area – rectangles, triangles, parallelograms

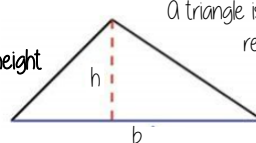
Rectangle
Base x Height



Parallelogram/ Rhombus
Base x Perpendicular height



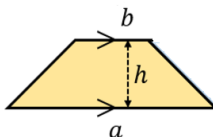
Triangle
 $\frac{1}{2} \times \text{Base} \times \text{Perpendicular height}$



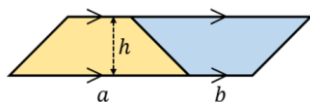
A triangle is half the size of the rectangle it would fit in

Area of a trapezium

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



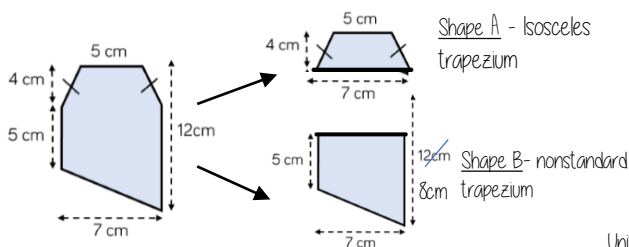
Why?



- Two congruent trapeziums make a parallelogram
- New length $(a+b) \times \text{height}$
- 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.



Shape A + Shape B = total area

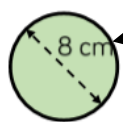
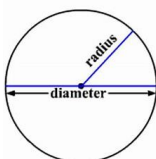
$$\frac{(5+7) \times 4}{2} + \frac{(5+8) \times 7}{2} = 24 + 45.5 = 69.5 \text{ cm}^2$$

Units

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
 $\pi \times \text{radius}^2$



Diameter = 8cm
 $\therefore$ Radius = 4cm

$$\begin{aligned} \pi \times \text{radius}^2 \\ &= \pi \times 4^2 \\ &= \pi \times 16 \\ &= 16\pi \text{ cm}^2 \end{aligned}$$

Find the area of one quarter of the circle



Circle Area = $16\pi \text{ cm}^2$
Quarter = $4\pi \text{ cm}^2$

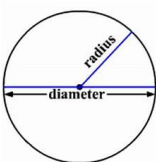
Area of a circle (Calculator)



SHIFT $\times 10^x$

How to get π symbol on the calculator

Area of a circle
 $\pi \times \text{radius}^2$



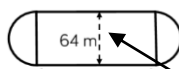
It is important to round your answer suitably – to significant figures or decimal places. This will give you a decimal solution that will go on forever!

Compound shapes including circles

Circumference
 $\pi \times \text{diameter}$

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

$$\begin{aligned} \text{Arc lengths} &= \pi \times 64 \\ &= 64\pi \end{aligned}$$

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

Arc lengths + Straight lengths = total perimeter

$$\begin{aligned} &= 64\pi + 150 + 150 \\ &= (300 + 64\pi) \text{ m} \\ \text{OR } &= 501.1 \text{ m} \end{aligned}$$

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

YEAR 8 - DEVELOPING GEOMETRY...

Line symmetry and reflection

@whisto_maths

What do I need to be able to do?

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

- Recognise line symmetry
- Reflect in a horizontal line
- Reflect in a vertical line
- Reflect in a diagonal line

Keywords

Mirror line: a line that passes through the center of a shape with a mirror image on either side of the line

Line of symmetry: same definition as the mirror line

Reflect: mapping of one object from one position to another of equal distance from a given line.

Vertex: a point where two or more line segments meet

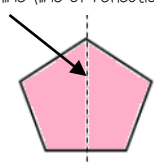
Perpendicular: lines that cross at 90°

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)

Lines of symmetry

Mirror line (line of reflection)



Shapes can have more than one line of symmetry...

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



Rhombus

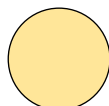
two lines of symmetry

Parallelogram

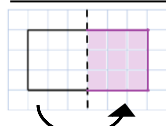
No lines of symmetry



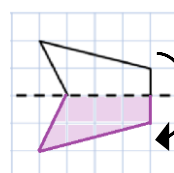
A circle has an infinite amount of lines of symmetry



Reflect horizontally/ vertically (1)



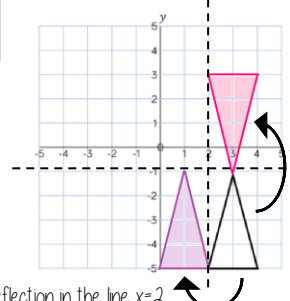
Reflection in a vertical line



Reflection in a horizontal line

Note: a reflection doubles the area of the original shape

Reflection on an axis grid

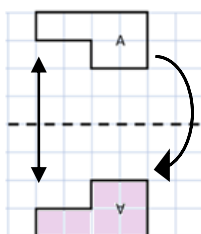


Reflection in the line $y=2$

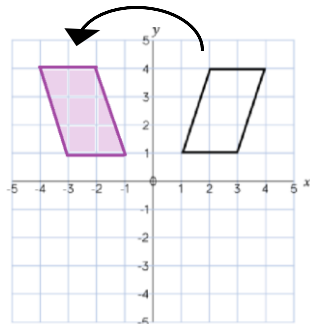
Reflection in the line $x=2$

Reflect horizontally/ vertically (2)

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 $x=0$

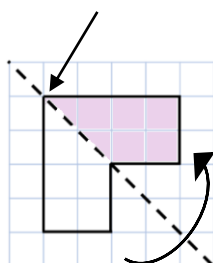


Lines parallel to the x and y axis
REMEMBER

Lines parallel to the x-axis are $y = \text{---}$
Lines parallel to the y-axis are $x = \text{---}$

Reflect Diagonally (1)

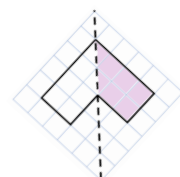
Points on the mirror line don't change position



Fold along the line of symmetry to check the direction of the reflection

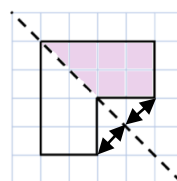
Turn your image

If you turn your image it becomes a vertical/ horizontal reflection (also good to check your answer this way)



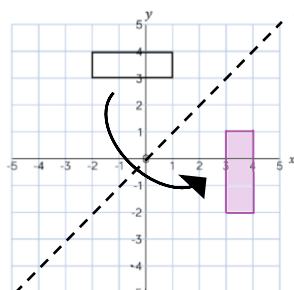
Drawing perpendicular lines

Perpendicular lines to and from the mirror line can help you to plot diagonal reflections

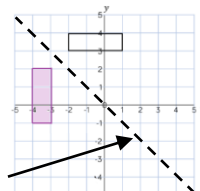


Reflect Diagonally (2)

This is the line $y = x$ (every y coordinate is the same as the x coordinate along this line)

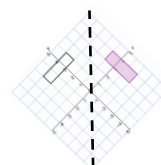


This is the line $y = -x$
The x and y coordinate have the same value but opposite sign



Turn your image

If you turn your image it becomes a vertical/ horizontal reflection (also good to check your answer this way)



YEAR 8

KNOWLEDGE ORGANISERS



BLOCK: REASONING WITH DATA

The data handling cycle

Measures of location

YEAR 8 - REASONING WITH DATA...

The data handling cycle

@whisto_maths

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

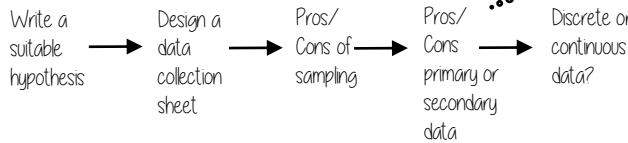
Continuous Data: numerical data that has an infinite number of values (often seen with height, distance, time)

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



Features of a data collection sheet

Data Title	Tally	Frequency
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

Pictogram

Language	
French	●●●●●
Spanish	●●●●●
German	●●●●●

● = 4 people

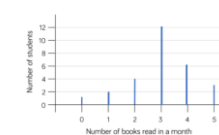
- Need to remember a key
- Visually able to identify mode

Bar Chart



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

Line Chart



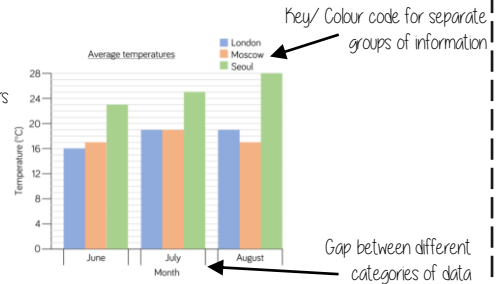
- Gaps between the lines
- Clearly labelled axes
- Scale for the axes
- Discrete Data

Represents quantitative data

Multiple Bar chart

Compares multiple groups of data

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



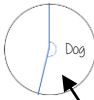
Draw and interpret Pie Charts

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

$$\frac{32}{60} \times 360 = 192^\circ$$



Use a protractor to draw This is 192°

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

Multiple method

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

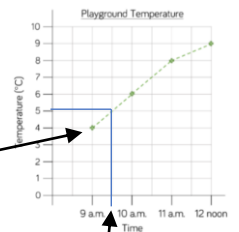
Represents quantitative, discrete data

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



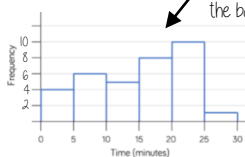
It is possible to make estimates from the line e.g. temperature at 9.30am is 5°C

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

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

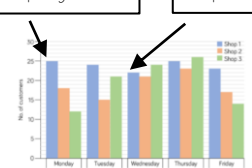
A range of 0 means all the data is the same value

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

Difference between the biggest and smallest values

Shop 1 highest value

Shop 1 lowest value



Range of customers = $25 - 22 = 3$ (Shop 1)

YEAR 8 - REASONING WITH DATA...

Measures of location

@whisto_maths

What do I need to be able to do?

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

- Understand and use mean, median and mode
- Choose the most appropriate average
- Identify outliers
- Compare distributions using averages and range

Keywords

Spread: the distance/ how spread out/ variation of data

Average: a measure of central tendency – or the typical value of all the data together

Total: all the data added together

Frequency: the number of times the data values occur

Represent: something that shows the value of another

Outlier: a value that stands apart from the data set

Consistent: a set of data that is similar and doesn't change very much

Mean, Median, Mode

The Mean

A measure of average to find the central tendency... a typical value that represents the data

24, 8, 4, 11, 8

Find the sum of the data (add the values) 55

Divide the overall total by how many pieces of data you have $55 \div 5$

Mean = 11

The Median

The value in the center (in the middle) of the data

24, 8, 4, 11, 8

Put the data in order

4, 8, 8, 11, 24

Find the value in the middle

4, 8, 8, 11, 24

Median = 8

NOTE: If there is no single middle value find the mean of the two numbers left

The Mode (The modal value)

This is the number OR the item that occurs the most (it does not have to be numerical)

24, 8, 4, 11, 8

This can still be easier if the data is ordered first

4, 8, 8, 11, 24

Mode = 8

Choosing the appropriate average

The average should be a representative of the data set – so it should be compared to the set as a whole - to check if it is an appropriate average

Here are the weekly wages of a small firm

£240	£240	£240	£240	£240
£260	£260	£300	£350	£700

Which average best represents the weekly wage?

The Mean = £307

The Median = £250

The Mode = £240

Put the data back into context

Mean/Median – too high (most of this company earn £240)

Mode is the best average that represents this wage

It is likely that the salaries above £240 are more senior staff members – their salary doesn't represent the average weekly wage of the majority of employers

Identify outliers

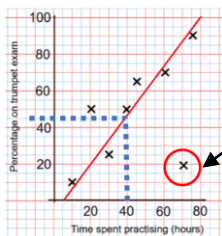
Outliers are values that stand well apart from the rest of the data

Outliers can have a big impact on range and mean. They have less impact on the median and the mode

Sometimes it is best to not use an outlier in calculations

Height in cm
152 150 142 158 182 151 153 149 156 160 151 144

Where an outlier is identified try to give it some context. This is likely to be a taller member of the group. Could it be an older student or a teacher?



Outliers can also be identified graphically e.g. on scatter graphs

Comparing distributions

Comparisons should include a statement of average and central tendency, as well as a statement about spread and consistency

Here are the number of runs scored last month by Lucy and James in cricket matches

Lucy: 45, 32, 37, 41, 48, 35

James: 60, 90, 41, 23, 14, 23

Lucy

Mean: 39.6 (1dp), Median: 38, Mode: no mode, Range: 16

James

Mean: 41.8 (1dp), Median: 32, Mode: 23, Range: 76

James has two extreme values that have a big impact on the range

"James is less consistent than Lucy because his scores have a greater range. Lucy performed better on average because her scores have a similar mean and a higher median"