YEAR 7 – ALGEBRAIC THINKING...

Block 1: Understanding Algebraic notation

@whisto_maths

What do I need to be able to do?

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

- Be able to use inverse operations and "operation families".
- Be able to substitute into single and two step function machines.
- Find functions from expressions.
- Form sequences from expressions
- Represent functions graphically.

Keywords

Function: a relationship that instructs how to get from an input to an output.
Variable: a letter used to represent an unknown quantity that can change
Inverse: the operation that undoes what was done by the previous operation. (The opposite operation)
Commutative: the order of the operations do not matter.
Substitution: replace one variable with a number or new variable.
Expression: a maths sentence with a minimum of two numbers and at least one math operation (no equals sign)
Sequence: items or numbers put in a pre-decided order

Single function machines

INPUT → [ ] → OUTPUT

The number that goes IN — The number that comes out

This box gives the calculation instruction

To find the input from the output
Use the INVERSE operation

Using letters to represent numbers

5 + 5 + 5	y + y + y + y	20 - h
3 x 5	y x 4	$\frac{20}{h}$
5 x 3	4 x y	
	4y	

Addition and multiplication can be done in any order
Commutative calculations

4y ↑ 4 lots of 'y'

$\frac{20}{h}$ ↑ 20 shared into 'h' number of groups

Single function machines (algebra)

INPUT → x 10 → OUTPUT

a → 10a

3c → 30c

÷ 10

To find the input from the output
Use the INVERSE operation

Find functions from expressions

INPUT 7x → ? → OUTPUT 14x

Find the relationship between the input and the output

Sometimes there can be a number of possible functions. e.g. +7x or x 2 could both be solutions to the above function machine

Substitution into expressions

4y ← 4 lots of 'y'

If y = 7 this means the expression is asking for 4 'lots of' 7

4 x 7 OR 7 + 7 + 7 +7 OR 7 x 4 = 28

e.g: y – 2
= 7 – 2 = 5

Two step function machines

INPUT → [ ] → [ ] → OUTPUT

Calculate the value at the end of each operation

For the input use the INVERSE operations

Two step function machines (algebra)

b → x 5 → 5b → + 4 → 5b + 4

÷ 5, - 4

IMPORTANT
Calculate the value at the end of each operation

c → + 4 → c+4 → x 5 → 5(c + 4) = 5c + 20

- 4, ÷ 5

NOTE: The whole first output is multiplied by 5

Find functions from expressions

$\frac{f + 5}{3}$ — f add 5 then divide by 3

f → + 5 → ÷ 3

NOTE: the difference in the two expressions

$\frac{f}{3} + 5$ — f divided by 3 then add 5

f → ÷ 3 → + 5

Sometimes it helps to try to explain the expression in word – and consider what has happened to the input

Substitution into an expression

2(x + 3)

Add 3 to the input then times 2

Put the expression into a function machine

INPUT → + 3 → x 2 → OUTPUT

If x = 10
10 + 3 = 13…. 13 x 2 = 26

Forming a sequence

2(x + 3)

INPUT	1	2	3
OUTPUT	8	10	12

The substitution is the 'input' value
The OUTPUT becomes the sequence

Representing functions graphically

Take the function and generate a sequence. 2(x + 3)

INPUT → + 3 → x 2 → OUTPUT

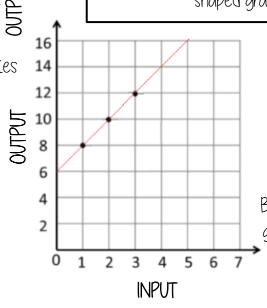
To represent graphically the input becomes x co-ordinates and the output becomes y co-ordinates

y=2(x + 3)

INPUT (x)	1	2	3
OUTPUT (y)	8	10	12

This becomes a co-ordinate pair (2, 10) to plot on a graph

Not all graphs will be linear only those with an integer value for x. Powers and fractions generate differently shaped graphs.



NOTE: Because this is a linear graph you can predict other values

YEAR 7 – ALGEBRAIC THINKING...

Block 2: Equality and Equivalence

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What do I need to be able to do?

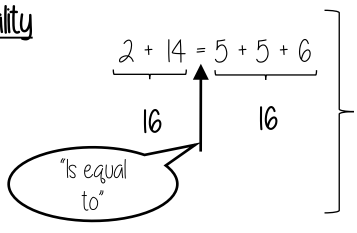
By the end of this unit you should be able to:

- Form and solve linear equations
- Understand like and unlike terms
- Simplify algebraic expressions

Keywords

Equation: a mathematical statement that two things are equal
Inverse: the operation that undoes what was done by the previous operation. (The opposite operation)
Term: a single number or variable
Expression: a maths sentence with a minimum of two numbers and at least one math operation (no equals sign)
Equivalent: something of equal value

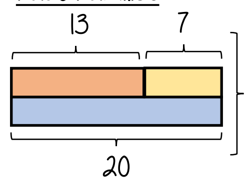
Equality



Saying it out loud sometimes helps you to understand equality

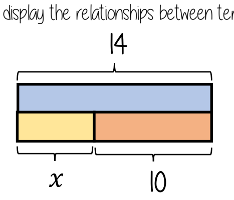
Fact Families

Use a bar model to display the relationships between terms and numbers.

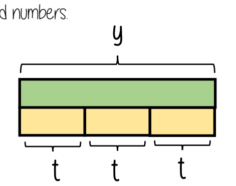


13 + 7 = 20 20 – 7 = 13
7 + 13 = 20 20 – 13 = 7

Fact Family



$x + 10 = 14$ $14 - 10 = x$
$10 + x = 14$ $14 - x = 10$



t + t + t = y y – t – t = t
3 x t = y y ÷ 3 = t
3t = y y ÷ t = 3

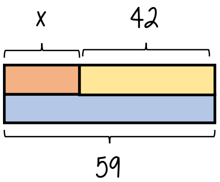
Solve one step equations (+/–)

There is more to this than just spotting the answer

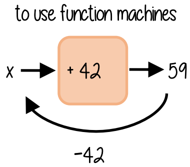
x + 42 = 59

x + 42 = 59
42 + x = 59

59 – x = 42
59 – 42 = x



Don't forget you know how to use function machines

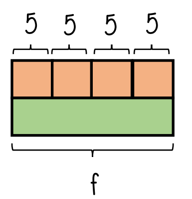


Solve one step equations (x/÷)

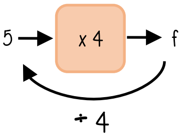
$\frac{f}{4} = 5$

f ÷ 4 = 5
f ÷ 5 = 4

5 x 4 = f
4 x 5 = f

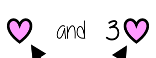


Don't forget you know how to use function machines



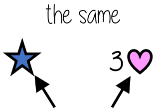
Like and unlike terms

Like terms are those whose variables are he same



are **like** terms

the variable is the same



are **unlike** terms

the variables are NOT the same

Examples and non-examples

Like terms	Un-like terms
y, $7y$	y, $7x$
$2x^2$, x^2	$2x^2$, $2c^2$
ab, $10ba$	ab, $10a$
5, -2	5, -2t

Note here ab and ba are commutative operations, so are still like terms

Equivalence

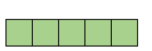
Check equivalence by substitution
e.g. m= 10

5m	2 x 2m	7m – 3m
5 x 10	2 x (2x 10)	(7x 10) – (3x 10)
= 50	= 2 x 20	= 70 – 30
	= 40	= 40

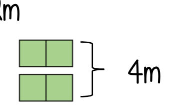
Equivalent expressions

Repeat this with various values for m to check

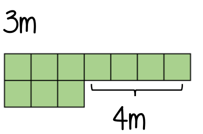
5m



2 x 2m



7m – 3m



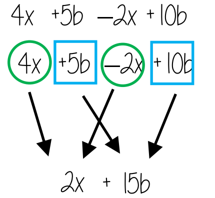
Collecting like terms ≡ symbol

The ≡ symbol means equivalent to.
It is used to identify equivalent expressions

Collecting like terms

Only **like terms** can be combined

4x +5b –2x +10b



Common misconceptions

$2x + 3x^2 + 4x \equiv 6x + 3x^2$

Although they both have the x variable x2 and x terms are un-like terms so can not be collected

YEAR 7 – PLACE VALUE AND PROPORTION

Block 3: Place value

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What do I need to be able to do?

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

- Understand place value and the number system including decimals
- Understand and use place value for decimals, integers and measures of any size
- Order number and use a number line for positive and negative integers, fractions and decimals;
- use the symbols =, ≠, ≤, ≥
- Work with terminating decimals and their corresponding fractions
- Round numbers to an appropriate accuracy
- Describe, interpret and compare data distributions using the median and range

Keywords

Approximate: To estimate a number, amount or total often using rounding of numbers to make them easier to calculate with

Integer: a whole number that is positive or negative

Median: A measure of central tendency (middle, average) found by putting all the data values in order and finding the middle value of the list

Range: The difference between the largest and smallest numbers in a set

Ascending: from smallest to largest

Descending: from largest to smallest

Integer Place Value

Billions			Millions			Thousands			Ones		
H	T	O	H	T	O	H	T	O	H	T	O
		3	1	4	8	0	3	3	0	2	9

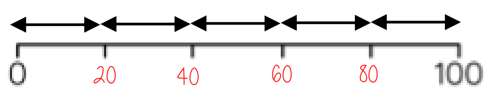
Placeholder

Three billion, one hundred and forty eight million, thirty three thousand and twenty nine

1 billion 1, 000, 000, 000

1 million 1 000, 000

Intervals on a number line



Divide the difference by the number of intervals (gaps).

E.g 100 ÷ 5 = 20

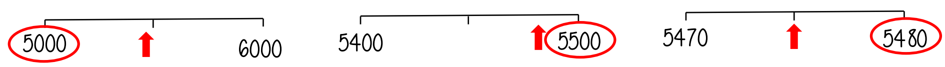
Rounding to the nearest power of ten

If the number is halfway between we "round up"

5495 to the nearest 1000

5475 to the nearest 100

5475 to the nearest 10



Compare integers using <, >, =, ≠

< less than

> greater than

= equal to

≠ not equal to

Two and a half million	=	2 500 000
300 000 000	=	Three billion
Six thousand and eighty	<	68 000

Range

Spread of the values

Difference between the biggest and smallest

3 9 8 12

Range: Biggest value – Smallest value

12 – 3 = 9

Range = 9

Median

The middle value

Example 1

4 3 9 8 12

Median: put the in order 3 4 8 9 12

find the middle number 3 4 (8) 9 12

Example 2

150 154 148

137 160 158

Median: put the in order

137 148 (150 154) 158 160

There are 2 middle numbers

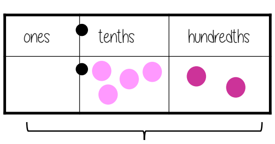
Find the midpoint

152

Decimals

We say "nought point five two"

Five tenths and two hundredths



0 ones, 5 tenth and 2 hundredths

0 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.01 + 0.01

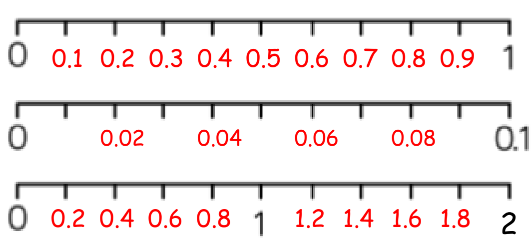
= 0 + 0.5 + 0.02

= 0.52

Decimal intervals on a number line

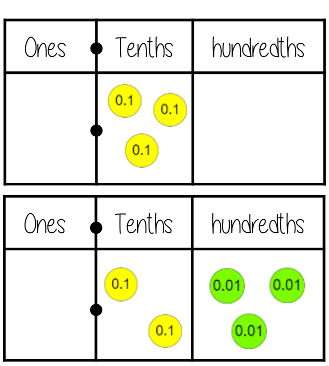
One whole spit into 10 parts makes tenths = 0.1

One tenth split into 10 parts makes hundredths = 0.01



Comparing decimals

Which the largest of 0.3 and 0.23?



0.3 > 0.23

"There are more counters in the furthest column to the left"

0.30

0.23

Comparing the values both with the same number of decimal places is another way to compare the number of tenths and hundredths

Round to 1 significant figure

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

0.00000037 to 1 significant figure is 0.0000004

Round to the first non zero number

YEAR 7 – PLACE VALUE AND PROPORTION...

Block 4: Fractions, decimals & percentages

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What do I need to be able to do?

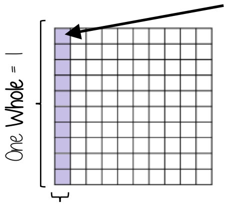
By the end of this unit you should be able to:

- Convert fluently between fractions, decimals & percentages

Keywords

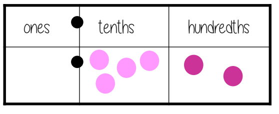
Equivalent: of equal value
Percent: a proportion of a whole represented as a number between 0 and 100
Numerator: the number above the line on a fraction. The top number. Represents how many parts are taken
Denominator: the number below the line on a fraction. The number represent the total number of parts

Tenths and hundredths



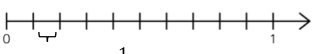
One **hundredth** (one whole split into 100 equal parts) $= \frac{1}{100} = 0.01$

One **tenth** (one whole split into 10 equal parts) $= \frac{1}{10} = 0.1$



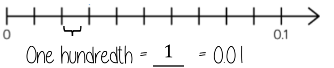
0 ones, 5 tenth and 2 hundredths
$0 + 0.1 + 0.1 + 0.1 + 0.1 + 0.1 + 0.01 + 0.01$
$= 0 + 0.5 + 0.02$
$= 0.52$

On a number line



One whole – split into 10 equal parts

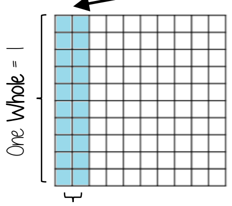
One tenth $= \frac{1}{10} = 0.1$



One tenth – split into 10 equal parts

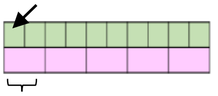
One hundredth $= \frac{1}{100} = 0.01$

Fifths



Twenty hundredths

One Whole = 1



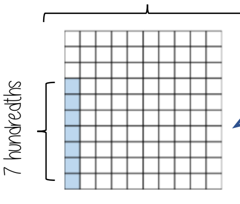
One tenth

Two tenths = one fifth

One **fifth** (one whole split into 5 equal parts) $= \frac{1}{5} = 0.2$

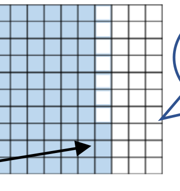
Percentages on a hundred grid

100% = a whole = 100 hundredths



7 hundredths
7 out of 100
7%

6 tenths

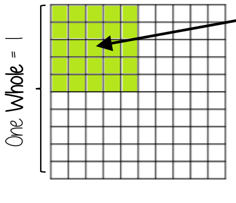


6 tenths and 3 hundredths
63 hundredths
63%

3 hundredths

Quarters

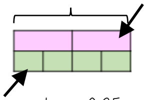
One **quarter** (one whole split into 4 equal parts) $= \frac{1}{4} = 0.25$



Twenty five hundredths

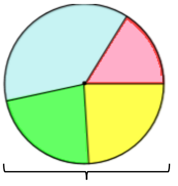
One whole

One half = 0.5



One quarter = 0.25

Simple pie charts



A pie chart has 360° so all FDP calculations are out of 360

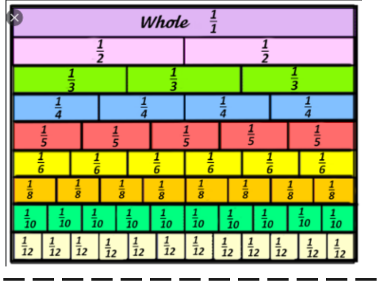
Split into 10 parts = 10% = 36°

Split into 2 parts = 50% = 180°

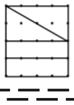
Split into 5 parts = 20% = 72°

Equivalent fractions

Represent equivalence with fraction walls

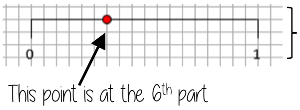


Fractions – on a diagram



The denominator is represented by EQUALLY sized parts – this is split into quarters

Fractions – on a number line



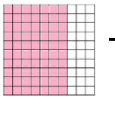
One whole split into 18 equal parts
18 is the **denominator**

This point is at the 6th part
6 is the **numerator**

$\frac{6}{18} \leftarrow \frac{3}{9} \leftarrow \frac{1}{3}$

Convert FDP

$\frac{70}{100}$ → 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

This will give you the answer in the simplest form

× 100 converts to a percentage

Be careful of recurring decimals

eg $\frac{1}{3} = 0.3333333$
$= 0.\dot{3}$

The dot above the 3

YEAR 7 – APPLICATION OF NUMBER

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Solving problems with addition and subtraction

What do I need to be able to do?

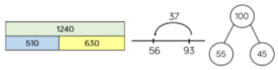
By the end of this unit you should be able to:

- Understand properties of addition/ subtraction
- Use mental strategies for addition/subtraction
- Use formal methods of addition/Subtraction for integers
- Use formal methods of addition/Subtraction for decimals
- Solve problems in context of perimeter
- Solve problems with finance, tables and timetables
- Solve problems with frequency trees
- Solve problems with bar charts and line charts

Keywords

Commutative: changing the order of the operations does not change the result
Associative: when you add or multiply you can do so regardless of how the numbers are grouped
Inverse: the operation that undoes what was done by the previous operation. (The opposite operation)
Placeholder: a number that occupies a position to give value
Perimeter: the distance/ length around a 2D object
Polygon: a 2D shape made with straight lines
Balance: in financial questions – the amount of money in a bank account
Credit: money that goes into a bank account
Debit: money that leaves a bank account

Addition/ Subtraction with integers



Modelling methods for addition/ subtraction

- Bar models
- Number lines
- Part/ Whole diagrams

Addition is commutative

6 + 3 = 3 + 6

The order of addition does not change the result

Subtraction the order has to stay the same

360 – 147 = 360 – 100 – 40 – 7

- Number lines help for addition and subtraction
- Working in 10's first aids mental addition/ subtraction
- Show your relationships by writing fact families

Formal written methods

	H	T	O
	1	8	7
+	5	4	2

	H	T	O
	4	2	7
–	2	4	9

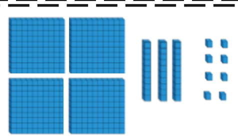
Remember the place value of each column. You may need to move 10 ones to the ones column to be able to subtract

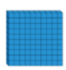
Addition/ Subtraction with decimals

4	.	3	8	
7	.	9	0	+

0 can be used to fill empty places with value

The decimal place acts as the placeholder and aligns the other values



If  represents 1 instead of 100

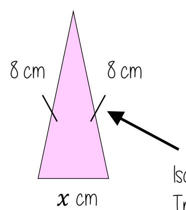
$5.43 + \frac{8}{10}$

Revisit Fraction – Decimal equivalence

5.43 + 0.8

Solve problems with perimeter

Perimeter is the length around the outside of a polygon



Isosceles Triangle notation

The triangle has a perimeter of 25cm.
Find the length of x

8cm + 8cm + $x$cm = 25cm
16cm + $x$cm = 25cm
$x$cm = 9cm

Solve problems with finance

Profit = Income - Costs

Credit – Money coming into an account

Debit – Money leaving an account

Money uses a two decimal place system.
14.2 on a calculator represents £14.20

Check the units of currency – work in the same unit

Tables and timetables

Distance tables

London			
211	Cardiff		
556	493	Glasgow	
518	392	177	Belfast

This shows the distance between Glasgow and London.
It is where their row and column intersects

Bus/ Train timetables

Harton	1005	1045	1130
Bridge	1024	1106	1147
Aville	1051	1133	1205
Ware	1117	1202	1233

Each column represents a journey, each row represents the time the 'bus' arrives at that location

TIME CALCUALTIONS – use a number line

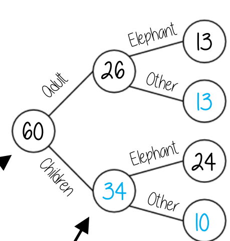
Two-way tables

	H	T
H	HH	HT
T	TH	TT

Where rows and columns intersect is the outcome of that action

Frequency trees

60 people visited the zoo one Saturday morning.
26 of them were adults. 13 of the adult's favourite animal was an elephant. 24 of the children's favourite animal was an elephant.

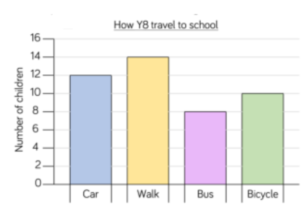


The overall total "60 people"

A frequency tree is made up from part-whole models.
One piece of information leads to another

Probabilities or statements can be taken from the completed trees
e.g. 34 children visited the zoo

Bar and line charts



Use addition/ subtraction methods to extract information from bar charts.

e.g. Difference between the number of students who walked and took the bus.
Walk frequency – bus frequency

When describing changes or making predictions.

- Extract information from your data source
- Make comparisons of difference or sum of values
- Put into the context of the scenario

YEAR 7 – APPLICATION OF NUMBER

@whisto_maths

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

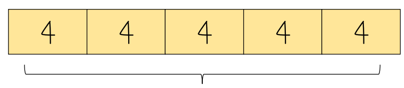
Square numbers have an ODD number of factors

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

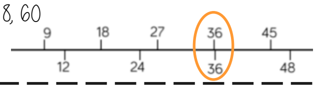
Lowest Common Multiples

LCM of 9 and 12

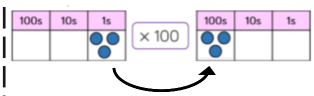
The first time their multiples match

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

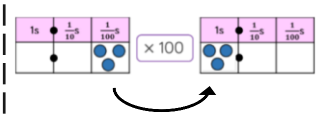
LCM = 36



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

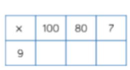
mm ⇄ cm (÷ 10 / × 10), cm ⇄ m (÷ 100 / × 100), m ⇄ km (÷ 1000 / × 1000)

g ⇄ kg (÷ 1000 / × 1000)

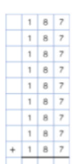
ml ⇄ L (÷ 1000 / × 1000)

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

3584 ÷ 7 = 512

Short division

$$7\,\overline{)\,3\;{}^{3}5\;8\;{}^{1}4}$$ = 5 1 2

Complex division

÷ 24 = ÷ 6 ÷ 4

Break up the divisor using factors

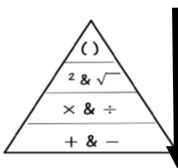
Division with decimals

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

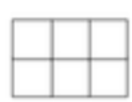
eg 10 – 3 + 5 ⟶ 10 - 3 ⟶ 7 + 5

6 x 4 + 8 x 2

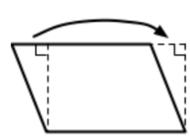
24 + 16 = 40

Area problems

Rectangle
Base x Perpendicular height

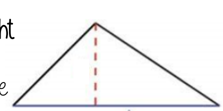


Parallelogram/ Rhombus
Base x Perpendicular height



Triangle
½ x Base x Perpendicular height

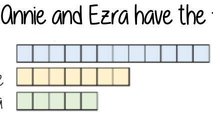
A triangle is half the size of the rectangle it would fit in



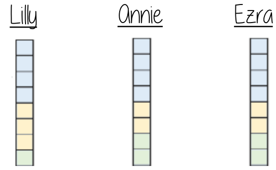
Mean problems

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

Lilly, Annie and Ezra have the following cubes



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



The mean number of blocks would be 8 each

YEAR 7 – APPLICATION OF NUMBER

Fractions and percentages of amounts

@whisto_maths

What do I need to be able to do?

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

- Find a fraction of a given amount
- Use a given fraction to find the whole or other fractions
- Find the percentage of an amount using mental methods
- Find the percentage of a given amount using a calculator

Keywords

Fraction: how many parts of a whole we have
Equivalent: of equal value
Whole: a number with no fractional or decimal part.
Percentage: parts per 100 (uses the % symbol)
Place Value: the value of a digit depending on its place in a number. In our decimal number system, each place is 10 times bigger than the place to its right
Convert: change into an equivalent representation, often fraction to decimal to a percentage cycle.

Fraction of a given amount

Find $\frac{2}{5}$ of £205

The bar represents the whole amount

£205

£41	£41	£41	£41	£41

2 out of the 5 equal parts

2 x £41 = £82

£205 ÷ 5 = £41

Each part of the bar model represents £41

90

30	30	30
15	15	15

45

Use bar models for comparisons

$\frac{1}{3}$ of 90 = 30

$\frac{2}{3}$ of 45 = 30

$\therefore \frac{1}{3}$ of 90 = $\frac{2}{3}$ of 45

Use a fraction of amount

$\frac{2}{3}$ of a value is 70. What is the whole number?

70

35	35	35

70 ÷ 2 = 35

Each part of the bar model represents 35.

35 x 3 = 105

The whole number is 105

The wording of the question is important to setting up the bar model

$\frac{3}{4}$ of a number is 63.

63

21	21	21	21

Find the whole

84

What is $\frac{1}{6}$ of the number?

14	14	14	14	14	14

= 14

Use the whole to find a given part

Find the percentage of an amount (Mental methods)

The **whole** represents 100%

10% = $\frac{1}{10}$ of the whole

0% 20% 40% 60% 80% 100%

10% = $\frac{1}{10}$ of the whole

50% = $\frac{5}{10}$ = $\frac{1}{2}$ of the whole

20% = $\frac{2}{10}$ = $\frac{1}{5}$ of the whole

5% = $\frac{1}{20}$ of the whole

Find 65% of 80

80

8	8	8	8	8	8	8	8	8	8

For bigger percentages it is sometimes easier to take away from 100%

Method 1:
65% = 10% x 6 + 5%
= (8 x 6) + 4
= 52

Method 2:
65% = 50% + 10% + 5%
= 40 + 8 + 4
= 52

Find the percentage of an amount (Calculator methods)

Using a multiplier

Find 65% of 80

Fraction, decimal, percentage conversion

65% = $\frac{65}{100}$ = 0.65 ← The multiplier

0.65 x 80 = 52

Using the percent button

Find 65% of 80

This brings up the % button on screen
You will see 65%

Type 65

Press SHIFT ((%)

Press ✕ 80 and then press =

You can also use the calculator to support non calculator methods and find 1% or 10% then add percentages together

"of" can represent 'x' in calculator methods

YEAR 7 – DIRECTED NUMBER

Operations with equations and directed numbers

@whisto_maths

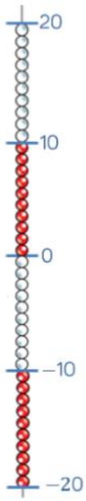
What do I need to be able to do?

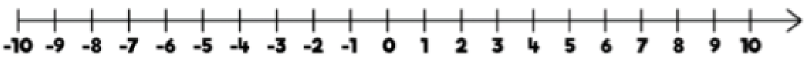
By the end of this unit you should be able to:

- 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)

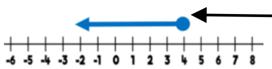




Perform calculations that cross zero

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

$4 - 6 = -2$

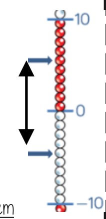


Use the number line to guide subtraction of 6

Start at 4

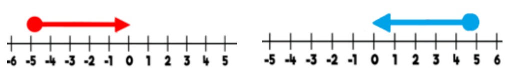
Find the difference between 6 and -4

From 6 to 0
6
From 0 to -4
4



10 beads between them

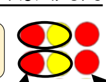
$-5 + 5 = 0$ Rearrangements of the same equation $5 - 5 = 0$



Add directed numbers

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

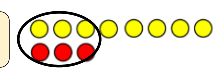
$2 + -4 = -2$



Zero pair (−1 + 1 = 0)

Two "−1" left = −2

$8 + -3 = 5$



Partitioning

$8 + -3 = 5$

$5 + 3 + -3 = 5$

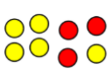
Partition the value to create a zero pair calculation

Generalisation

+ − = −

Subtract directed numbers

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



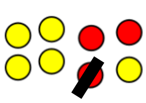
=

Representation for calculation

2

"Subtract" – means take away or remove

$2 - -1 = 3$

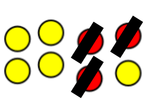


= 3

Take away one (red counter)

Start with the representation of 2

$2 - -3 = 5$

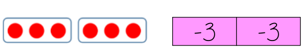


= 5

Generalisation

− − = +

Multiply/ Divide directed numbers



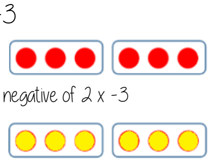
Two representations of the same calculation

$2 \times -3 = -6$

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

10				
x	x	x	x	2
10				

$4x + 2 = 10$

$10 - 4x = 2$

Representing the same question (use fact families)

8			
x	x	x	x
8			

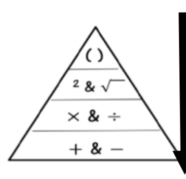
→ x / 2

Function machine

x → ×4 → +2 → 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 7 – FRACTIONAL THINKING

Addition and subtraction of fractions

@whisto_maths

What do I need to be able to do?

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

- Convert between mixed numbers and fractions
- Add/Subtract unit fractions (same denominator)
- Add/Subtract fractions (same denominator)
- Add/Subtract fractions from integers
- Use equivalent fractions
- Add/Subtract any fractions
- Add/Subtract improper fractions and mixed numbers
- Use fractions in algebraic contexts

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

Equivalent: of equal value

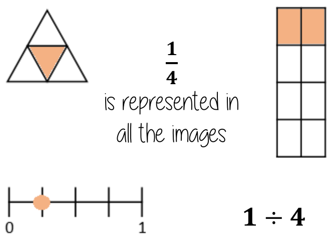
Mixed numbers: a number with an integer and a proper fraction

Improper fractions: a fraction with a bigger numerator than denominator

Substitute: replace a variable with a numerical value

Place value: the value of a digit depending on its place in a number. In our decimal number system, each place is 10 times bigger than the place to its right

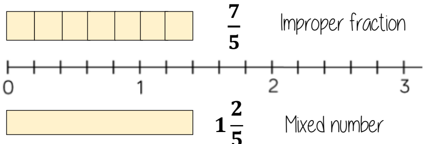
Representing Fractions



$\frac{1}{4}$ is represented in all the images

$1 \div 4$

Mixed numbers and fractions



$\frac{7}{5}$ Improper fraction

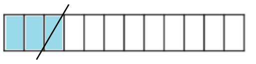
$1\frac{2}{5}$ Mixed number

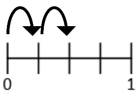
In this model 5 parts make up a whole

Fractions can be bigger than a whole

Add/Subtract unit fractions

Same denominator

$\frac{1}{12} + \frac{1}{12} - \frac{1}{12}$  $= \frac{2}{12}$

$\frac{1}{4} + \frac{1}{4}$  $= \frac{2}{4}$

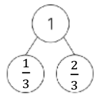
With the same denominator ONLY the numerator is added or subtracted

Add/Subtract fractions

Same denominator

$\frac{2}{7} + \frac{3}{7}$  $= \frac{5}{7}$

Sequences

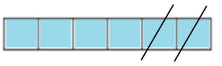


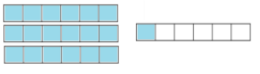
$\frac{1}{3}, 1, 1\frac{2}{3}, 2\frac{1}{3}, 3, \ldots$

$+\frac{2}{3}$ $+\frac{2}{3}$

Represent this on a number line to help

Add/Subtract from integers

$1 - \frac{2}{6}$  $= \frac{4}{6}$

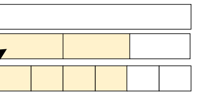
$3 + \frac{1}{6}$  $= 3\frac{1}{6}$

The denominator indicates the number of parts a whole is made up of

Equivalent fractions

Numerator and denominator have the same multiplier

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



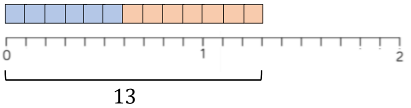
$\frac{1}{3} = \frac{2}{6}$

Add/Subtraction fractions (common multiples)

$\frac{3}{5} + \frac{7}{10}$

$\frac{6}{10} + \frac{7}{10}$

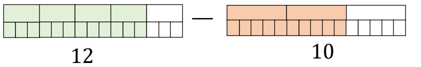
Addition/Subtraction needs a common denominator



$\frac{13}{10}$

Add/Subtraction any fractions

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



$\frac{12}{15} - \frac{10}{15} = \frac{2}{15}$

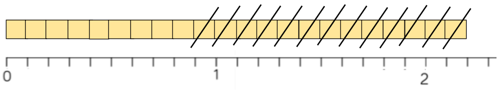
Use equivalent fractions to find a common multiple for both denominators

Add/Subtraction fractions (improper and mixed)

$2\frac{1}{5} - 1\frac{3}{10}$

$2\frac{2}{10}$

$\frac{22}{10} - \frac{13}{10} = \frac{9}{10}$



- Convert to an improper fraction
- Calculate with common denominator

Partitioning method

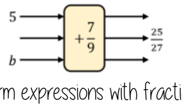
$2\frac{1}{5} - 1\frac{3}{10} = 2\frac{2}{10} - 1\frac{3}{10} = 2\frac{2}{10} - 1 - \frac{3}{10} = 1\frac{2}{10} - \frac{3}{10} = \frac{9}{10}$

Fractions in algebraic contexts

$k - \frac{5}{8} = 2$

Apply inverse operations

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



Form expressions with fractions

$b + \frac{7}{9} \longrightarrow b + \frac{7}{9}$

$p = 5 \quad m = 2$

$\frac{p}{8} + \frac{1}{m}$

Substitution

$\frac{5}{8} + \frac{1}{2}$

Fractions and decimals

$\frac{1}{10} = 0.1$

$\frac{1}{100} = 0.01$

Example

$\frac{6}{10} + 0.3 \longrightarrow 0.6 + 0.3$

$\frac{6}{10} + \frac{3}{10}$

Remember to use equivalent fractions and common denominators

YEAR 7 – LINES AND ANGLES

Constructing, measuring and using geometric notation

@whisto_maths

What do I need to be able to do?

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

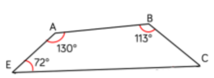
- Use letter and labelling conventions
- Draw and measure line segments and angles
- Identify parallel and perpendicular lines
- Recognise types of triangle
- Recognise types of quadrilateral
- Identify polygons
- Construct triangles (SAS, SSS, ASA)
- Draw Pie charts

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

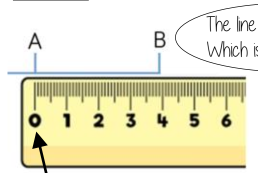


Angle Notation: three letters ABC
This is the angle at B = 113°

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

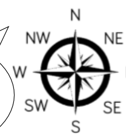
AB is a line segment (part of the line)

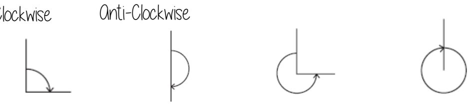
Make sure the start of the line is at 0.

Angles as measures of turn

Clockwise
Anti-Clockwise

East to South is a quarter turn clockwise





Quarter Turn
90°
Clockwise

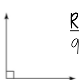
Half Turn
180°

Three-quarter Turn
270°
Anti-Clockwise

Full Turn
360°

Classify angles

Acute Angles
0°< angle <90°



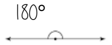
Right Angles
90°

Right angle notation

Obtuse
90°< angle <180°

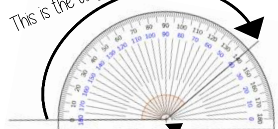
Reflex
180°< angle <360°

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°

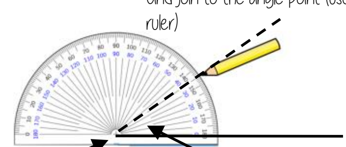
The base line follows the line segment

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)

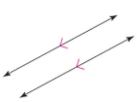


Make sure the cross is at the end of the line (where you want the angle)

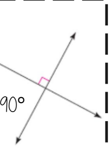
The angle

Parallel and Perpendicular lines

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



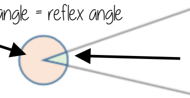
Perpendicular lines
Straight lines that meet at 90°



Angles over 180°

360° - smaller angle = reflex angle

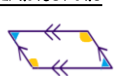
Use your knowledge of straight lines 180° and angles around a point 360°



Measure the smaller angle first (less than 180°)

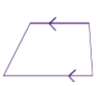
Properties of Quadrilaterals

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

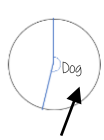
Rhombus
All sides equal size
Opposite angles are equal

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

$\frac{32}{60} \times 360 = 192°$

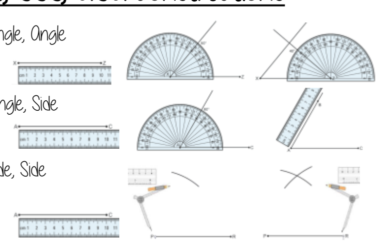
Use a protractor to draw
This is 192°

SAS, SSS, ASA constructions

Side, Angle, Angle

Side, Angle, Side

Side, Side, Side



Polygons

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

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

YEAR 7 – LINES AND ANGLES

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Geometric reasoning

What do I need to be able to do?

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

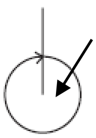
- Understand/use the sum of angles at a point
- Understand/use the sum of angles on a straight line
- Understand/use equality of vertically opposite angles
- Know and apply the sum of angles in a triangle
- Know and apply the sum of angles in a quadrilateral

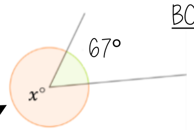
Keywords

Vertically Opposite: angles formed when two or more straight lines cross at a point.
Interior Angles: angles inside the shape
Sum: total, add all the interior angles together
Convex Quadrilateral: a four-sided polygon where every interior angle is less than 180°
Concave Quadrilateral: a four-sided polygon where one interior angle exceeds 180°
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

Sum of angles at a point

The sum of angles around a point is 360°



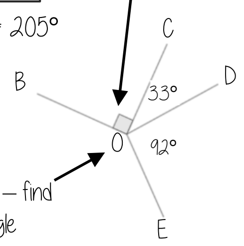


360° - 67° = 293 °

Find angle BOE

90° + 33° + 92° = 205°
360° - 205°
BOE = 155°

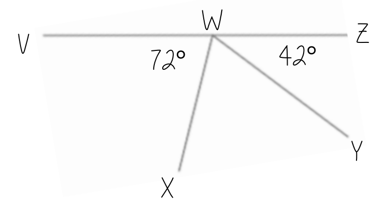
Angle notation – 90°



Angle notation – find this missing angle

Sum of angles on a straight line

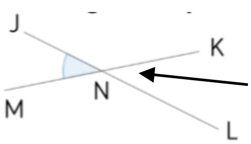
Adjacent angles that share a common point on a line add up to 180°



Find angle XWY

72° + 42° = 114°
180° - 114° = 66°

Vertically opposite angles

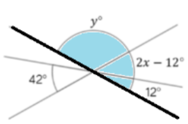


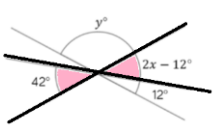
Angle JNM is vertically opposite to angle KNL

JNM = KNL

Vertically opposite angles are the same

Other angle rules still apply.
Look for straight line sums and angles around a point.



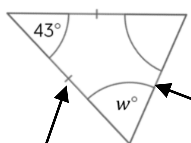


Form equations with information from diagrams:

$2x - 12 = 42$
$2x = 54$
$x = 27°$

Sum of angles in triangles

Sum of interior angles in a triangle = 180°



The two base angles will be the same size

Look at triangle notation. This indicates an isosceles triangle
∴ 180 - 43 = 137
137 ÷ 2 = 68.5°

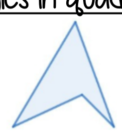
A triangle can only have ONE right angle

Have a go!
Tearing the corners from triangles forms a straight line which is therefore 180°

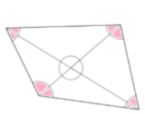
Sum of angles in quadrilaterals

Sum of interior angles in a quadrilateral = 360°

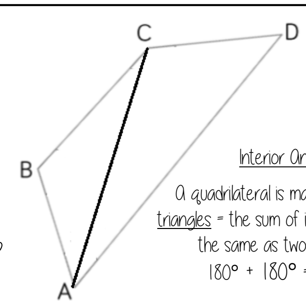
Convex Quadrilateral



Concave Quadrilateral



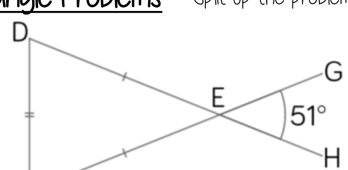
Interior angles are those that make up the perimeter (outline) of the shape



Interior Angles
A quadrilateral is made up of two triangles = the sum of interior angles is the same as two triangles:
180° + 180° = 360°

Angle Problems

Split up the problem into chunks and explain your reasoning at each point using angle notation



EDF = ____°

1. Angle DEF = 51° because it is a vertically opposite angle DEF = GEH
2. Triangle DEF is isosceles (triangle notation) ∴ EDF = EFD and the sum of interior angles is 180°
   180° - 51° = 129°   129° ÷ 2 = 64.5°
3. Angle EDF = 64.5°

Keep working out clear and notes together

YEAR 7 – REASONING WITH NUMBER

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Developing number sense

What do I need to be able to do?

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

- Know and use mental addition/ subtraction
- Know and use mental multiplication/ division
- Know and use mental arithmetic for decimals
- Know and use mental arithmetic for fractions
- Use factors to simplify calculations
- Use estimation to check mental calculations
- Use number facts
- Use algebraic facts

Keywords

Commutative: changing the order of the operations does not change the result
Associative: when you add or multiply you can do so regardless of how the numbers are grouped
Dividend: the number being divided
Divisor: the number we divide by
Expression: a maths sentence with a minimum of two numbers and at least one math operation (no equals sign
Equation: a mathematical statement that two things are equal
Quotient: the result of a division

Mental methods for addition/ subtraction

Addition is commutative

6 + 3 = 3 + 6

The order of addition does not change the result

Subtraction the order has to stay the same

360 – 147 = 360 – 100 – 40 – 7

- Number lines help for addition and subtraction
- Working in 10's first aids mental addition/ subtraction

Mental methods for multiplication/ division

Multiplication is commutative

2 x 4 = 4 x 2

The order of multiplication does not change the result

Partitioning can help multiplication

24 x 6 = 20 x 6 + 4 x 6
= 120 + 24
= 144

Division is not associative

Chunking the division can help 4000 ÷ 25
"How many 25's in 100" then how many chunks of that in 4000

Mental methods for decimals

Multiplying by a decimal < 1 will make the original value smaller   e.g x 0.1 = ÷ 10

Methods for multiplication 1.2 x 0.03

12 × 3 = 36
1.2 × 3 = 3.6
1.2 × 0.3 = 0.36
1.2 × 0.03 = 0.036

12 x 3 = 36
÷ 10, ÷ 100, ÷ 1000
1.2 x 0.03 = 0.036

Methods for addition 2.3+2.4

2 + 2 = 4
0.3 + 0.4 = 0.7
4 + 0.7 = 4.7

Methods for division 1.5 ÷ 0.05

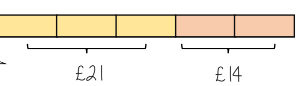
Multiply by powers of 10 until the divisor becomes an integer

1.5 ÷ 0.05
x100   x100
150 ÷ 5 = 30

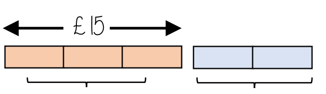
Mental methods for fractions

Use bar models where possible

I've spent $\frac{2}{5}$ of my money I have £21 left



How much did they have to begin with?



$\frac{3}{3} + \frac{2}{3}$

What is $\frac{5}{3}$ of £15?

Using factors to simplify calculations

30 x 16

10 x 3 x 4 x 4
2 x 5 x 3 x 2 x 2 x 2 x 2
10 x 3 x 2 x 8
16 x 10 x 3

Multiplication is commutative
Factors can be multiplied in any order

Estimation

Estimations are useful – especially when using fractions and decimals to check if your solution is possible.

Most estimations round to 1 significant figure

Estimations are useful – especially when using fractions and decimals to check if your solution is possible.

210 + 899 < 1200

This is true because even if both numbers were rounded up, they would reach 300 + 900.
The correct estimation would be 200 + 900 = 1100.

Number facts

Use 124 x 5 = 620

For multiplication, each value that is multiplied or divided by powers of 10 needs to happen to the result

620 ÷ 124 = 50

For division you must consider the impact of the divisor becoming smaller or bigger.
Smaller – the answer will be bigger
(It is being shared into less parts)
Bigger – the answer will be smaller
(It is being shared into more parts)

Algebraic facts

2a + 2b = 10   Everything x 2

0.1a + 0.1b = 0.5   Everything ÷ 10

a + b = 5

Add 2 to the total   a + b + 2 = 7

The unknown quantity isn't changing but the variables change what is done to give the result

YEAR 7 – REASONING WITH NUMBER

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Sets and probability

What do I need to be able to do?

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

- Identify and represent sets
- Interpret and create Venn diagrams
- Understand and use the intersection of sets
- Understand and use the union of sets
- Generate sample spaces for single events
- Calculate the probability of a single event
- Understand and use the probability scale

Keywords

Set: collection of things
Element: each item in a set is called an element
Intersection: the overlapping part of a Venn diagram (AND ∩)
Union: two ellipses that join (OR ∪)
Mutually Exclusive: events that do not occur at the same time
Probability: likelihood of an event happening
Bias: a built-in error that makes all values wrong (unequal) by a certain amount, e.g. a weighted dice
Fair: there is zero bias, and all outcomes have an equal likelihood
Random: something happens by chance and is unable to be predicted

Identify and represent sets

The **universal set** has this symbol ξ – this means EVERYTHING in the Venn diagram is in this set

A set is a collection of things – you write sets inside curly brackets { }

ξ = {the numbers between 1 and 50 inclusive}

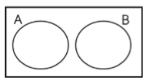
My sets can include every number between 1 and 50 including those numbers

A = {Square numbers}

A = {1, 4, 9, 16, 25, 36, 49}

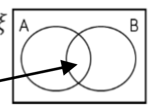
All the numbers in set A are square number and between 1 and 50

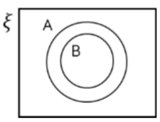
Interpret and create Venn diagrams



Mutually exclusive sets
The two sets have nothing in common
No overlap

Union of sets
The two sets have some elements in common – they are placed in the intersection



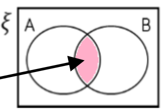


Subset
All of set B is also in Set A so the ellipse fits inside the set

The box
Around the outside of every Venn diagram will be a box. If an element is not part of any set it is placed outside an ellipse but inside the box

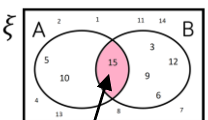
Intersection of sets

Elements in the intersection are in set A AND set B



The notation for this is $A \cap B$

ξ = {the numbers between 1 and 15 inclusive}
A = {Multiples of 5} B = {Multiples of 3}

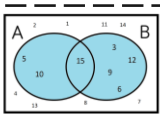


The element in $A \cap B$ is 15

In this example there is only one number that is both a multiple of 3 and a multiple of 5 between 1 and 15

Union of sets

Elements in the union could be in set A OR set B

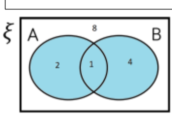


The notation for this is $A \cup B$

ξ = {the numbers between 1 and 15 inclusive}
A = {Multiples of 5} B = {Multiples of 3}

The elements in $A \cup B$ are 5, 10, 15, 3, 9, 6, 12

There are 7 elements that are either a multiple of 5 OR a multiple of 3 between 1 and 15



This Venn shows the **number of elements** in each set

Sample space – for single events

A sample space for rolling a six-sided dice is S = {1, 2, 3, 4, 5, 6}

A sample space for this spinner is S = {Pink, Blue, Yellow}

You only need to write each element once in a sample space diagram

- A Sample space represents a possible outcome from an event
- They can be interpreted in a variety of ways because they do not tell you the probability

Probability of a single event

Probability = $\frac{\text{number of times event happens}}{\text{total number of possible outcomes}}$

Probability notation P (event)

P(Blue) = $\frac{4}{10}$ ← There are 4 blue sectors; 10 ← There are 10 sectors overall

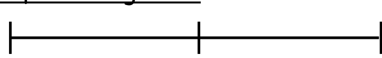
= $\frac{2}{5}$

Probability can be a fraction, decimal or percentage value

$\frac{4}{10}$ = $\frac{40}{100}$ = 0.40 = 40%

Probability is always a value between 0 and 1

The probability scale

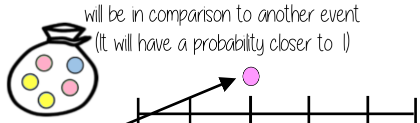


Impossible
0 or 0%

Even chance
0.5, $\frac{1}{2}$ or 50%

Certain
1 or 100%

The more likely an event the further up the probability it will be in comparison to another event (It will have a probability closer to 1)



There are 2 pink and 2 yellow balls, so they have the same probability

There are 5 possible outcomes
So 5 intervals on this scale, each interval value is $\frac{1}{5}$

Sum of probabilities

Probability is always a value between 0 and 1

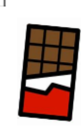
The probability of getting a blue ball is $\frac{1}{5}$
∴ The probability of NOT getting a blue ball is $\frac{4}{5}$

The sum of the probabilities is 1

The table shows the probability of selecting a type of chocolate

Dark	Milk	White
0.15	0.35	

P(white chocolate) = 1 – 0.15 – 0.35
= 0.5



YEAR 7 – REASONING WITH NUMBER

@whisto_maths

Prime numbers and Proof

What do I need to be able to do?

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

- Find and use multiples
- Identify factors of numbers and expressions
- Recognise and identify prime numbers
- Recognise square and triangular numbers
- Find common factors including HCF
- Find common multiples including LCM

Keywords

Multiples: found by multiplying any number by positive integers
Factor: integers that multiply together to get another number.
Prime: an integer with only 2 factors.
Conjecture: a statement that might be true (based on reasoning) but is not proven.
Counterexample: a special type of example that disproves a statement.
Expression: a maths sentence with a minimum of two numbers and at least one math operation (no equals sign)
HCF: highest common factor (biggest factor two or more numbers share)
LCM: lowest common multiple (the first time the times table of two or more numbers match)

Multiples

The "times table" of a given number

All the numbers in this lists below are multiples of 3.

3, 6, 9, 12, 15…

This list continues and doesn't end

$3x, 6x, 9x$ …

x could take any value and as the variable is a multiple of 3 the answer will also be a multiple of 3

Non example of a multiple

4.5 is not a multiple of 3 because it is 3 x 1.5 ← Not an integer

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

Factors and expressions

x	x	x	x	x	x

$6x \times 1$ OR $6 \times x$

Factors of $6x$
6, x, 1, $6x$, $2x$, 3, $3x$, 2

$x\ x$ / $x\ x$ / $x\ x$ → $2x \times 3$

$x\ x\ x$ / $x\ x\ x$ → $3x \times 2$

Prime numbers

- Integer
- Only has 2 factors
- and itself

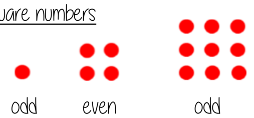
2 — The first prime number. The only even prime number

Learn or how-to quick recall…

2, 3, 5, 7, 11, 13, 17, 19, 23, 29…

Square and triangular numbers

Square numbers



Representations are useful to understand a square number n^2

1, 4, 9, 16, 25, 36, 49, 64 …

Triangular numbers

Representations are useful – an extra counter is added to each new row

Add two consecutive triangular numbers and get a square number

1, 3, 6, 10, 15, 21, 28, 36, 45…

Common factors and HCF

1 is a common factor of all numbers

Common factors are factors two or more numbers share

HCF – Highest common factor

HCF of 18 and 30

18	1, 2, 3, 6, 9, 18
30	1, 2, 3, 5, 6, 10, 15, 30

Common factors (factors of both numbers)
1, 2, 3, 6

HCF = 6

6 is the biggest factor they share

Common multiples and LCM

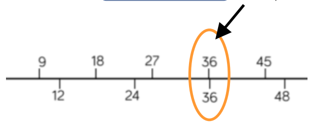
Common multiples are multiples two or more numbers share

LCM – Lowest common multiple

LCM of 9 and 12

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

LCM = 36 — The first time their multiples match



Comparing fractions

$\frac{3}{5}$ and $\frac{7}{10}$ ← Compare fractions using a LCM denominator → $\frac{6}{10}$ and $\frac{7}{10}$

Conjectures and counterexamples

Conjecture

1, 2, 4….
The numbers in the sequence are doubling each time.

A pattern that is noticed for many cases

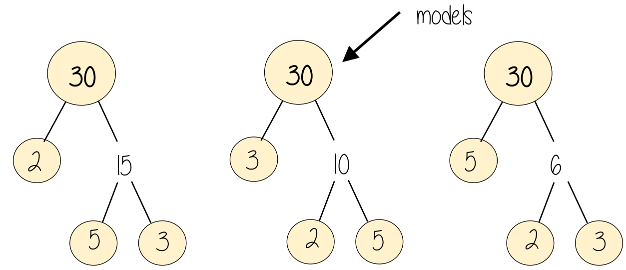
Counterexamples

This sequence isn't doubling it is adding 2 each time

Only one counterexample is needed to disprove a conjecture

Product of prime factors

Multiplication part-whole models



All three prime factor trees represent the same decomposition

Multiplication is commutative

30 = 2 x 3 x 5 ← Multiplication of prime factors

Using prime factors for predictions

eg 60	30 x 2	2 x 3 x 5 x **2**
150	30 x 5	2 x 3 x 5 x **5**