Balshaw's
Church Of England High School

Numeracy across the curriculum
Skills support booklet

Non Sibi Sed Aliis

Your word is a lamp to my feet and a light to my path.
Psalm 119, vs 105

Numeracy is an important life skill. Being numerate allows us to function responsibly in everyday life. As we get older, being numerate becomes more important to hold down a good job as well as taking on responsibilities as a householder – paying the bills, finding the right deals etc.

This booklet is designed to show you the basics of numeracy, as well as other topics in Mathematics which have cross-curricular links, and how we teach it in the Maths department. We will all have been taught different ways of doing a particular mathematical calculation and sometimes a barrier to staff and parental confidence in delivery of numeracy skills, is the unfamiliarity of methods and approaches.

This booklet has been produced to help staff deliver numeracy consistently and effectively across the school and to also help parents in supporting children with their numeracy.

If you are still unsure of any of the methods used please use the links to the videos which will show examples in practise, or ask a member of the Maths department for further help.

For parents/carers, if you would like any further help or support, or if you would like a hard copy of this booklet, please email Miss Hunkin.

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Document created: September 2021
Document updated: September 2022
(To be reviewed annually)

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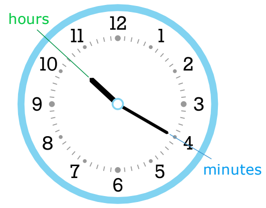
Time

An analogue clock is **a clock or watch that has moving hands and (usually) hours marked from 1 to 12 to show you the time**. Some have Roman Numerals (I, II, III, etc) instead, or no numbers at all, instead only relying on the positioning of the hands and what angle they're at to indicate the time.



The smaller hand on the clock shows the **hour.** The hour hand will sit directly on a number when it is exactly on that hour, as the minutes go past, the hour hand will slowly move towards the next hour. When the hour hand is halfway between two numbers, we know it is **'half past'** that hour.

The longer hand on the clock shows the **minutes**. When the minutes hand goes past 12, and towards 6, we say it is **'past the hour'**. For example, the time on the clock above is 20 past 10. Each small line represents one minute on the clock. Each gap between a number represents 5 minutes.

As the minutes hand goes past 6 and back towards 12, we say the time is **'to the next hour'**.
For example, on this clock below, we say the time is 20 to 7. This is because there are twenty minutes until we reach the next hour of 7.

On an analogue clock, the time needs to be given as AM, or PM.
From midnight 12:00 until 11:59 (morning), the time is AM.
From 12:00 (noon, lunchtime etc), until 11:59 at night, the time is PM.

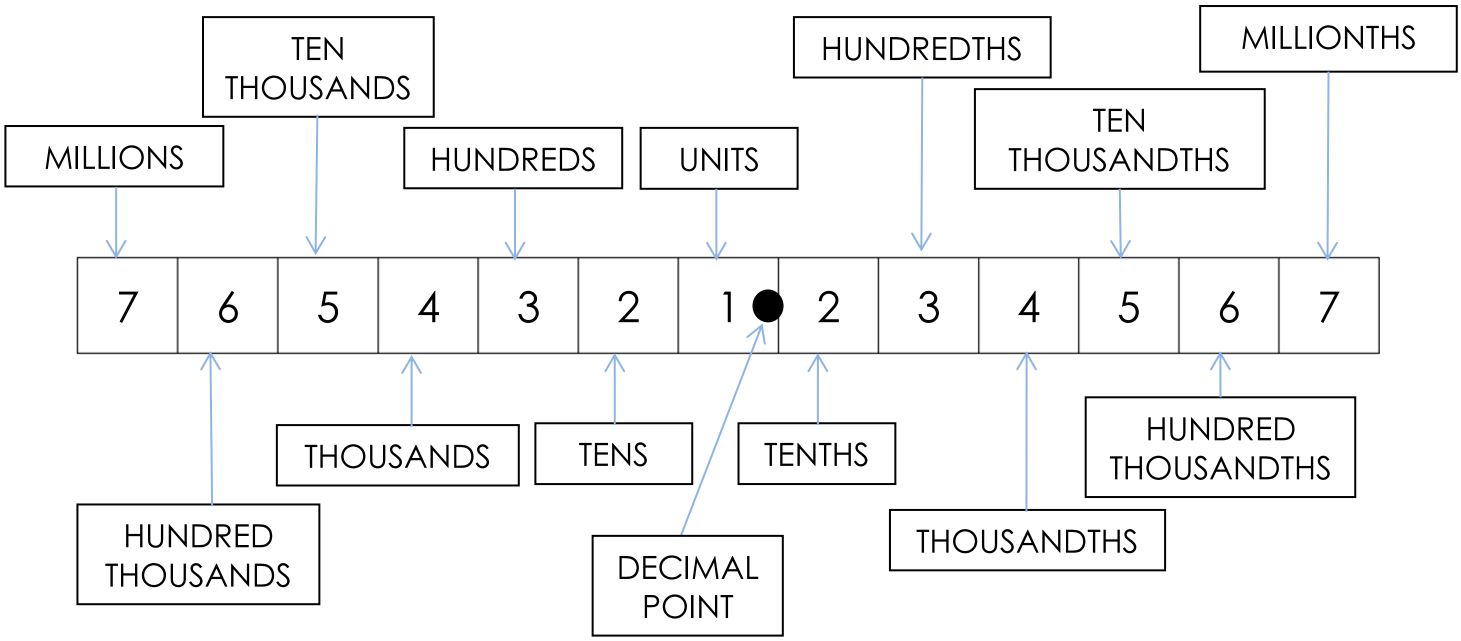
A digital clock tells us the **'24 hour'** time. This is most commonly found on phones, laptops, and other smart devices.

The number before the colon tells us the hour and the numbers after the colon, tells us how many minutes past the hour it is. For example, 12:45, it is 45 minutes past 12. If we wanted to know how many minutes until the next hour, we have to subtract the minutes from 60, as there are **60 minutes in an hour.**

Once the time on a digital clock gets to 'PM'. The hour numbers count up from 12 to 24 hours (which is given as 00:00). If you add 12 onto the analogue PM time, it will give you the time in the 24-hour clock.
The conversions for these times are as follows;

1:00pm → 13:00	2:00pm → 14:00	3:00pm → 15:00	4:00pm → 16:00	5:00pm → 17:00
6:00pm → 18:00	7:00pm → 19:00	8:00pm → 20:00	9:00pm → 21:00	10:00pm → 22:00
11:00pm → 23:00	12:00am → 00:00			

Place value



To read a large whole number (an integer), break the number up into groups of three digits from right hand side and then read it in groups from the left…

74194 → 74,194 → Seventy four thousand, one hundred and ninety four

9301049 → 9,301,049 → Nine million, three hundred and one thousand, and forty nine

To read a decimal number, ensure you are not changing the value of the digits...

1.64 → One point six four **not** one point sixty four

It is very common to read dates differently… **2020 as twenty, twenty**
The correct way is to read it is… **two thousand and twenty.**

How to spell common numbers….

1		**One**	11	**Eleven**	30	**Thirty**
2		**Two**	12	**Twelve**	40	**Forty**
3		**Three**	13	**Thirteen**	50	**Fifty**
4		**Four**	14	**Fourteen**	60	**Sixty**
5		**Five**	15	**Fifteen**	70	**Seventy**
6		**Six**	16	**Sixteen**	80	**Eighty**
7		**Seven**	17	**Seventeen**	90	**Ninety**
8		**Eight**	18	**Eighteen**	100	**One hundred**
9		**Nine**	19	**Nineteen**	1000	**One thousand**
10		**Ten**	20	**Twenty**	1,000,000	**One million**
					0	**Zero or nought**

Times tables

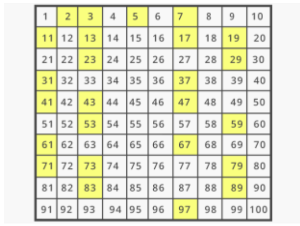
Pupils are expected to know their times tables up to 12 x 12.

Below is a times tables grid we often use with students who haven't as yet memorised them…

×	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

Types of number

Prime numbers



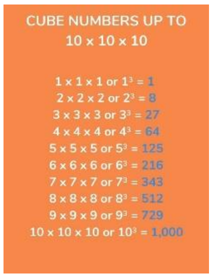
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Prime numbers are numbers which are only divisible by themselves and 1.
Pupils should know their prime numbers up to 20.

Square numbers

A square number is the number we get after multiplying an integer (whole number) by itself. Pupils should know their square numbers up to 12 x 12. They are the diagonal line in the times table grid on the previous page. **E.g. 2 x 2 = 4 so 4 is a square number**.

Cube numbers



A cube number is the number we get after multiplying an integer (whole number) by itself twice.
E.g. 2 x 2 x 2 = 8 so 8 is a cube number.

Factors

A factor of a number is a number which divides into it exactly with no remainders.
We give these in pairs.
E.g. Factors of 24 → 1, 24, 2, 12, 3, 8, 4, 6

Multiples

A multiple of a number is in their times tables.
E.g. Multiples of 6 → 6, 12, 18, 24, 30, ….

Even numbers

Even numbers end in 0, 2, 4, 6 and 8. All of these numbers divide by 2 with no remainders.

Odd numbers

Odd numbers end in 1, 3, 5, 7, and 9.

Positive numbers

Positive numbers are any numbers larger than 0.

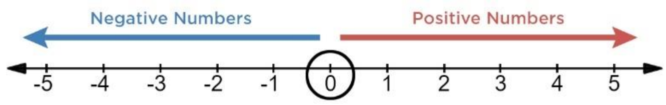
Negative numbers

Negative numbers are any numbers smaller than 0.

Integers

Integers are whole numbers (not decimals).

Negative numbers

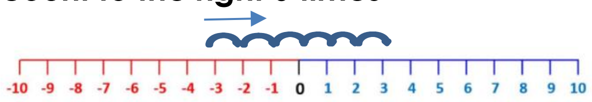


When talking about the numbers less than zero we say negative and not minus.
E.g Negative 4 not minus 4

Adding and subtracting

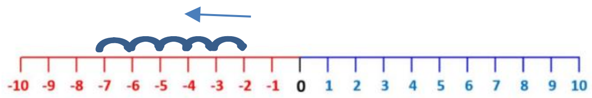
When adding we move to the right on the number line, and when subtracting we move left.

Example -3 + 6
Use the number line, start at -3 and count to the right 6 times



-3 + 6 = 3

Example -2 - 5
Use the number line, start at -2 and count to the left 5 times



-2 - 5 = -7

When we have two signs in the middle of a calculation we then need to follow some rules.

If the signs in the middle are the **same** then we change to an **addition**
If the signs in the middle are **different** then we change to a **subtraction**

Example -2 - -7

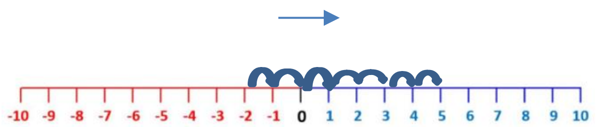
Step 1: Circle the signs in the middle

-2 - -7

Step 2: Choose which rule to use.
The signs are the same so we change to an addition.

-2 + 7

Step 3: Use your number line, start at -2 and count to the right 7 times.



-2 - - 7 = 5

Example 4 + - 6

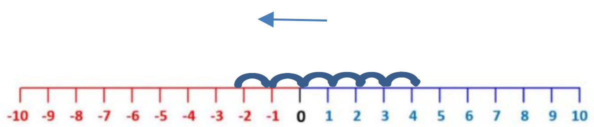
Step 1: Circle the signs in the middle

4 + - 6

Step 2: Choose which rule to use.
The signs are different so we change to a subtraction.

4 - 6

Step 3: Use your number line, start at 4 and count to the left 6 times.



4 + - 6 = -2

Multiplying and dividing

When multiplying and dividing with negative numbers we need to follow these rules:

Positive x Positive = Positive

Negative x Negative = Positive

If the signs are the same then the answer will be positive

Positive x Negative = Negative

If the signs are different then the answer will be negative

These rules are exactly the same for dividing

Positive ÷ Positive = Positive

Negative ÷ Negative = Positive

If the signs are the same then the answer will be positive

Positive ÷ Negative = Negative

Negative ÷ Positive = Negative

If the signs are different then the answer will be negative

Example -5 x - 4

Step 1: Multiply the two numbers together first

5 x 4 = 20

Step 2: Check whether your answer should be positive or negative

Negative x Negative = Positive

So, the answer is 20.

Example -48 ÷ 8

Step 1: Divide the numbers first

48 ÷ 8 = 6

Step 2: Check whether your answer should be positive or negative

Negative ÷ Positive = Negative

So, the answer is -6.

Multiplying and Dividing by 10, 100 and 1000

Using a place value grid will help with this.

Multiplying by 10

When multiplying any number by 10 you move all of the digits one place to the left.

Example: 453 x 10 = 4530

Thousands	Hundreds	Tens	Units
	4	5	3
4	5	3	0

Example: 5.76 x 10

Tens	Units	Tenths	Hundreths
	5	● 7	6
5	7 ●	6	

A zero only needs adding if it would change the value of the number.

Multiplying by 100

When multiplying any number by 100 you move all of the digits two places to the left.

Example: 452 x 100 = 45200

Ten Thousands	Thousands	Hundreds	Tens	Units
		4	5	2
4	5	2	0	0

Example: 2.87 x 100 = 287

Hundreds	Tens	Units	● Tenths	Hundreths
		2	● 8	7
2	8	7 ●		

Multiplying by 1000

When multiplying any number by 1000 you move all of the digits three places to the left.

Example: 9.5 x 1000 = 9500

Thousands	Hundreds	Tens	Units	● Tenths
			9	● 5
9	5	0	0 ●	

Example: 0.07 x 100 = 70

Tens	Units	● Tenths	Hundreths	Thousandths
	0	● 0	7	
7	0 ●			

Dividing by 10

When dividing any number by 10 you move all of the digits one place to the right.

Example: 957 ÷ 10 = 95.7

Hundreds	Tens	Units	Tenths
9	5	7	
	9	5	7

Example: 70.6 ÷ 10 = 7.06

Tens	Units	Tenths	Hundreths
7	0	6	
	7	0	6

Dividing by 100

When dividing any number by 100 you move all of the digits two places to the right.

Example: 654 ÷ 100 = 6.54

Hundreds	Tens	Units	Tenths	Hundreths
6	5	4		
		6	5	4

Example: 1.65 ÷ 100 = 0.0165

Units	Tenths	Hundredths	Thousandths	Ten thousandths
1	6	5		
0	0	1	6	5

Dividing by 1000

When dividing any number by 1000 you move all of the digits three places to the right.

Example: 138.6 ÷ 1000 = 0.1386

Hundreds	Tens	Units	Tenths	Hundreths	Thousandths	Ten thousandths
1	3	8	6			
		0	1	3	8	6

Addition and subtraction

Mentally by partition…

Example: 77 + 28

Break the 77 into a 70 and a 7
Break the 28 into a 20 and an 8
70 + 20 = 90
7 + 8 = 15
90 + 15 = 105

93 – 48

Think of the 48 as 50
Subtract the 50 from 93 to give 43
Now add back on the 2 extra to give 45

Written addition calculation using columns…

Example 5293 + 924

	5	2	8	3
	$+_1$	9_1	2	4
	6	2	0	7

1) 3 + 4 = 7

2) 8 + 2 = 10 Write the units (0) and carry the tens (1) into the next column

3) 2 + 9= 11 plus the carry gives 12 Write the units (2) and carry the tens (1) into the next column

4) 5 + 0= 5 plus the carry gives 6

Subtraction

Example 3138 – 1445

	$^{2}\cancel{3}$	$^{10}\cancel{1}$	$^{1}3$	8
–	1	4	4	5
	1	6	9	3

1) Always work from right to left 8 – 5 = 3 This means 3 units

2a) 3 – 4 would take us into negative numbers so we 'borrow' from the digit to the left. This then becomes 13 – 4 = 9

2b) When we borrow from the 1 the value decreases to 0 and the 3 becomes 13.

3) Again, this sum 0 – 4 would take us into negatives so we need to 'borrow' from the digit to the left. This then becomes 10 – 4 = 6 This is 6 hundreds.

4) 2 – 1 = 1 This means 1 thousand.

Multiplication

We teach the column method for multiplication where we set the question out in the same way we did for addition and subtraction.

Example 152 x 9

	1	5	2
	x		9
1	3 $_4$	6 $_1$	8
	7	5	2

We are multiplying each of the digits in 127 by 9

1) 2 x 9 = 18 – write down the units (8) carry the tens (1).

2) Then 5 x 9 = 45. Write down the units (5) plus the carried (1) 5 + 1 = 6. Carry the tens (4)

3) 1 x 9 = 9
9 + the carried (4) = 13. As this is the last digit to multiply by we write down the full number.

Example 94 x 28

		9	4
	x	2	8
	7	5 $_3$	2
1 $_1$	8 $_1$	8	0
2	6	3	2

We are doing 94 x 8 on this row

We are doing 94 x 20 on this row so we add a 0 at the end because we are multiplying by a tens digit

1) 4 x 8 = 32 – write down the units (2) carry the tens (3). Then 8 x 9 = 72 + carry of 3 = 75.

2) Write a 0 first because we are multiplying by a 10s digit. Then 2 x 4 = 8. Then 2 x 9 = 18

3) Add the two rows together

Multiplying decimals

When multiplying decimals, we convert to whole numbers first, and then change back to decimals at the end of the calculation.

Example 2.7 x 3.5

Multiply each of the numbers by 10 to get 27 x 35, and then use the same method as above to do this calculation

		2	7
	x	3	5
	1	**3** $_3$	**5**
	8 $_2$	**1**	**0**
	9	**4**	**5**

The answer here is 945, however, as we multiplied by ten twice at the beginning (we multiplied each number by ten). We now need to divide by ten twice at the end (this is the same as dividing by 100)
945 ÷ 100 = 9.45

Division

Pupils are taught to use the ‘bus-stop method’ when dividing small and larger numbers.

In this method you but the number of the left of the divide sign (the **dividend**) inside the ‘bus-stop’ and the number of the right (the **divisor**) outside. The answer is the number formed on top of the ‘bus-stop’.

Example 1736 ÷ 8

Start on the left-hand side of the number
1) 8 doesn’t go into 1, so put a 0 in the answer line (top) and carry the 1 into the next column. As it is 10x bigger it becomes a 10s digit in the next column to give 17

	0	2	1	7
8	1	$^{1}7$	$^{1}3$	$^{5}6$

4) 8 goes into 56 seven times exactly. Write 7 in the answer line.
The answer is 217

2) 8 goes into 17 twice with a remainder of 1. Write 2 in the answer line and carry the 1 into the next column (to give 13)

3) 8 goes into 13 once with a remainder of 5. Write 1 in the answer line and carry the 5 into the next column (to give 56)

Example 3920 ÷ 16

1)Start on the left-hand side of the number
As we are dealing with the 16 times table, it is advised to write down the first 5 multiples of 16 to help. (Just keep adding 16 each time)
16, 32, 48, 64, 80

		0	2	4	5
1	6	3	$^{3}9$	$^{7}2$	$^{8}0$

5) 16 goes into 80 five times exactly. Write 5 in the answer line.
The answer is 245

2) 16 doesn’t go into 3, so put a 0 in the answer line (top) and carry the 3 into the next column to make 39.

3) 16 goes into 39 twice (see step 1) with a remainder of 7. Write 2 in the answer line and carry the 7 into the next column to make 72.

4) 16 goes into 72 four times with a remainder of 8. Write 4 in the answer line and carry the 8 into the next column to make 80.

We can also use this method when the answer would be a decimal.

Example 1527 ÷ 6

Start on the left-hand side of the number
1) 6 doesn’t go into 1, so put a 0 in the answer line (top) and carry the 1 into the next column. As it is 10x bigger it becomes a 10s digit in the next column to give 15

	0	2	5	4 •	5
6	1	$^{1}5$	$^{3}2$	$^{2}7$ •	$^{3}0$

5) 6 goes into 30 fives times exactly. Write 5 in the answer line and as there are no remainders, the final answer is 254.5

2) 6 goes into 15 twice with a remainder of 3. Write 2 in the answer line and carry the 3 into the next column (to give 32)

3) 6 goes into 32 five times with a remainder of 2. Write 5 in the answer line and carry the 2 into the next column (to give 27)

4) 6 goes into 27 four times with a remainder of 3. Write 4 in the answer line and place a decimal point after the final digit. We now need to carry the remainder of 3 into the next column (to give 30).

Dividing decimals

When dividing decimals, it is best to consider them as equivalent fractions.

Example 504 ÷ 0.4

Writing this as a fraction we get;

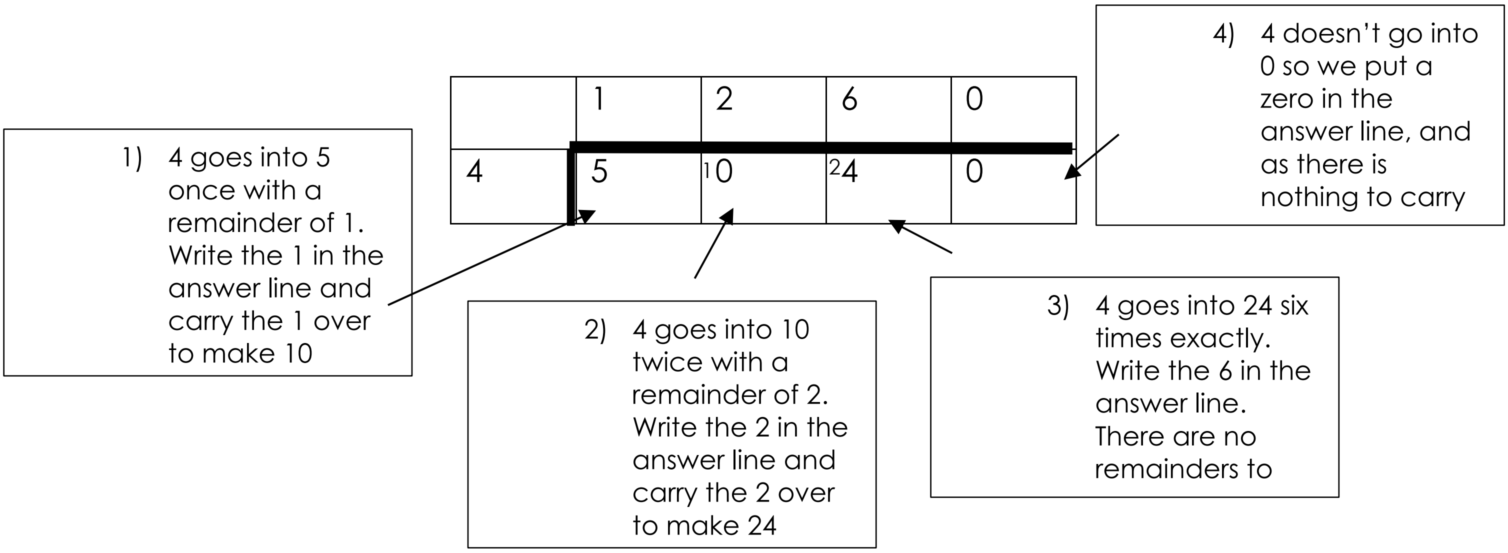
The line in the fraction means divide

$$\frac{504}{0.4}$$

We now want to convert this fraction so the numerator and denominator are both whole numbers (integers). The rule when doing this is, whatever you do to the top, you must do to the bottom.
E.g. if you multiply the numerator by 10, you must multiply the denominator by 10 too.

$$\frac{504}{0.4} \begin{matrix} \times 10 \\ \times 10 \end{matrix} \quad \frac{5040}{4}$$

This sum now becomes 5040 ÷ 4, which we can work out using our bus stop method



As we converted our original calculation into an equivalent fraction. The answer to both calculations will be the same and therefore we do not have to divide our answer at the end like we do when multiplying decimals.

Rounding and estimation

The three ways of estimating numbers:

- Rounding to a particular place value (eg nearest ten, hundred, whole number)
- Rounding to a particular number of decimal places (d.p.)
- Rounding to a particular number of significant figures (s.f.)

The difference between the three types is how the digit to be rounded is located. The method of rounding is the same – once you have located the digit, look at the next digit – if it is 5 or above, the digit to be rounded goes up 1. If it is less than 5 the digit to be rounded stays as it was.

Rounding to place value

Example: Round 8395 to (a) the nearest thousand (b) the nearest ten

The thousands digit is the 8 so this will either stay as an 8 or round up to a 9.

Th	H	T	U
8	3	9	5
8	0	0	0

The next digit is a 3. This is less than 5 so the 8 does not round up.

The 8 stays as it is and the rest of the digits after this go to 0.

The tens digit is the 9 so this will either stay as an 9 or round up to 10.

Th	H	T	U
8	3	9	5
8	4	0	0

The next digit is a 5. This is 5 or above so the 9 rounds up to 10. A column can't hold 10 or higher so write a 0 and carry the tens digit into the next column to turn the 3 into a 4

This gives 840 and the units digit goes to a 0 as well to give 8400.

Rounding to decimal places

You start counting decimal places from the first digit after the decimal point.

	1st d.p,	**2nd d.p,**	**3rd d.p,**	**4th d.p,**	**5th d.p,**
9 ●	1	2	3	4	5

Example Round 3.2382 to 2 decimal places (2 d.p.)

The 2nd d.p. is the 3. This will either stay as a 3 or round up to a 4.

3 ●	2	3	8	2
3 ●	2	4		

The next digit is an 8 – this is 5 or higher so the 3 rounds up to a 4.

Everything after the digit that has been rounded is ignored – the answer is 3.24

Significant figures

The first significant figure (s.f.) is the first non-zero digit. The 2nd, 3rd, 4th etc s.f. can be a 0. You start counting from the 1st significant figure.

Example Round (a) 52911 to 2 s.f. (b) 0.0861 to 1 s.f.

The 1st s.f. is the 5, the 2nd s.f. is the 2. This will either stay as a 2 or round up to a 3

5	2	9	1	1
5	3	0	0	0

The next digit is an 9 – this is 5 or higher so the 2 rounds up to a 3.

Everything after the digit that has been rounded up to where the decimal point would be changes to 0.

The 1st s.f. cannot be a 0 so the 1st s.f. is the 8. This will either stay as an 8 or round up to 9

0 ●	0	8	6	1
0 ●	0	9		

The next digit is an 9 – this is 5 or higher so the 2 rounds up to a 3.

The digit being rounded is after the decimal point so everything after it is ignored.

Estimating calculations

When we estimate calculations we usually round each number involved in the calculation to 1 significant figure.

This means that the numbers are much easier to do mental calculations with.

Example: Estimate 481.3 x 18.34

481.3 → The 1st s.f. is the 4 – the next digit is 8 which means round the 4 up to 5.
So, 481.3 to 1 significant figure is 500

18.34 → The 1st s.f. is the 1 – the next digit is 8 which means round the 1 up to 2.
So, 18.34 to 1 significant figure is 20

Therefor, 481.3 x 18.34 is approximately 500 x 20.

To calculate 500 x 20 in your head quickly:
Ignore the 0's first This gives 5 x 2 = 10
We ignored 3 0's which we need to add on the end.
So, 500 x 20 = 10000

Example: Estimate 4192 ÷ 4.93

4192 → The 1st s.f. is the 4 – the next digit is 1 which means leave the 4 alone.
So, 4192 to 1 significant figure is 4000

4.93 → The 1st s.f. is the 4 – the next digit is 9 which means round the 4 up to 5.
So, 4.93 to 1 significant figure is 5

Therefor, 4192 ÷ 4.93 is approximately 4000 ÷ 5.

4 ÷ 5 isn't a whole number, but 40 ÷ 5 is 8. We haven't dealt with the extra 2 0's so we tag these on to the end to give 800.

<u>Order of operations</u>

An operation in mathematics is a mathematical process such as adding or multiplying. When you have a calculation involving a variety of operations, you have to perform the operations in a particular order.

We use BIDMAS to help us remember the order:

Brackets
Indices
Division
Multiplication
Addition
Subtraction

(Sometimes the mnemonic BODMAS is used where the O is the 2nd letter of powers)

Brackets take priority over anything else – if you see brackets whatever operation(s) is inside them must be performed first – then indices (powers) are next and so on.

In the calculation 4 + 3 x 5 if you got 35 you did the 4 + 3 first (because you performed the calculation the way you read it – from left to right) but the correct way is to do the multiplication first 3 x 5 = 15 and then add on 4, 15 + 4 = 19.

Example ***What is the value of 5 x (12 – 5) + 3^2***

Brackets come first 12 – 5 = 7
The calculation then becomes 5 x 7 + 3^2

Indices come next 3^2 = 3 x 3 = 9
The calculation then becomes 5 x 7 + 9

Next comes multiplication 5 x 7 = 35
The calculation then becomes 35 + 9 **= 44**

Fractions

A fraction is a part of a whole. The words associated with a fraction are:

$$\frac{3 \longleftarrow \text{Numerator}}{5 \longleftarrow \text{Denominator}}$$

Finding the fraction of a quantity

To find the fraction of a quantity:

- Divide by the denominator
- Multiply by the numerator
  (Divide by the bottom, multiply by the top)

Example ***Find $\frac{4}{9}$ of £108***

Divide by the denominator: £108 ÷ 9 = £12
Multiply by the numerator: £12 x 4 **= £48**

Adding and subtracting fractions

You can only add or subtract fractions when they have the same denominators

Example ***Find $\frac{3}{7} + \frac{2}{7}$***

These have the same denominators so we just add their numerators – we don't add or subtract the denominators

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

Example ***Find $\frac{6}{7} - \frac{3}{5}$***

This time they have different denominators, so we need to find a common denominator and alter both fractions so they have this denominator.
The denominators are 7 and 5 so we need a number which is a multiple of both 7 and 5. The first number which fits this description is 35. So we change both fractions so they have a denominator of 35

$$\frac{6}{7} \underset{\text{x5}}{\overset{\text{x5}}{=}} \frac{30}{35} \qquad \frac{3}{5} \underset{\text{x7}}{\overset{\text{x7}}{=}} \frac{21}{35}$$

Now we can add or subtract the fractions like we did before…

$$\frac{6}{7} - \frac{3}{5} = \frac{30}{35} - \frac{21}{35} = \frac{30-21}{35} = \mathbf{\frac{9}{35}}$$

Multiplying fractions

The method for multiplying fractions is:

- Multiply the numerators to get the new numerator
- Multiply the denominators to get the new denominator

Find $\frac{5}{8} \times \frac{3}{11}$

$$\frac{5}{8} \times \frac{3}{11} = \frac{5 \times 3}{8 \times 11} = \frac{15}{88}$$

Dividing fractions

There is another mnemonic to help you to divide fractions…

Keep the first fraction as it is

Flip the second fraction upside down

Change the ÷ sign to a x sign

Example $\frac{11}{12} \div \frac{3}{7}$

$$\frac{11}{12} \div \frac{3}{7} = \frac{11}{12} \times \frac{7}{3} = \frac{11 \times 7}{12 \times 3} = \frac{77}{36}$$

1) **K**eep the first fraction the same

2) **F**lip the 2nd fraction upside down

3) **C**hange the ÷ sign to a x sign

<u>Percentages</u>

A percentage is a fraction of one hundred.

How to work out some common percentages mentally should be known in a way times tables are known – they can also be used in combination to work out more challenging percentages.

Percent	How to work it out
50%	Halve the quantity (÷2)
25%	Quarter the quantity (halve then halve again or ÷4)
10%	Tenth (divide by 10)
5%	Find 10% then halve it (÷20)
1%	Hundredth (divide by 100)

You can use these basic percentages to find more complicated ones.

***Example* Find 37% of £250**

37% can be broken down into 3 lots of 10%, 1 lot of 5% and 2 lots of 1%.

10% of £250 = £250 ÷ 10 = £25
5% of £250 = £25 ÷ 2 = £12.50
1% = £250 ÷ 100 = £2.50
37% = (3 x £25) + £12.50 + (2 x £2.50) **= £92.50**

Much of the percentage work we do in school however is done using a calculator.

One thing to know is that **we <u>never ever</u> use the % button on the calculator.**

We reduce the percentage down to its decimal multiplier and then use this to calculate the various types of percentages.

To reduce a percentage to its decimal multiplier we simply divide it by 100.

***Example* Find 8.2% of £420**

The decimal multiplier for 8.2% = 8.2% ÷ 100 = 0.082

8.2% of £420 = 0.082 x £420 **= £34.44**

Percentage increase and decrease without a calculator

Example: Increase £250 by 10%

Step 1: Find 10% of £250

£250 ÷ 10 = £25, so 10% = £25

Step 2: As this is an increase we add this onto the original amount

£250 + £25 = £275

Example: Decrease £400 by 25%

Step 1: Find 25% of £400

£400 ÷ 4 = £100, so 25% = £100

Step 2: As this is a decrease we subtract this from the original amount

£400 - £100 = £300

Percentage increase and decrease with a calculator

To increase or decrease a quantity by a percentage we start with 100% which represents the original quantity (unchanged).

If we are increasing, we add the % increase to 100%
If we are decreasing, we subtract the % decrease from 100%
We then find the decimal multiplier of the result.

Example: Increase £500 by 18.1%

100% + 18.1% = 118.1%
Decimal multiplier = 118.1% ÷ 100 = 1.181

1.181 x £500 = £590.50

Example: Decrease £500 by 9.3%

100% - 9.3% = 90.7%
Decimal multiplier = 90.7%÷100 = 0.907

0.907 x £500 = £453.50

Quantities as a percentage of another

To do this we turn the question into a fraction first.
If we are working out A as a percentage of B our fraction would be $\frac{A}{B}$.
We then turn the fraction into a decimal (numerator ÷ denominator) and then into a percentage by multiplying by 100.

Example: There are 14 boys and 18 girls in a class. What percentage of the class are girls?

We are finding the girls as a percentage of all those in the class, so 18 out of 32 are girls, which as a fraction is $\frac{18}{32}$

$$\frac{18}{32} = 18 \div 32 \times 100 = \mathbf{56.25}\%$$

Turn fraction to a decimal

Turn decimal to a %

% of the class who are girls

Percentage change

To find the percentage change (this will be either an increase or decrease) our formula is

$$\frac{\text{Change in values}}{\text{Original value}} \times 100$$

Example In 2016 the population of a town was 14,000. In 2017 it had grown to 15,140. Find the % change.

$$\frac{15140 - 14000}{14000} = 1140 \div 14000 = 0.08142857$$

0.08142857 x 100 = 8% (to the nearest integer)

As the value went up from 14000 to 15140 this is an increase.

Example A car was bought for £8000. It was sold for £5200. Work out the % change in value.

$$\frac{8000 - 5200}{8000} = 2800 \div 8000 = 0.35$$

0.35 x 100 = 35%

As the value went down from £8000 to £5200 this is a decrease.

<u>Proportion</u>

Proportion questions can usually be answered using the unitary method. This is a method where one part of the proportion is reduced to one (a unit) which can then be transformed into another quantity very easily.

Example **5 miles is approximately 8km.**
(a) Convert 17 miles into km.
(b) Convert 19km into miles.

(a) Start with the original proportion

It is the miles we are converting so this needs to be reduced to 1 so divide by itself (5)

Now we know how many km 1 mile is, it is easy to convert 1 mile into 17 miles by x by 17

5 miles = 8 km

÷ 5

1 mile = 1.6km

x 17

17 miles = 27.2km

(b) Start with the original proportion

5 miles = 8 km

÷ 8

0.625 mile = 1km

x 19

11.875 miles = 27.2km

This time it is the km we are converting so this needs to be reduced to 1 so divide by itself (8)

Now we know how many miles 1km is, it is easy to convert 1 km into 19 miles by x by 19

We can also use proportion when working with best buys.

Example: A pack of six egg costs £1.30, a pack of 15 costs £3.50. Which one is the best value for money?

With a calculator

6 eggs = £1.30

÷6 ÷6

1 egg = 0.216666…
1 egg = 22p
(to nearest pence)

15 eggs = £3.50

÷15 ÷15

1 egg = 0.2333333
1 egg = 23p
(to nearest pence)

Therefore, the pack of 6 is the best value.

Without a calculator:
6 and 15 are both multiples of 3

6 eggs = £1.30
÷ 2
3 eggs = 65p

15 eggs = £3.50
÷ 5
3 eggs = 70p

Therefore, the pack of 6 is the best value.

Ratio

How you read a ratio is how you write it, so if we say there are 3 red counters to every 5 blue counters we write this as a ratio 3:5 – the red comes first in the sentence so it comes first in the ratio.

This is where the commonest misconception between ratios and fractions occurs.
A ratio of 3:5 is often incorrectly written as a fraction $^3/_5$.

There are 3 red for every 5 blue counters so in every 8 counters there are 3 red and 5 blue so the fraction of red counters is $^3/_8$ and the fraction of blue counters is $^5/_8$.

When performing calculations with ratios, we use a bar-model method to illustrate the ratio – this often makes the ratio much easier to understand. These examples which show the two different kinds of ratio questions we usually encounter.

Example **The ratio of concrete is 1 part cement to 2 parts sand and 3 parts gravel. How much of each element will be needed for 72kg of concrete?**

Each row of the bar model represents one element of the ratio.
Each box represents 1 part of the ratio.

12kg	12kg	12kg	12kg	12kg	12kg

Concrete Cement Cement Sand Sand Sand

So 72kg needs to be shared equally amongst 6 parts (6 boxes)
1 part = 72 ÷ 6 = 12kg.
So each box represents 12kg.
Cement = 1 box = 12kg
Sand = 2 boxes = 2 x 12 = 24kg
Concrete = 3 boxes = 3 x 12 = 36kg.

Example **Ian and Shelley share money in the ratio 4 : 7.**
Shelley gets £60 more than Ian.
How much do they each get?

Ian	Ian	Ian	Ian	Shelley	Shelley	Shelley	Shelley	Shelley	Shelley	Shelley

The extra boxes that Shelley has equal £60.
She has 3 extra boxes.
3 boxes = £60
1 box = £20

Ian has 4 boxes: £20 x 4 = £80
Shelley: £20 x 7 = £140

Algebraic notation

Algebra is the use of letters to represent numbers. The letters represent unknown quantities and obviously the letter x is commonly used to represent this unknown quantity (but it could be any letter).

Key words in algebra

Variable this is something which can vary. This is the quantity that is represented by a letter in algebra

Constant This is something that does not vary

Coefficient A number attached to a variable – for example in $9x$, 9 is the coefficient and x is the variable

Expression This is a collection of constants and variable – but no = sign. $5x + 7$ is an example of an expression

Equation This is an expression with an = sign – this allows us to solve the equation (find the value of the unknown). For example $3x + 6 = 12$

Formula This looks like an equation but shows how one variable is related to another variable – it will have at least two variable in it. For example $y = 3x + 5$

Identity This has an ≡ rather than an = sign. This means the left hand side is ALWAYS the same as the right hand side irrespective of the value of the variable. For example $5(2x + 3) \equiv 10x + 15$

Expand This is when we get rid of (expand) brackets

Factorise This is the opposite of expanding – we put brackets back into an expression.

Notation

a + a = 2a	2 x a = 2a
b + b = 2b	a x b = ab
a x a = a^2	a ÷ b = $\frac{a}{b}$
a x a x a = a^3	

Collecting like terms

When adding and subtracting algebraic terms, we can only collect together the 'like' terms (i.e the same letter).

Example: Simplify 2a + 3b + 5a + 6b

We have two letters; a and b. We can group them together separately.

$2a + 5a = 7a$
$3b + 6b = 9b$

So, we have **7a + 9b**

Example: Simply $2x^2 + 5x + x^2 - 3x$

Again, we need to group together the 'like' terms

$2x^2 + x^2 = 3x^2$
$5x – 3x = 2x$

So, we have **$3x^2 + 2x$**

Multiplying terms

When multiplying we remove the multiplication symbol and group terms together. The number always goes in front of the letter.

Example: 5a x 6b

We start by multiplying the numbers: 5 x 6 = 30
Then we multiply the letters by removing the sign: a x b = ab
So, we therefore have **30ab**

Dividing terms

When dividing terms, we start by dividing the numbers, and then cancel out any common letters. In algebra we write divides in a fraction.

$6ab \div 2a$

Write as a fraction in full: $\frac{6 \text{ x } a \text{ x } b}{2 \text{ x } a}$

Then divide the numbers: $6 \div 2 = 3$

Then cancel out any common letters: $\frac{6 \text{ x } \cancel{a} \text{ x } b}{2 \text{ x } \cancel{a}}$ they both have an a so we can cancel these out and we are left with b.

Finally, combine with the 3 and the answer is **3b**

<u>Substitution</u>

Substitution means putting numbers in place of letters to calculate the value of an expression.

Example: When a = 5 and b = 6, work out the value of the expression 2a + 3b

2a means 2 multiplied by a, as a = 5 we need to do: **2 x 5 = 10**

3b means 3 multiplied by b, as b = 6 we need to do: **3 x 6 = 18**

Finally, we add the two as the expression is 2a + 3b: **10 + 18 = 28**

There are instances where you may need to substitute into a formula.

Example: $E = \frac{1}{2}mv^2$

E = energy in Joules
m = mass in Kg
v = speed in m/s

Find the energy of an object with mass 20kg which is moving at 5m/s.

In this example you firstly need to identify the variables which you have the values for and those that you are looking for.

E = energy which we are trying to work out

$$E = \frac{1}{2} \times 20 \times 5^2$$

V = speed Which we are told is 5m/s

M = mass Which we are told is 20kg

We now need to use BIDMAS

Indices first: $5^2 = 25$

So, we then have: $\frac{1}{2}$ x 20 x 25

As they are all multiplication we can do this from left to right: **$\frac{1}{2}$ x 20 = 10**
10 x 25 = 250

Expanding and factorising

Expanding brackets

Expanding a bracket means to remove the bracket from the expression. We do this by multiplying the terms on the outside of the bracket by everything inside of the bracket.

Example: Expand 3(a + 5)

Step 1: We multiply the 3 by the a first of all

$$3(a + 5) \rightarrow 3 \times a = 3a$$

Step 2: We then multiply the 3 by the 5

$$3(a + 5) \rightarrow 3 \times 5 = 15$$

Step 3: We then combine the two terms by adding as we have an addition in the bracket. So, our final answer is

3a + 15

Factorising

Factorising is the opposite of expanding. We want to put an expression back in to a bracket and we do this by dividing.

Example: Factorise 12ab + 40b

Step 1: We look at the numbers to find a common factor (something they both divide by). The highest common factor for 12 and 40 is 4.

Step 2: We then look at the letters and see if they have any letters in common. In this instance they both have a b.

Step 3: We then put everything they have in common outside of the bracket

4b(   )

Step 4: We then have to work out what we multiply 4b by to get to the original expression of 12ab + 40b.

4b(3a + 10)

Solving equations

To solve an equation, we can either use a function machine or the balancing method. Both methods use inverse operations.

The inverse of adding is subtracting
The inverse of subtracting is adding
The inverse of multiplying is dividing
The inverse of dividing is multiplying
The inverse of squaring is to square root
The inverse of finding the square root is to square

Using the balancing method

Example **Solve the equations**

$$\mathbf{5x + 9 = 24}$$
$$-9 \quad -9$$
$$5x = 15$$
$$\div 5 \quad \div 5$$
$$x = 3$$

Solving equations with unknowns on both sides

Using the balancing method

Example **Solve the equations**

$$\mathbf{8x + 2 = 6x + 12}$$
$$-6x \qquad -6x$$
$$\mathbf{2x + 2 = 12}$$
$$-2 \quad -2$$
$$\mathbf{2x = 10}$$
$$\div 2 \quad \div 2$$
$$\mathbf{x = 5}$$

We start by subtracting the smallest x value from both sides

We then use our inverses in the balancing method

The function machine method can be used instead of the balancing method, but this method only works when you have missing variables on one side of the equation

Using a function machine

Example **Solve the equations**

$$\mathbf{5x + 9 = 24}$$

$$\mathbf{x \longrightarrow \times 5 \longrightarrow +9 \longrightarrow 24}$$

$$\mathbf{3 \longleftarrow \div 5 \longleftarrow -9 \longleftarrow 24}$$

Therefore, x = 3

Co-ordinates and graphs

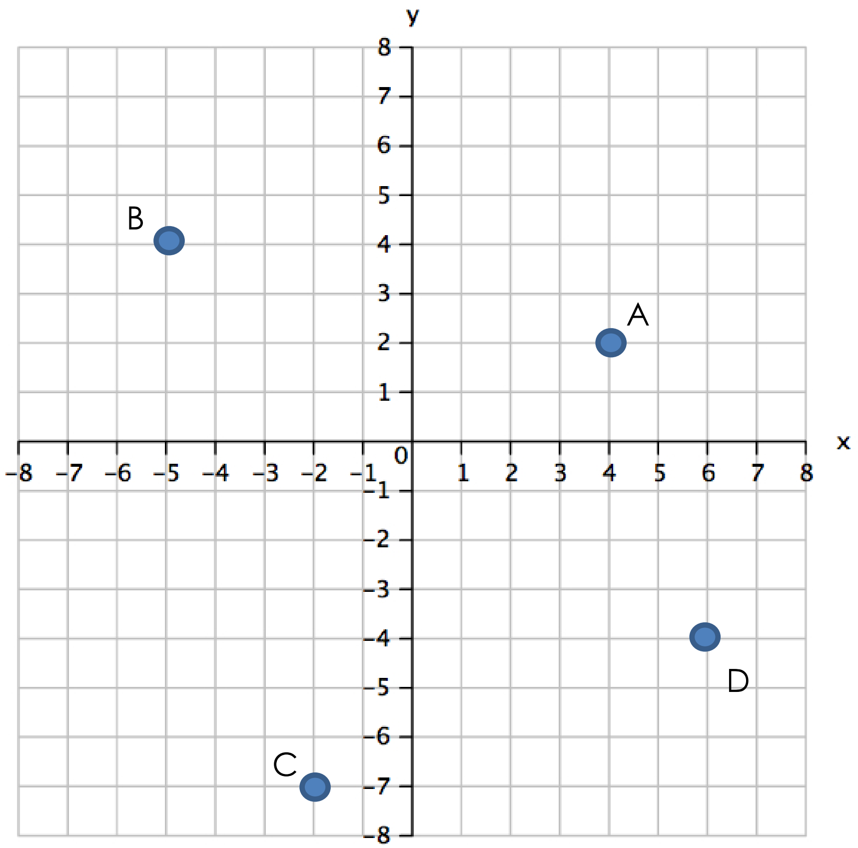
We work with 2-dimensional coordinates. They are written in brackets such as (4, 2).

The first number is the x-coordinate and tells you have far horizontally from the origin (0,0), and the y coordinate tells you how far vertically from the origin.

So (4, 2) means 4 right and 2 up. If the signs were negative this would indicate the opposite direction, so (-4, -2) would mean 4 left and 2 down.

The way of remembering the order is ***Along the corridor and up the stairs.***

When plotting coordinates use the grid lines rather than the squares…



In the diagram
A has coordinate (4, 2)
B is (-5, 4)
C is (-2, -7)
D is (6, -4)

Plotting linear graphs

When plotting a linear graph from an equation, we need to draw a table of values.

We use the equation of the line to substitute our values into.

Example: Draw the equation of the line y = 2x + 1

This equation means we need to multiply our x values by 2 and add 1 to get to our y values.

x	-2	-1	0	1	2	3	4	5
y								

1) Draw a table of values. If you are choosing your own x values then select a range from positive and negative values

x	-2	-1	0		1	2	3	4	5
y			1		3	5	7	9	11

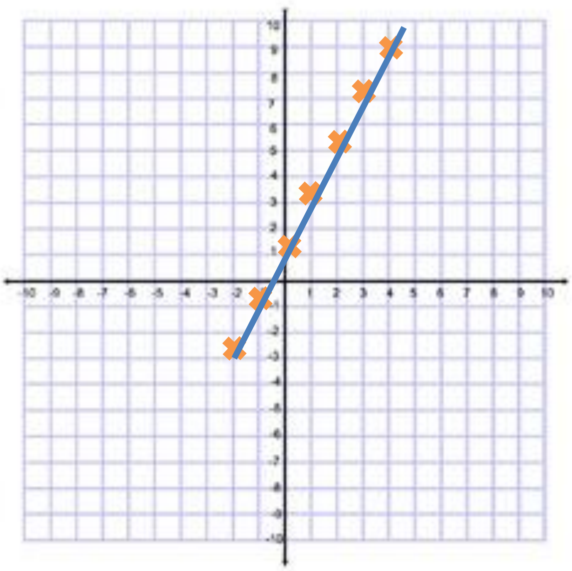
2) Substitute each of your x values into the equation by multiplying by 2 and adding 1. Always start with the positive x values
E.g. 5 x 2 = 10
10 + 1 = 11

x	-2	-1	0	1	2	3	4	5
y	-3	-1	1	3	5	7	9	11

3) Once you get to the negative values you will notice a pattern.
The values differ by two each time.
This is helpful if you are unsure of multiplying and adding/subtracting with negatives.

Always use squared paper, a pencil and a ruler to draw a graph

x	-2	-1	0	1	2	3	4	5
y	-3	-1	1	3	5	7	9	11



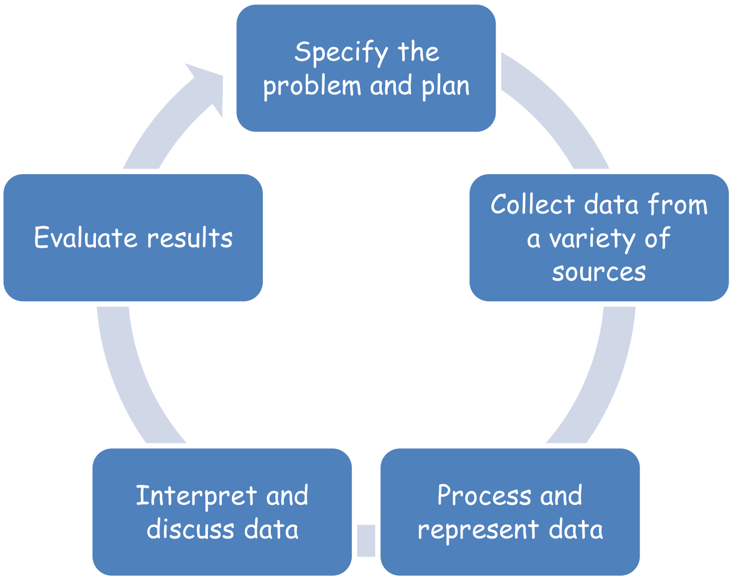
The first coordinate is (-2,-3) as they are the first x and y values.
(-2,-3) (-1,-1) (0,1) (1,3) (2,5) (3,7) (4,9) (5,11)

Plot the co-ordinates one at a time using a small cross.
Ensure the crosses are on the lines and not in the middle of squares

Finish by drawing a straight line through the points with a ruler and pencil

Data Handling

The **data handling cycle.**



Types of data

Primary → Primary data is a type of data that is collected by researchers directly from main sources through interviews, surveys, experiments, etc.

Secondary → Secondary data is the data that has already been collected through primary sources and made readily available for researchers to use for their own research.

Discrete → Data that can only take certain values. For example: the number of students in a class (you can't have half a student).

Continuous → Continuous data is **data** that can be measured on an infinite scale, it can take any value between two numbers, no matter how small.

Qualitative → Qualitative data is information that cannot be counted, measured or easily expressed using numbers.

Quantitative → Quantitative data is, quite simply, information that can be quantified. It can be counted or measured, and given a numerical value

Once data has been collected and categorised, we can use averages and graphs to analyse, compare and evaluate.

Averages

The main measures we use for average and spread are mode, median, mean and range.

Mode: The is the MOST popular piece of data. This is the only average that doesn't have to be a number. If more than one piece of data is equally the most popular there can be more than one mode. However if each different piece of data appears the same number of times there is no mode.

Median: This is the middle value AFTER the data has been put in order.
If there is an odd number of pieces of data there will be one middle number which will be the median. If there is an even number of pieces of data there will be two middle numbers – the median will be half-way between these two values.

Mean: This is when the sum of all the data is found and divided by the number of pieces of data there were.

Range: This is the highest value subtract the lowest value. This tells us the spread of the data.

Example **Find the mode, median, mean and range for the set of data**

11, 5, 9, 5, 8, 9, 10, 11, 2, 5

Mode: 5 appears three times therefor this is the mode.

Median: Put the numbers in order first…

2, 5, 5, 5, 8, 9, 9, 10, 11, 11

There are two middle numbers – 8 and 9 – so the median is halfway between these so the median is 8.5.

Mean: Add the numbers together first

$$11 + 5 + 9 + 5 + 8 + 9 + 10 + 11 + 2 + 5 = 75$$

There are 10 pieces of data so divide by 10

$$\text{Mean} = 75 \div 10 = 7.5$$

Range: The largest piece of data is 11, the smallest is 2

$$\text{Range} = 11 - 2 = 9$$

Pictograms

A pictogram is a chart/graph which uses pictures or symbols to represent data.

The most important part of a pictogram is a **key.** This must clearly show what each picture or symbol represents.

Pictograms must be drawn with a pencil and ruler.

Example: Use the data from the frequency table to construct a pictogram.

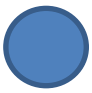
Favourite sport	Frequency
Football	10
Netball	6
Basketball	3

The frequency tells us how many people chose each sport

Step 1: Draw an outline of your pictogram with the information from the table

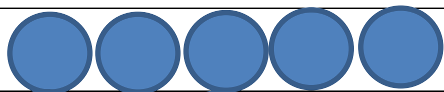
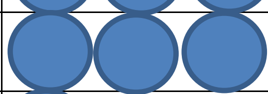
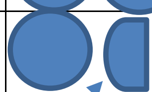
Favourite sport	Number of pupils
Football	
Netball	
Basketball	

Step 2: Decide on a suitable key and picture for your pictogram. If we chose 1, we would need to draw 10 of our pictures for football. A more sensible option would be to choose 2.

Key:  **= 2 pupils**

Always chose an easy picture to draw. A circle represents a ball as all of these sports play with a ball.

Step 3: Fill in your table using your key

Favourite sport	Number of pupils
Football	
Netball	
Basketball	

Half a circle represents 1 person

<u>Bar charts</u>

When drawing bar charts, we must:

- Always use a pencil and ruler
- Chose an appropriate scale for recording our frequency on the y-axis
- Label both of the axes
- Include a relevant title which is underlined
- Have gaps in between the bars, these gaps **must** be of equal width
- Ensure the bars are all of equal width

We use a frequency table to construct a bar chart

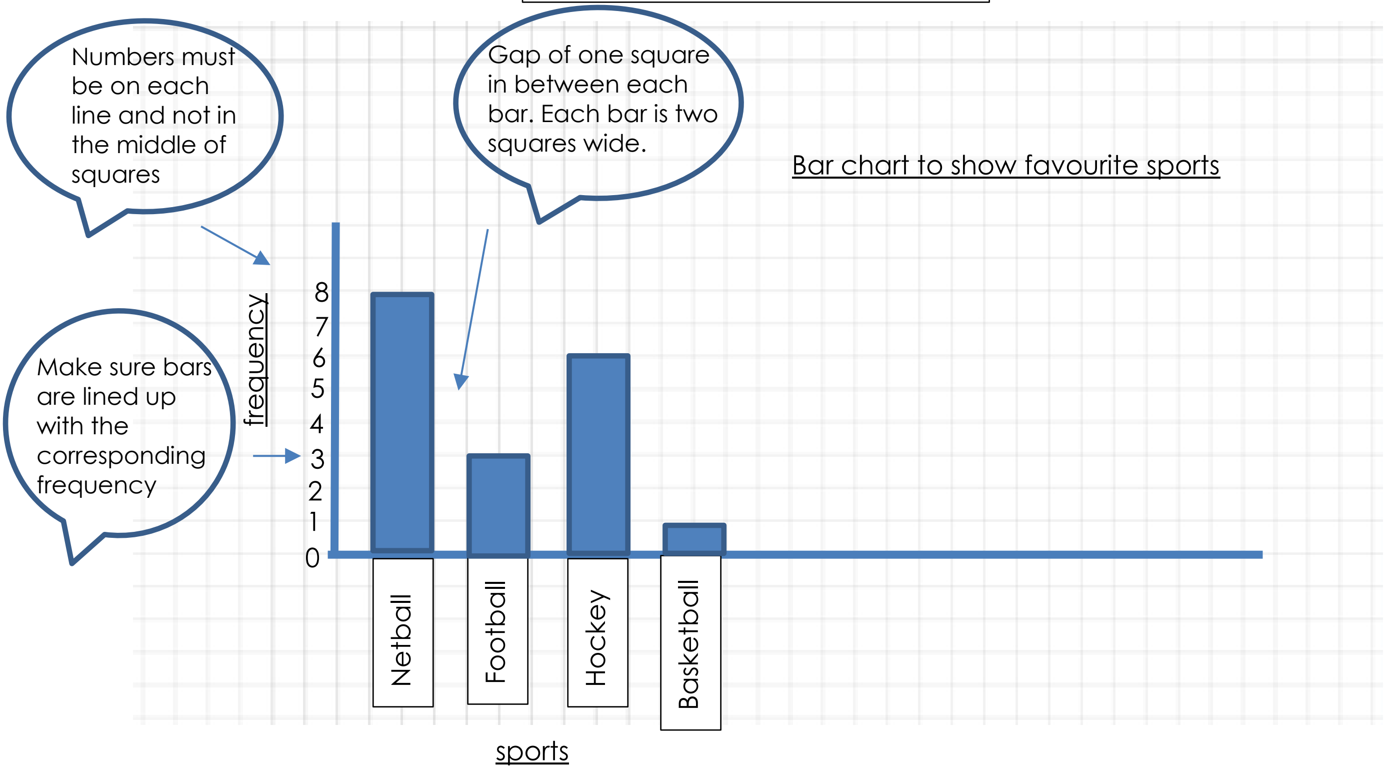
Favourite sport	Frequency
Netball	8
Football	3
Hockey	6
Basketball	1

1) Look at the frequency to decide on a suitable scale. As these are all single digit numbers we can go up in 1's.

2) Draw your x and y axis using a pencil and ruler

3) Draw your bars, ensuring they are of equal width and leaving equally spaced gaps in between each one.

4) Label the axis and give your bar chart a title.



Pie charts

. To draw a pie-chart a pair of compasses, ruler and protractor is needed.
We measure angles in degrees which is represented using the symbol ˚
Angles in a pie chart add to 360˚, half of a pie chart is 180˚, and a quarter of a pie chart is 90˚.

Example **The favourite football teams of 30 Year 7 students was surveyed**
Draw a pie chart to illustrate this.

Team	Frequency	Angles
Arsenal	3	**12 x 3 = 36˚**
Liverpool	4	**12 x 4 = 48˚**
Manchester United	5	**12 x 5 = 60˚**
Sheffield United	10	**12 x 10 = 120˚**
Sheffield Wednesday	8	**12 x 8 = 96˚**
Total	**30**	**360**

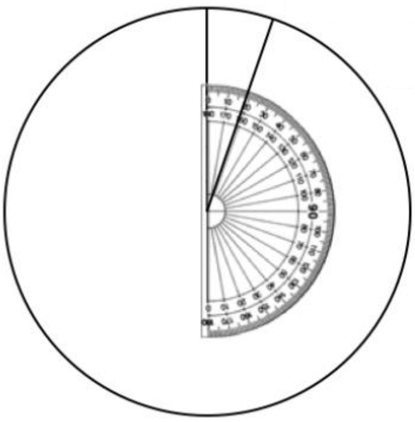
Step 4: Multiply the angle for one person (from step 3) by the frequency in each column.

Step 1: Add the frequency

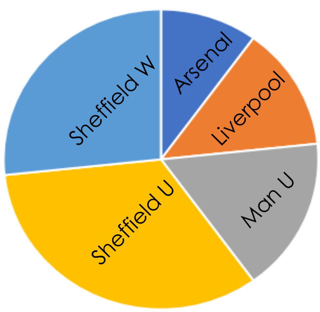
Step 2: Fill in the total angles as 360 as we know there are 360˚ in a pie chart.

Step 3: We work out the angle for one person by doing total angles divided by total people.
360 ÷ 30 = 12

Drawing the pie chart using the table



1)Draw a line from the centre to the top of the circle and line the protractor with the zero facing up the line as shown.
2) Measure around the outside until the degrees for the section.
3) Move the protractor around as you are drawing in each new section



Each section must be labelled.

Scatter graphs

We use scatter graphs to display two sets of data to see if there is a correlation, or connection.

Example

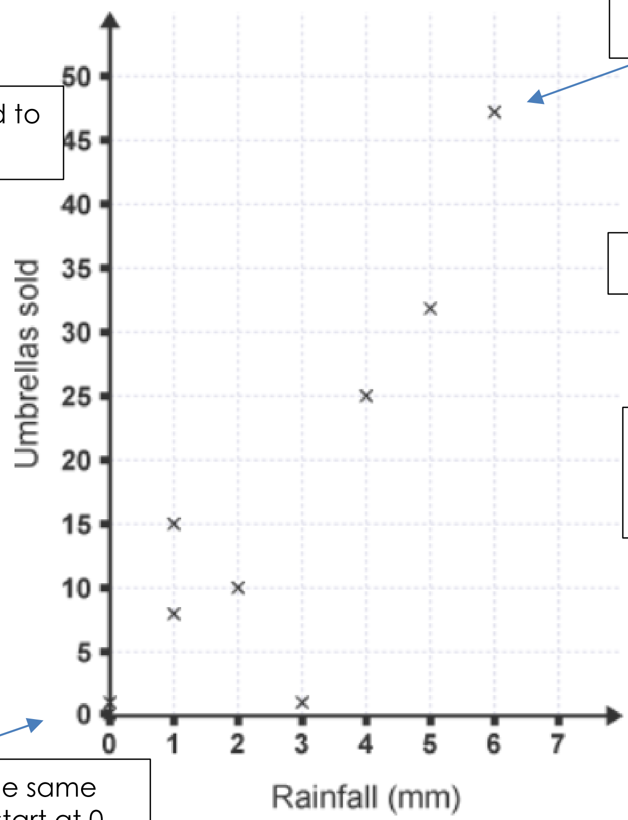
The number of umbrellas sold and the amount of rainfall on 9 days is shown on the scatter graph.

We plot each point using a small cross on the line, not in the middle of squares.

Both axes need to be labelled to show what the data is about.

DO NOT join the points up.

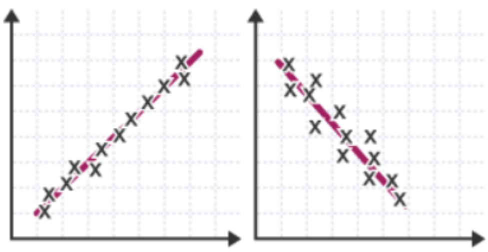
We use a **line of best fit** to recognise correlation and to estimate data.



The scales do not need to be the same on both axes but they need to start at 0.

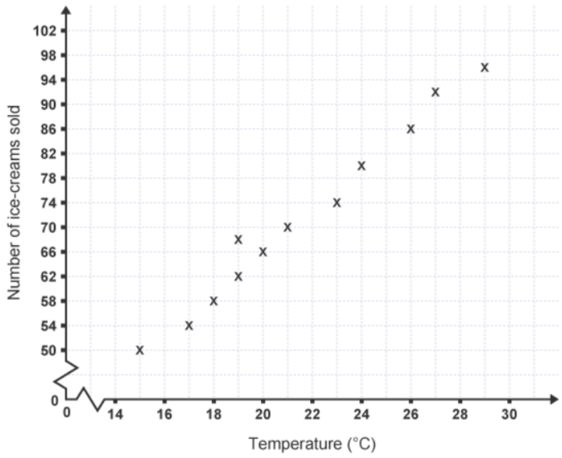
Lines of best fit

A **line of best fit** is a sensible straight line that goes as centrally as possible through the coordinates plotted. It should also follow the same steepness of the crosses.



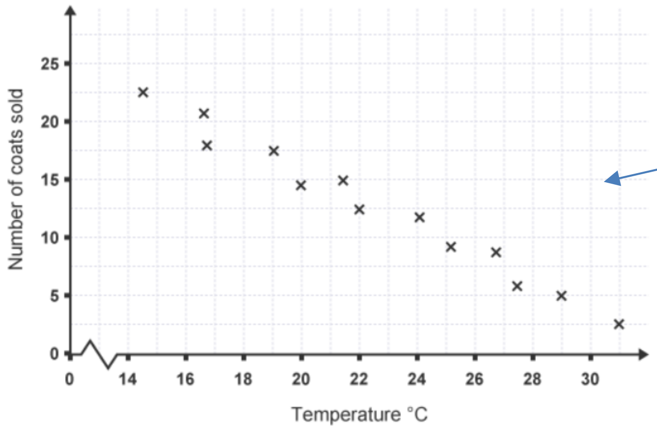
Correlation

Positive correlation means as one variable increases, so does the other variable. They have a positive connection.



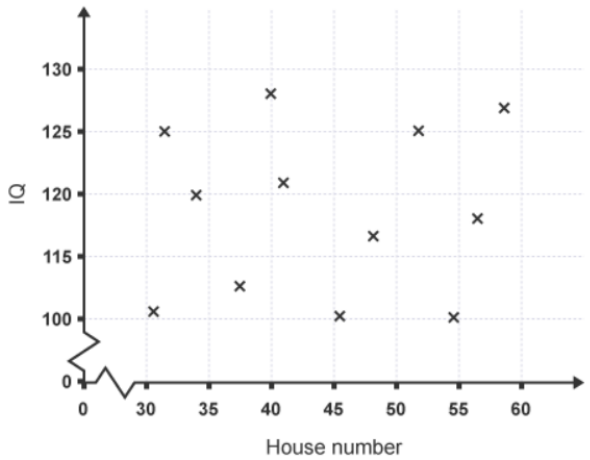
The data is sloping upwards to the right

Negative correlation means as one variable increases, the other variable decreases. They have a negative connection.



The data is sloping downwards to the left

No correlation means there is no connection between the two variables.



The data is scattered and does not follow any pattern.

Spreadsheets, Computer Drawn Graphs & Diagrams

It is very common to use **Excel** or other spreadsheets to draw graphs to represent data.

Formulas

Every formula that you use in Excel must start with "="
Each entry into the spreadsheet has a cell reference, eg. cell B13 which has a value of £55.
The advantage of using formulas in Excel rather than writing in the values is that the answer changes if the original data does. All calculations are then done automatically for you.

D22 *fx*

	A	B	C	D	E	F	G	H
1	Month	Gas (G)	Electric (E)	Total Price of G and E				
2	January	£ 45.00	£ 34.00					
3	February	£ 56.00	£ 35.00					
4	March	£ 56.00	£ 45.00					
5	April	£ 45.00	£ 43.00			Average Gas Price		
6	May	£ 34.00	£ 34.00			Maximum Gas price		
7	June	£ 53.00	£ 32.00			Minimum electric price		
8	July	£ 45.00	£ 47.00					
9	August	£ 67.00	£ 45.00					
10	September	£ 65.00	£ 43.00					
11	October	£ 33.00	£ 23.00					
12	November	£ 44.00	£ 46.00					
13	December	£ 55.00	£ 50.00					
14	Total							
15								
16								
17								
18								
19								

Simple formulas

To work out the total price of G and E (column D), which will be £45 +£34, you need to find out the cell reference for each part of the equation. £45 is B2 and £34 is C2.
You are going to write the formula in D2.
So, the formula that you will input into cell D2 is "=B2+C2", which will produce the answer.
You are going to use the same formula for the whole of column D.

D2 =B2+C2

	A	B	C	D
1	Month	Gas (G)	Electric (E)	Total Price of G and E
2	January	£ 45.00	£ 34.00	£ 79.00
3	February	£ 56.00	£ 35.00	
4	March	£ 56.00	£ 45.00	
5	April	£ 45.00	£ 43.00	
6	May	£ 34.00	£ 34.00	
7	June	£ 53.00	£ 32.00	
8	July	£ 45.00	£ 47.00	
9	August	£ 67.00	£ 45.00	
10	September	£ 65.00	£ 43.00	
11	October	£ 33.00	£ 23.00	
12	November	£ 44.00	£ 46.00	
13	December	£ 55.00	£ 50.00	
14	Total			

If you click on the little black dot in the corner of cell D2 and drag it down to cell D13, the formula will replicate, saving you from inputting the formula into every cell.

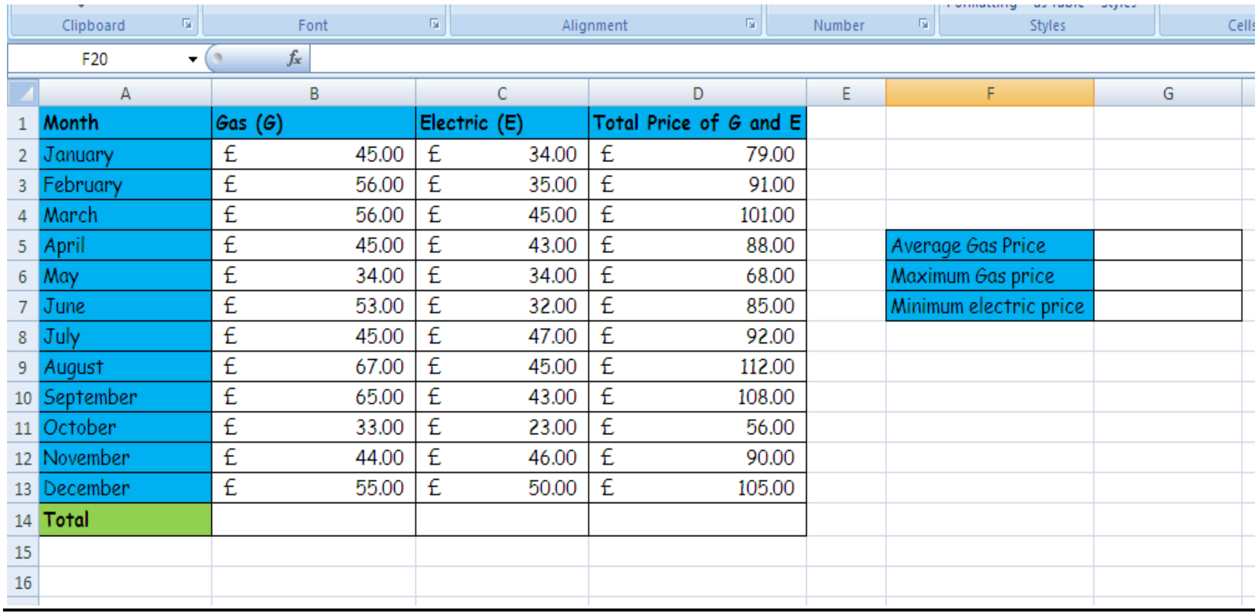
The following formulas have the same format as the addition formula.
Subtraction example: "=B2-C2"
Multiplication example: "=B2*C2"
Division example: "=B2/C2"

D19

	A	B	C
1	Month	Gas (G)	Electric (E)
2	January	£ 45.00	£ 34.00
3	February	£ 56.00	£ 35.00
4	March	£ 56.00	£ 45.00
5	April	£ 45.00	£ 43.00
6	May	£ 34.00	£ 34.00
7	June	£ 53.00	£ 32.00
8	July	£ 45.00	£ 47.00
9	August	£ 67.00	£ 45.00
10	September	£ 65.00	£ 43.00
11	October	£ 33.00	£ 23.00
12	November	£ 44.00	£ 46.00
13	December	£ 55.00	£ 50.00
14	Total		

To work out the Total Price of Gas used that year. You need to use the formula
"=SUM (B2:B13)"
To work out the Total price of electric that year
"=SUM (C2:C13)"

Average, Minimum and Maximum Formulas



	A	B	C	D	E	F	G
1	Month	Gas (G)	Electric (E)	Total Price of G and E			
2	January	£ 45.00	£ 34.00	£ 79.00			
3	February	£ 56.00	£ 35.00	£ 91.00			
4	March	£ 56.00	£ 45.00	£ 101.00			
5	April	£ 45.00	£ 43.00	£ 88.00		Average Gas Price	
6	May	£ 34.00	£ 34.00	£ 68.00		Maximum Gas price	
7	June	£ 53.00	£ 32.00	£ 85.00		Minimum electric price	
8	July	£ 45.00	£ 47.00	£ 92.00			
9	August	£ 67.00	£ 45.00	£ 112.00			
10	September	£ 65.00	£ 43.00	£ 108.00			
11	October	£ 33.00	£ 23.00	£ 56.00			
12	November	£ 44.00	£ 46.00	£ 90.00			
13	December	£ 55.00	£ 50.00	£ 105.00			
14	Total						
15							
16							

To work out the minimum value of a set of data you need to use "=MIN (_:_)". Eg. To find the minimum value for electric that year, you use the formula "=MIN (C2:C13)"

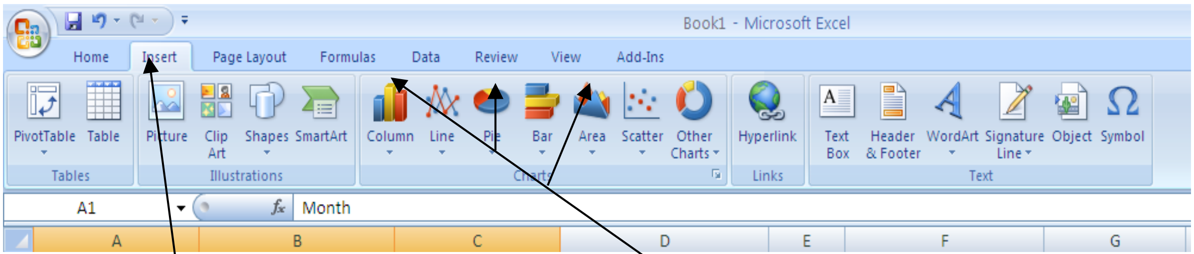
To work out the maximum value of a set of data you need to use "=MAX (_:_)" Eg. To find out the maximum value for gas that year, you use the formula "=MAX (B2:B13)"

To work out the average value for a set of data you need to use "=AVERAGE (_:_)" Eg. To find out the average value for gas used that year, you use the formula "=AVERAGE(B2,B13)"

Creating graphs in Excel

To create a graph in Excel you need to highlight the data that you wish to have in your graph. You do this by holding the left-hand button on the mouse and dragging over the data.
Eg. You want to create a graph that shows you the gas and electric prices all the months in the year.

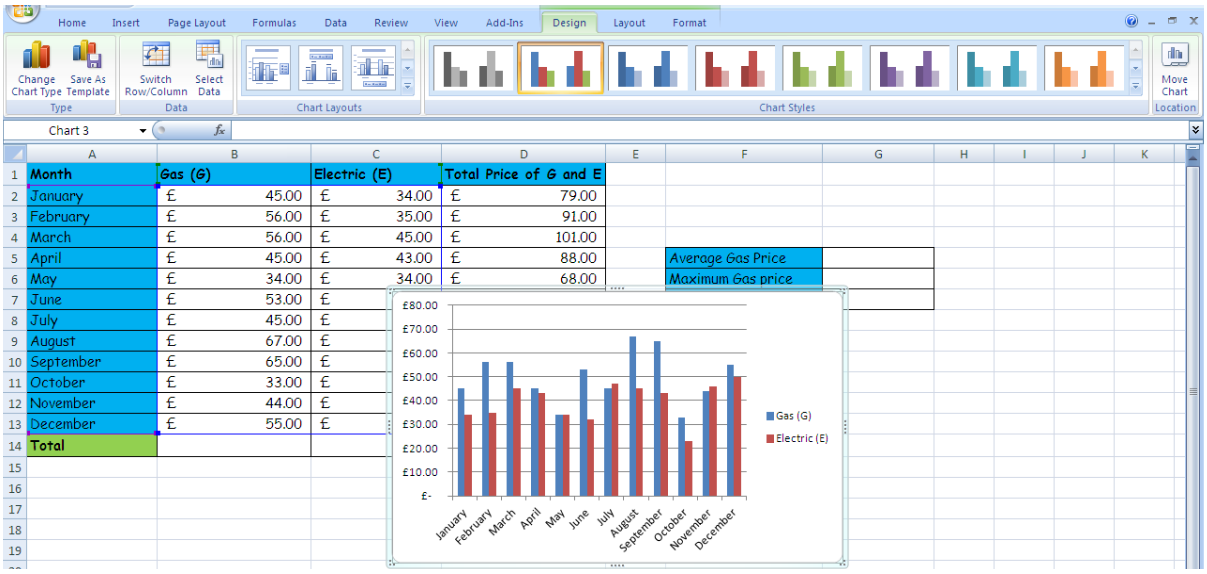
	A	B		C		D	
1	**Month**	**Gas (G)**		**Electric (E)**		**Total Price of G and E**	
2	January	£	45.00	£	34.00	£	79.00
3	February	£	56.00	£	35.00	£	91.00
4	March	£	56.00	£	45.00	£	101.00
5	April	£	45.00	£	43.00	£	88.00
6	May	£	34.00	£	34.00	£	68.00
7	June	£	53.00	£	32.00	£	85.00
8	July	£	45.00	£	47.00	£	92.00
9	August	£	67.00	£	45.00	£	112.00
10	September	£	65.00	£	43.00	£	108.00
11	October	£	33.00	£	23.00	£	56.00
12	November	£	44.00	£	46.00	£	90.00
13	December	£	55.00	£	50.00	£	105.00
14	**Total**						
15							



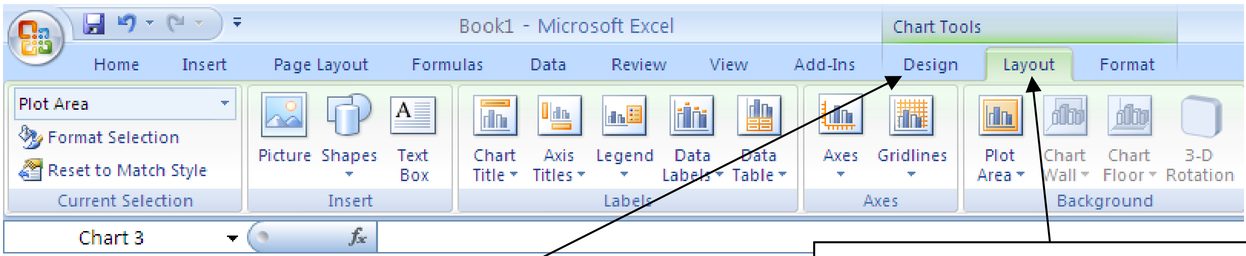
1. Once you have selected the data, you need to click on insert on the

2. Select the graph you wish to create.

Once you have selected the graph type, the graph will automatically come up on your spreadsheet.

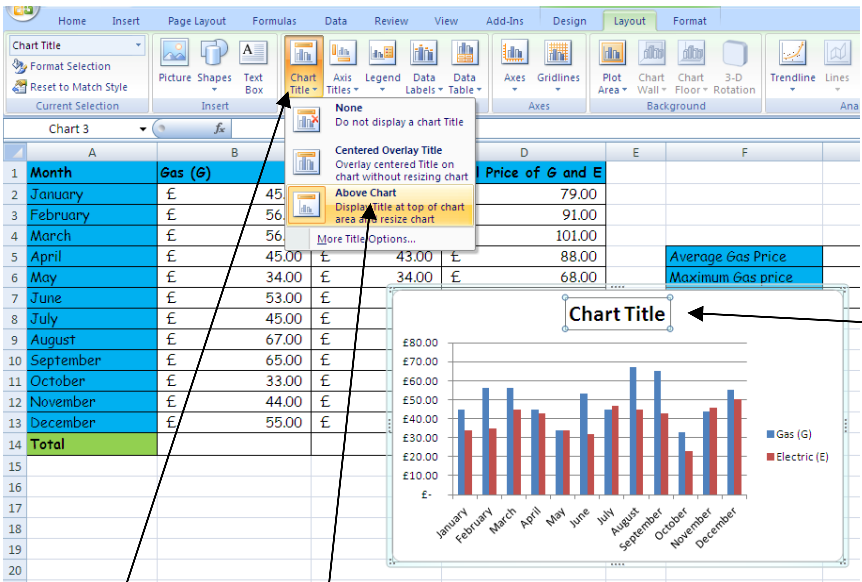


To label the axis, and change the colours of the graph you need to click on the following buttons in the toolbar.



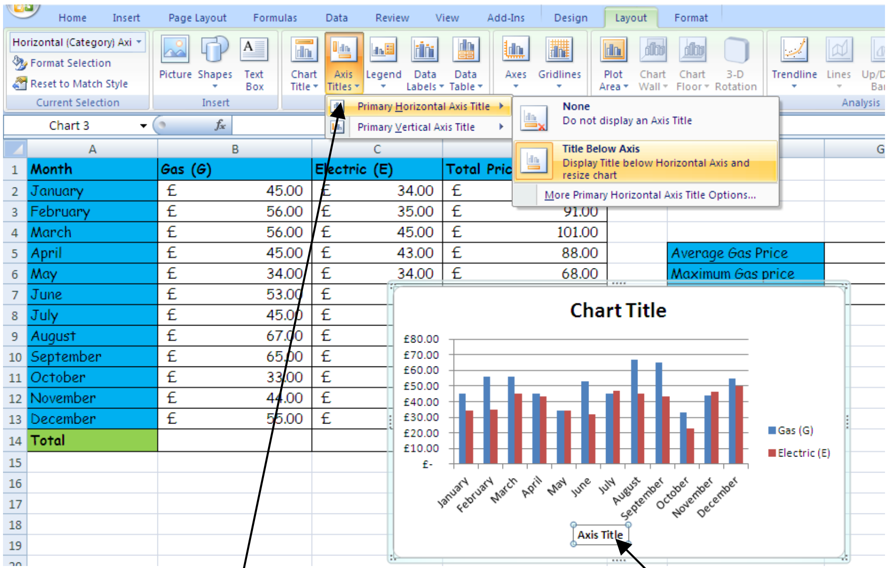
Clicking on the design button will enable you to change the colours of the graph.

Clicking on the layout button on the toolbar will enable you to label your graph and



2. Double click on 'Chart title' and enter your title.

1. Select chart Title and select where you want your title to go on the



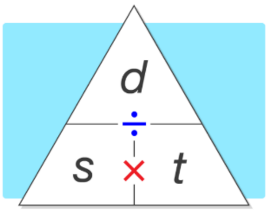
Select axis title from the toolbar and select which axis you wish to label, then select where you want to put the

2. Double click on ‘axis title’ and enter your axis title.

Speed, distance, time

Speed tells us how **fast** something or someone is travelling. You can find the average speed of an object if you know the **distance** travelled and the **time** it took.

We can use a triangle to help us remember our formula



The formula can be rearranged in three ways:

- **speed** = distance ÷ time
- **distance** = speed × time
- **time** = distance ÷ speed

We must always include units on our answer. For speed we use the distance and time for our units.

Example

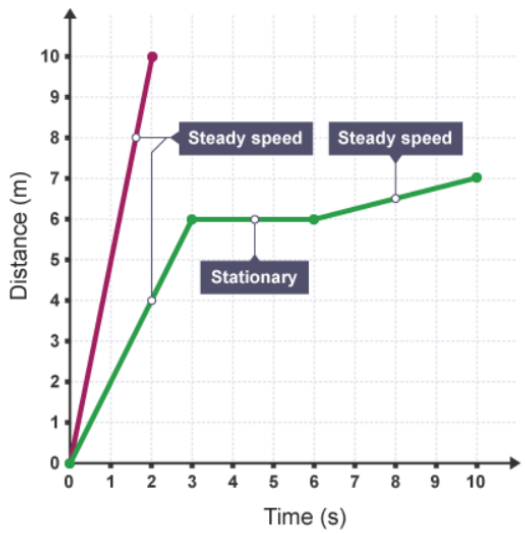
Work out the speed of a car which travelled for 150 miles in 2 hours.

Step 1 → We want to work out the speed so use the formula **speed = distance ÷ time**

Step 2 → Substitute the values, **Speed = 150 miles ÷ 2 hours**

Step 3 → Speed = 75 miles per hour which we shorten to **75mph.**

Distance-time graphs



In a distance time graph, the lines which are sloping show the object is moving over time.
If the line is flat the object is stationary

Histograms

Histograms are a way of representing data. They are like bar charts, but show the frequency density instead of the frequency. They can be used to determine information about the distribution of data.

A histogram is drawn like a bar chart, but often has bars of unequal width. It is the area of the bar that tells us the frequency in a histogram, not its height.

To work out the frequency density which we plot on the y axis we use the formula:

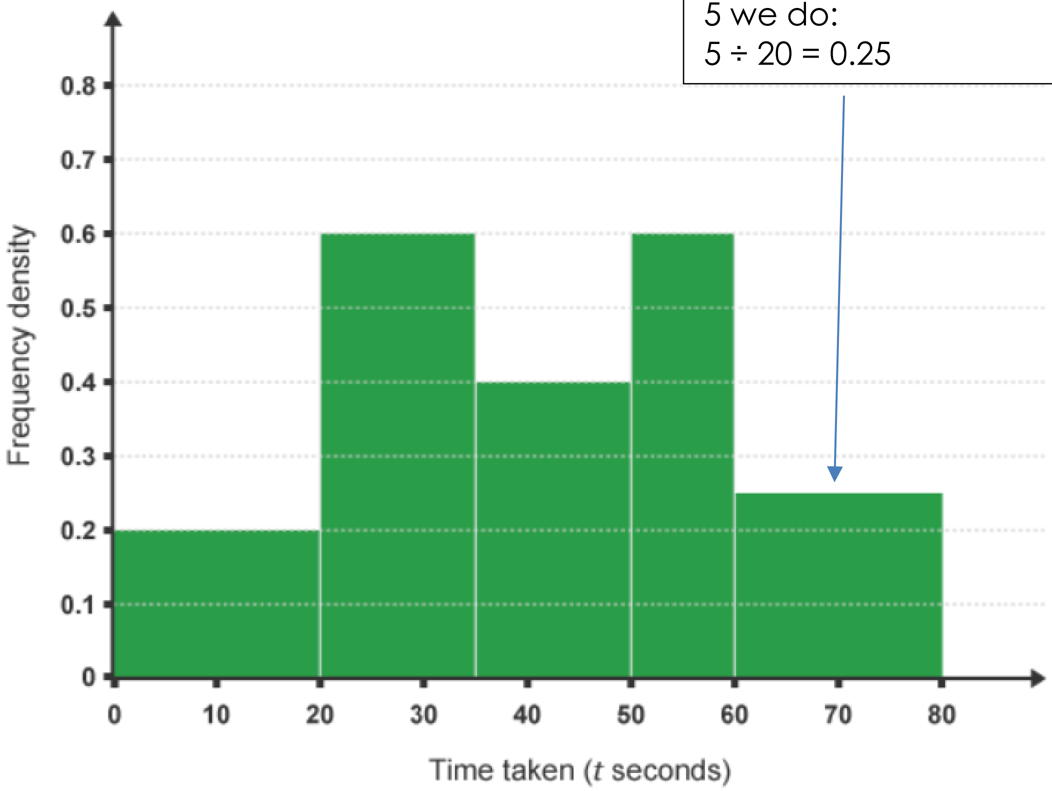
$$\text{Frequency density} = \text{frequency} \div \text{group width}$$

The group width is the difference between the values in each group.

Time taken (t seconds)	$0 < t \leq 20$	$20 < t \leq 35$	$35 < t \leq 50$	$50 < t \leq 60$	$60 < t \leq 80$
Frequency	4	9	6	6	5

The group width for $60 < t \leq 80$ is 20 because this is the difference between 60 and 80.

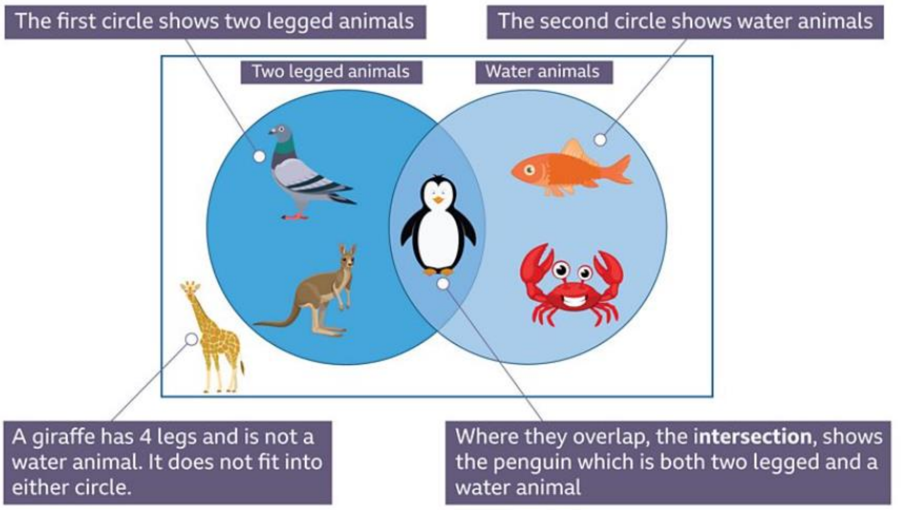
As the frequency for this group is 5 we do:
$5 \div 20 = 0.25$



Venn diagrams

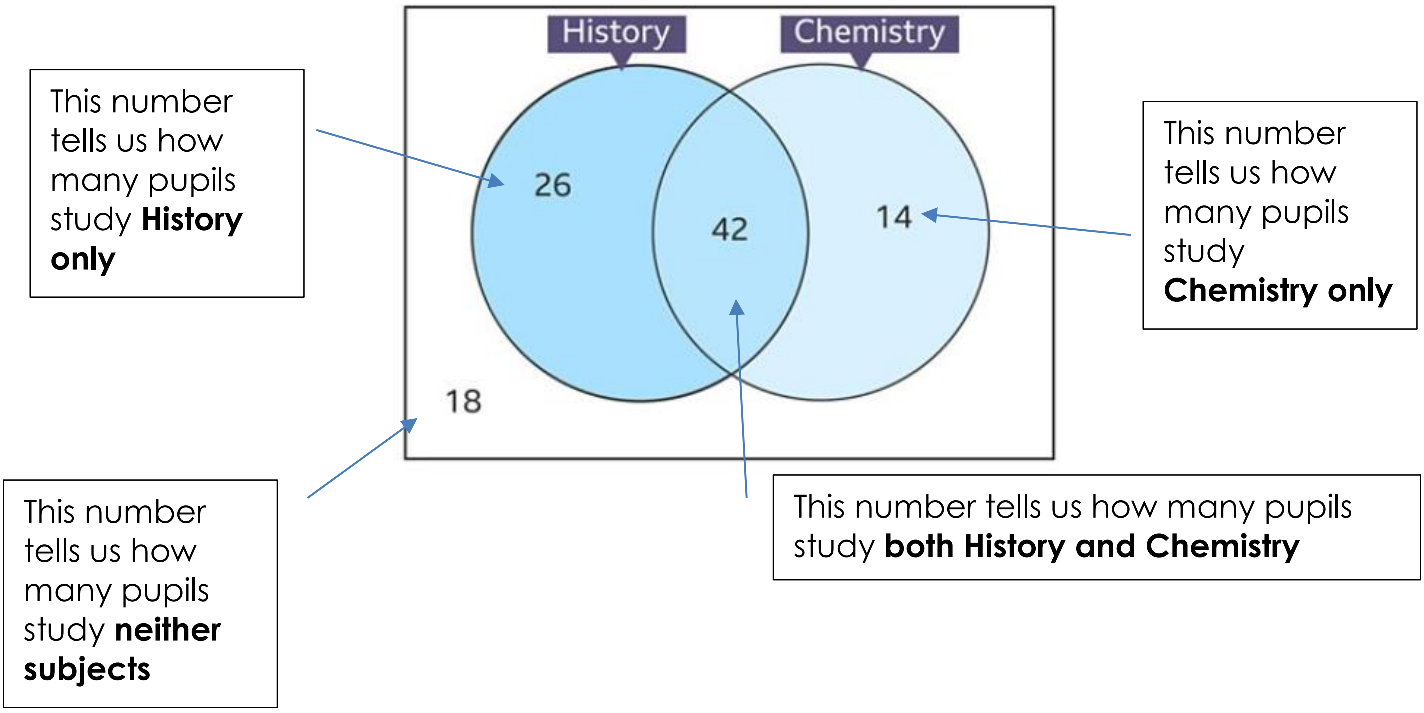
A Venn diagram shows the relationship between groups of different things.

They are used in many areas of life to classify items as well as highlighting similarities and differences.



Venn diagrams can be used to solve mathematical problems

For example, here is a Venn diagram showing the subjects studied by pupils in a year group. If we wanted to work out how many pupils there is in total we can add together all of the numbers in the diagram.



Metric and imperial measures

We use a range of measures and in the UK there are a number of imperial measures that are in common use. Metric conversions should be learned.
Here are some of the most common…

LENGTH

Metric
1 centimetre (cm) = 10 millimetres (mm)
1 metre (m) = 100 cm
1 kilometre = 1000m

Imperial
1 foot = 12 inches
1 yard = 3 feet
1 mile = 1760 yards

Metric/Imperial
1 inch ≈ 2.54cm
5 miles ≈ 8 km

MASS

Metric
1 gram (g) = 1000 milligrams (mg)
1 kilograms (kg) = 1000g
1 tonne = 1000 kilograms

Imperial
1 pound (lb) = 16 ounces (oz)
1 stone = 14 lb
1 ton = 2240 lb

Metric/Imperial
1kg ≈ 2.2 lb

CAPACITY

Metric
1 litre = 1000 millilitre (ml)
1 litre = 100 centilitres (cl)
1 centilitre = 10 millilitres

Imperial
1 gallon = 4.5 pints

Metric/Imperial
1 litre = 1.75 pints

2D shapes

Quadrilaterals – 4 sided shapes. Angles in any quadrilateral add up to 360°

Square

a **square** is the only regular quadrilateral

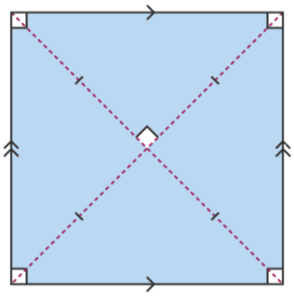
all angles are equal (90°)

all sides are of equal length

opposite sides are parallel

the diagonals bisect each other at 90°

the diagonals are equal in length



Rectangle

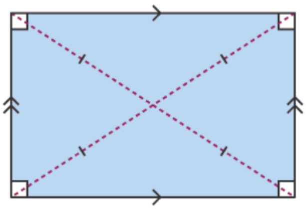
with a **rectangle**, all angles are equal (90°)

opposite sides are of equal length

the diagonals are equal in length

opposite sides are parallel

the diagonals bisect each other



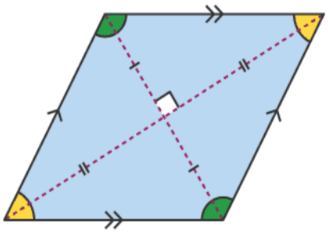
Rhombus

with a **rhombus**, all sides are of equal length

opposite sides are parallel

diagonally opposite angles are equal

the diagonals bisect each other at 90°



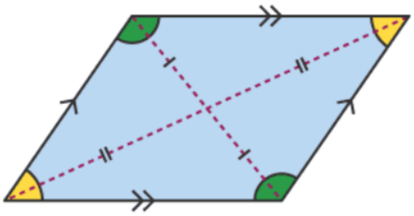
Parallelogram

with a **parallelogram**, diagonally opposite angles are equal

opposite sides are of equal length

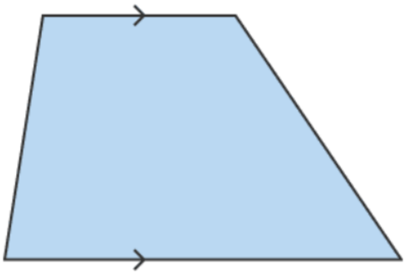
opposite sides are parallel

the diagonals bisect each other



Trapezium

with a **trapezium**, one pair of opposite sides is parallel



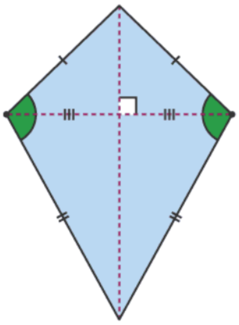
Kite

with a **kite**, two pairs of sides are of equal length

one pair of diagonally opposite angles is equal

only one diagonal is bisected by the other

the diagonals cross at 90°

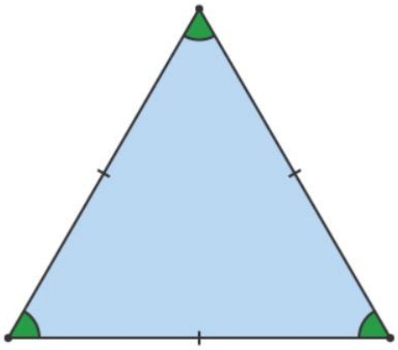


Triangles

The angles in any triangle add up to 180˚

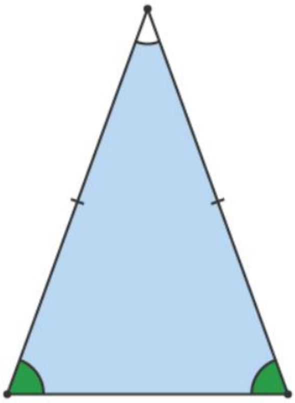
Equilateral triangle

- all sides are of equal length
- all angles are equal (60°)



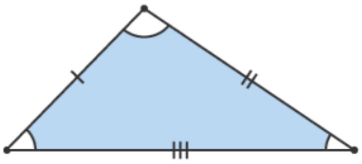
Isosceles triangle

- two sides are of equal length
- two angles are equal (called the base angles)



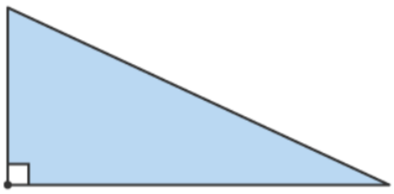
Scalene triangle

- the three sides are all different lengths
- none of the angles are equal



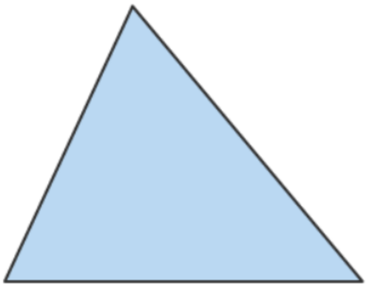
Right-angled triangle

- contains a right angle
- can be either isosceles or scalene



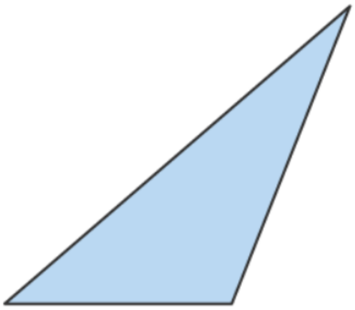
Acute-angled triangle

- all three angles are **acute**
- can be equilateral, isosceles or scalene



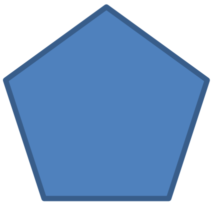
Obtuse-angled triangle

- contains an **obtuse angle**
- can be either isosceles or scalene

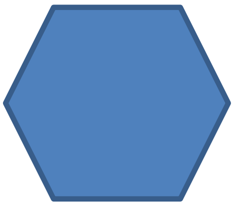


Polygons

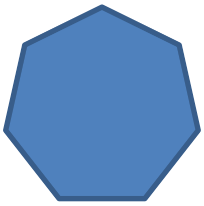
Pentagon – 5 sides



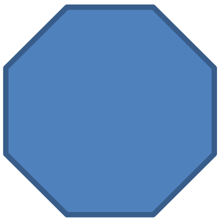
Hexagon – 6 sides



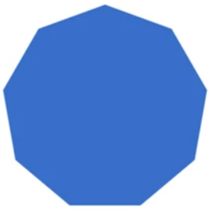
Heptagon – 7 sides



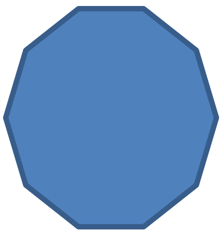
Octagon – 8 sides



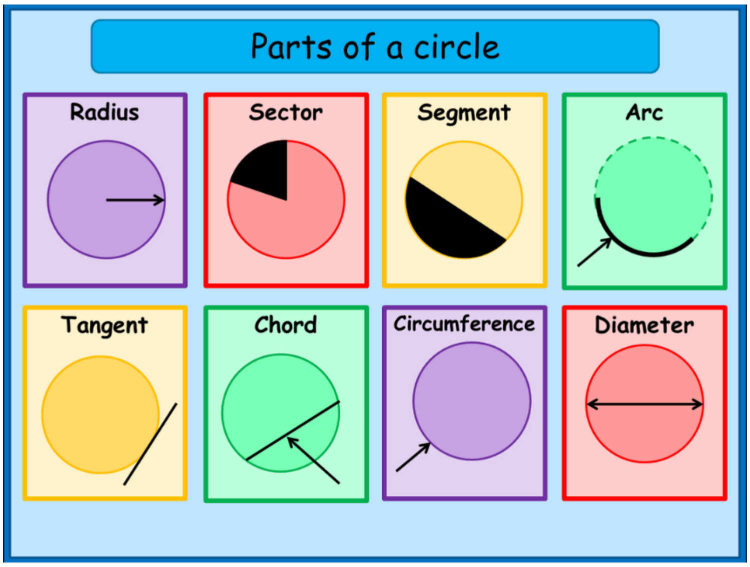
Nonagon – 9 sides



Decagon – 10 sides



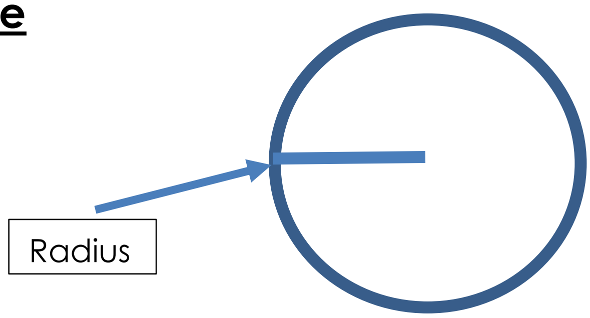
Circles



When working with circles we use Pi, which is represented using this symbol π. The value of π is approximately 3.14 and represents the relationship between a circle's diameter and its circumference.

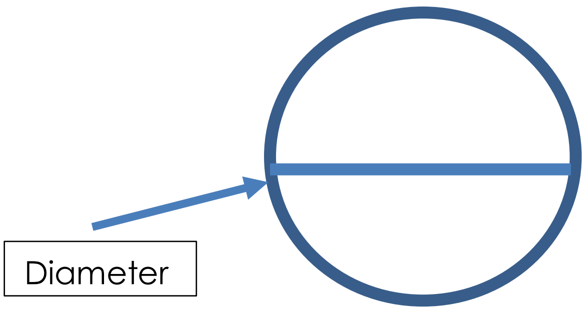
Working out the area of a circle

Area of a circle = π x radius²



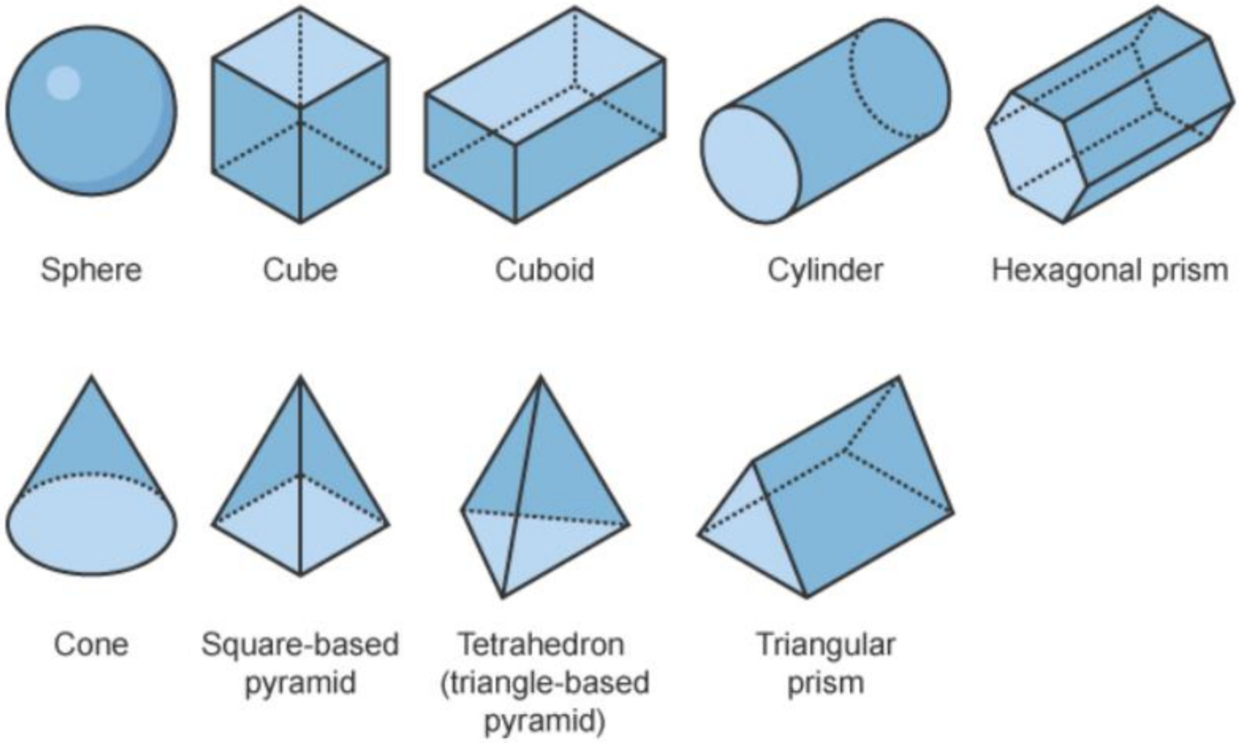
Working out the circumference of a circle

Area of a circle = π x diameter



3D shapes

Here are some common solid shapes.

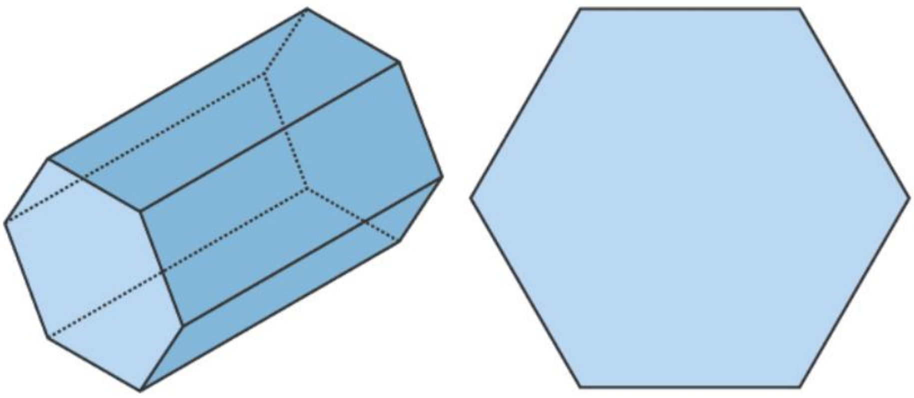


Prisms

A **prism** is a 3D shape which has a constant cross section - both ends of the solid are the same shape and anywhere you cut parallel to these ends will give you the same shape.

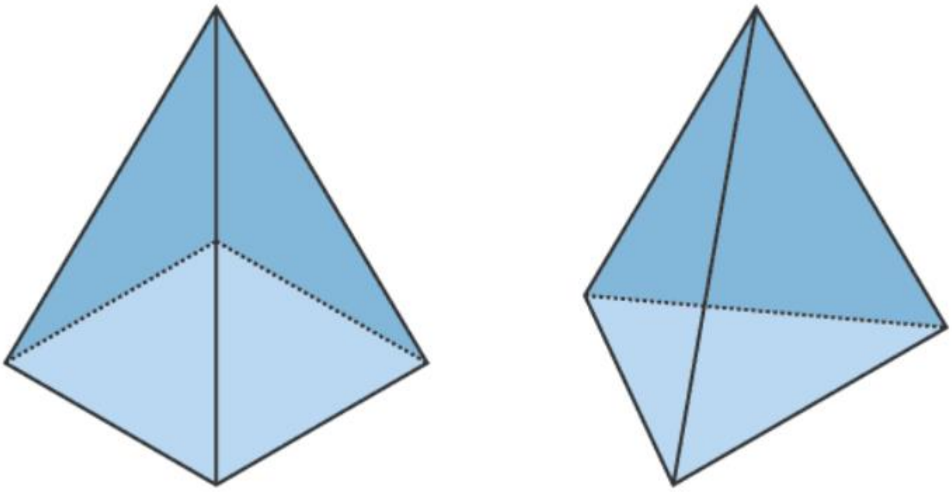
For example, in the prism below, the cross section is a hexagon.

This is called a **hexagonal prism**.



Pyramids

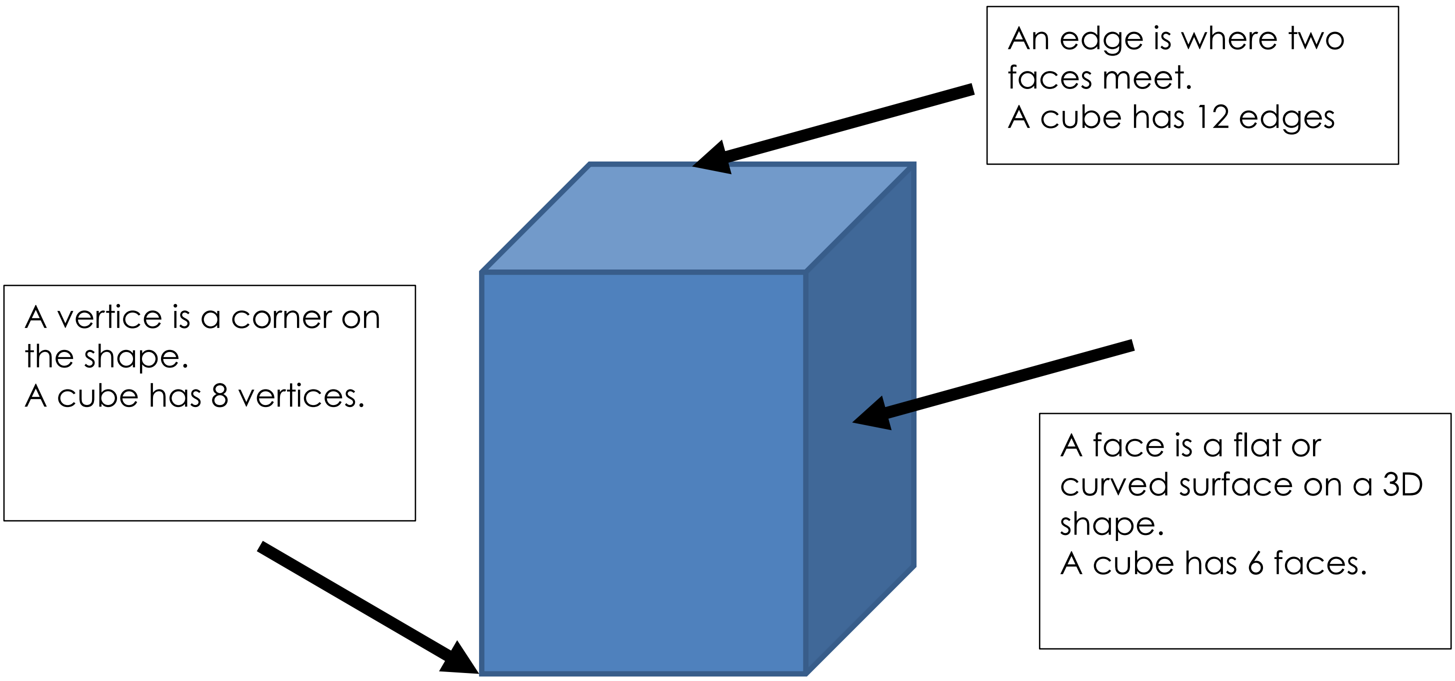
A **pyramid** has sloping faces that meet at a vertex.



Square-based pyramid   Tetrahedron

Properties of 3D shapes

We identify faces, edges and vertices on 3D shapes.

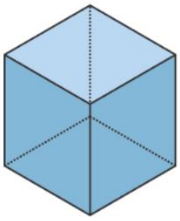


Nets

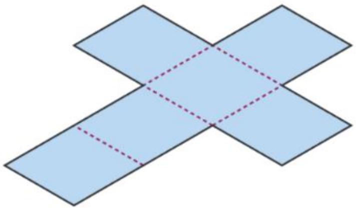
Some 3D shapes, like cubes and pyramids, can be opened or unfolded along their edges to create a flat shape.

The unfolded shape is called the **net** of the solid.

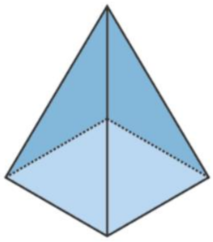
Here are some 3D shapes and their nets.



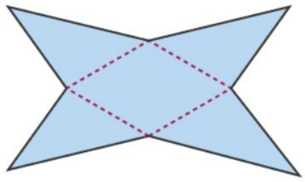
Cube



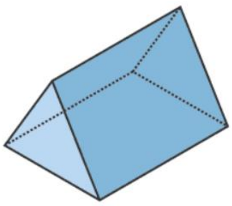
Net of a cube



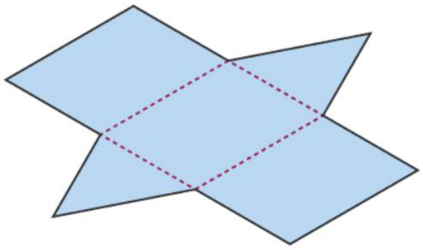
Square-based pyramid



Net of a square-based pyramid



Triangular prism

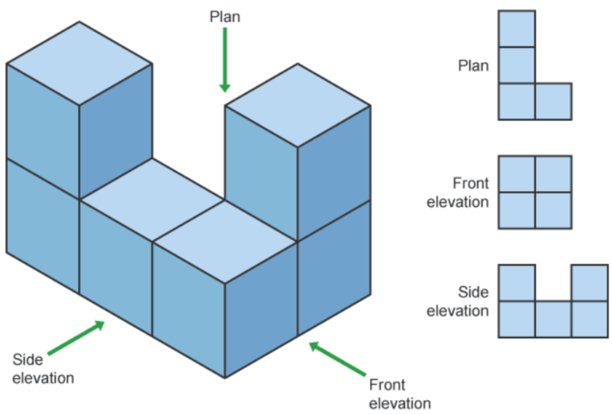


Net of a triangular prism

2D representations of 3D shapes

When architects design buildings, they often sketch 2D drawings to show what the building will look like from each side. These drawings are called **plans** and **elevations**.

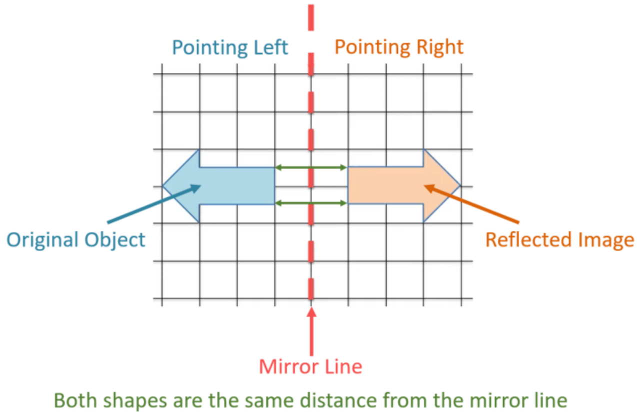
- The view from the **top** is called the plan.
- The view from the **front** and **sides** are called the elevations (front elevation and side elevation).



Transformations

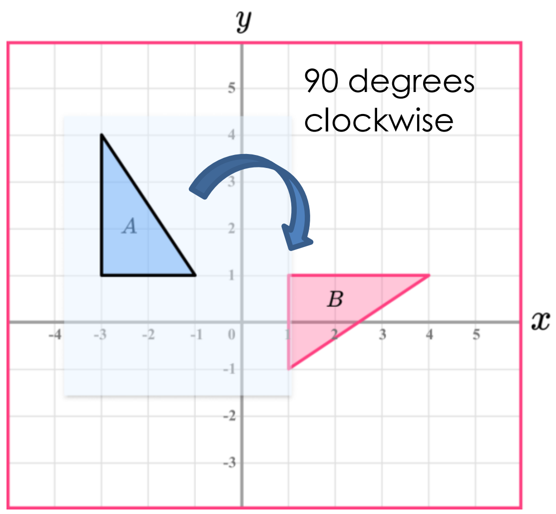
Reflection

Images of shapes that are formed by reflecting a given shape about a line of reflection (or mirror line) are called reflections of the shapes.
Lines of symmetry can be identified in images where reflection has already taken place. When an object is reflected, the lengths and the angles remain the same.



Rotation

A rotation can be described as a fraction of a turn or as an angle of a turn eg. 90 degrees is a quarter turn, 180 degrees is a half turn, and 270 degrees is three quarters of a turn. The direction can be described as clockwise or anticlockwise.
The point about which the shape is turned is called the centre of rotation and is often given as a coordinate.
When an object is rotated, the lengths and the angles remain the same, but the shape is turned.



Translation

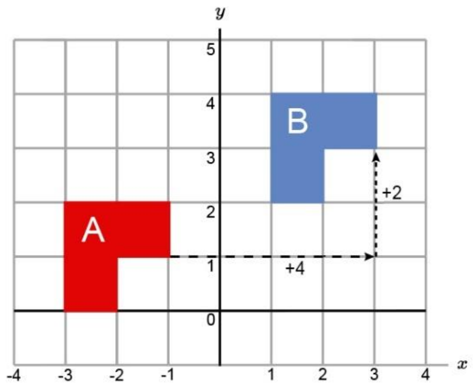
A translation is a sliding movement made from one or more moves. Both the direction and the distance need to be described for each move.

Translations can be described using column vectors, for example $\binom{3}{2}$.

The top number describes the movement to the right, the bottom number describes the movement up.

A negative number means movement in the opposite direction (left and down).

When an object is translated, the lengths and the angles remain the same.

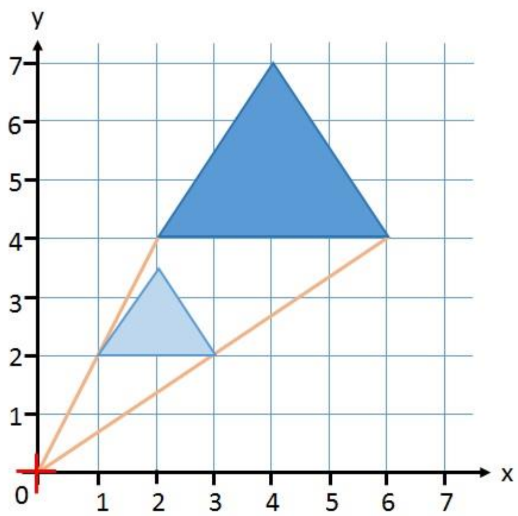


Enlargement

An enlargement changes the size of the shape. It changes the lengths of the sides but not the shape.

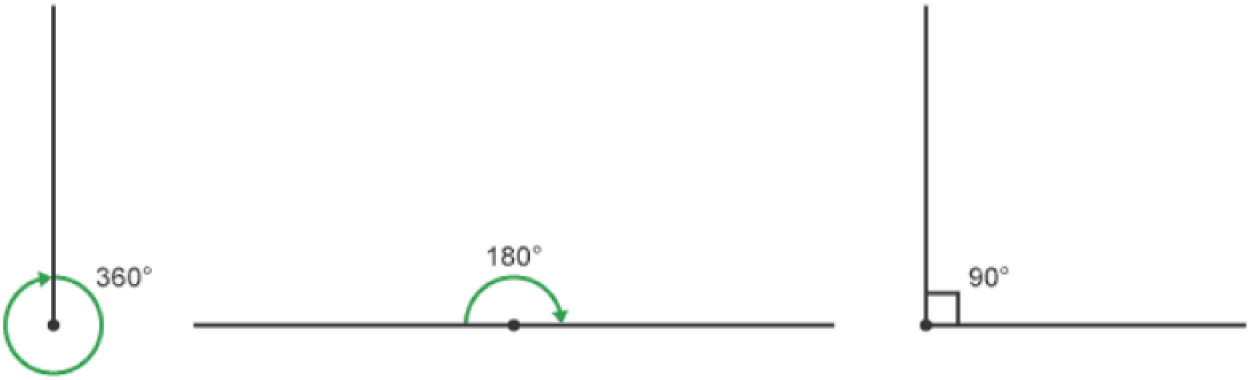
The scale factor of the enlargement is the number by which the lengths are multiplied by to get the lengths in the image.

For example, a scale factor of 2 means all the lengths are doubled. Shapes can be enlarged from a point called the centre of enlargement.

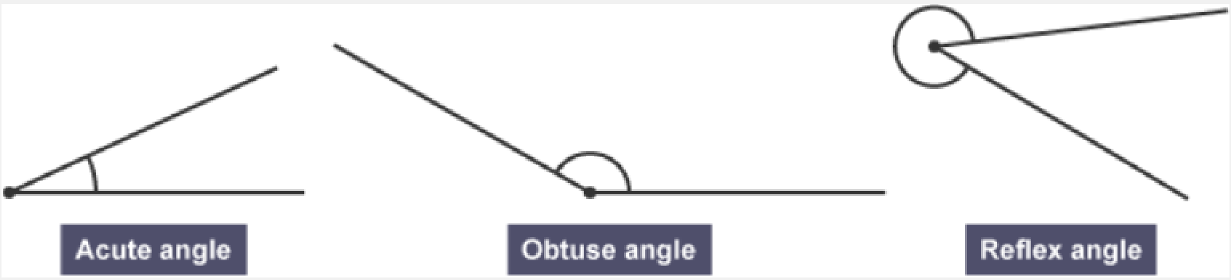


<u>Angles</u>

There are 360° in a full turn, 180° in a half turn and 90° in a quarter turn. A quarter turn is called a **right angle**.



There are three different types of angle.



An **acute angle** is an angle less than 90°.

An **obtuse angle** is an angle between 90° and 180°.

A **reflex angle** is an angle between 180° and 360°.

Angles at a point

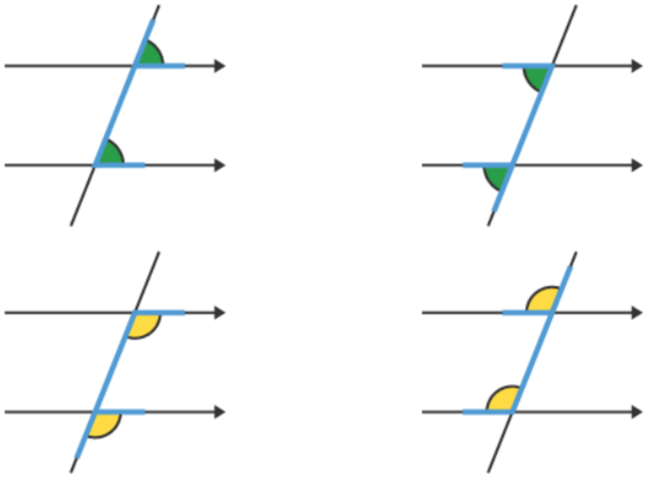
<u>Angles</u> around a point add up to 360°. This fact can be used to calculate missing angles.

Angles on a straight line

Angles on a straight line add up to 180°. This fact can also be used to calculate angles.

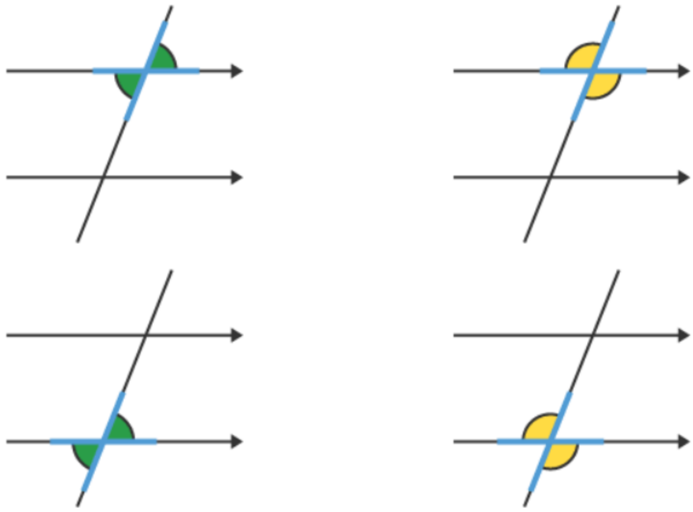
Corresponding angles

Corresponding angles are equal. The lines make an **F shape**.
Notice that the F shape can be upside down or back to front.



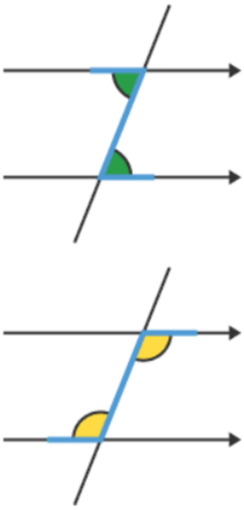
Vertically opposite angles

Vertically opposite angles are equal.



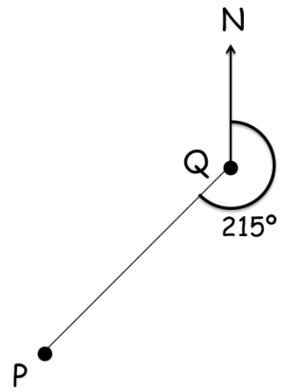
Alternate angles

Alternate angles are equal. The lines make a **Z shape** which can also be back to front.



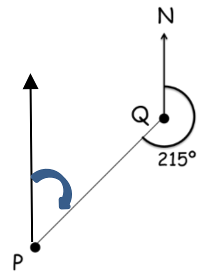
Bearings

Bearings are used to describe directions with angles.
They are more precise than using North, South, East and West. Bearings are always measured clockwise, from the North line and must have 3 digits.
For example, 50° must be written as 050°.



To correctly read and write bearings, we must ensure we look at the direction of the bearing.
The bearing to the right is going **from Q to P**. We know this as the north line is drawn at Q and measured clockwise from there.

To calculate the bearing of **Q from P**, we would need a north line at P, and to measure clockwise from P. (see below)



Scale drawing

Maps and plans are accurate drawings from which measurements can be made.

A scale is a ratio which shows the relationship between the length of the drawing (or model) and the length in real life.

On this map, for every 4cm, the real distance would be 1km (1000m).
This would mean for every 1cm, the distance would be 250m in real life.

To work out a distance on this map you would measure the distance in cm and then multiply by 250 to get the distance in metres.

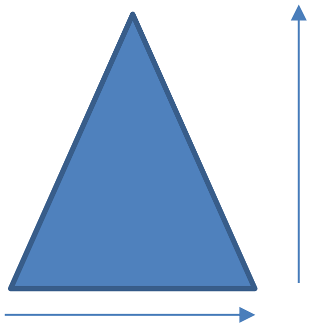
Area and Perimeter

Perimeter is the distance around the outside of a 2D shape.

Area is the space inside a 2D shape.

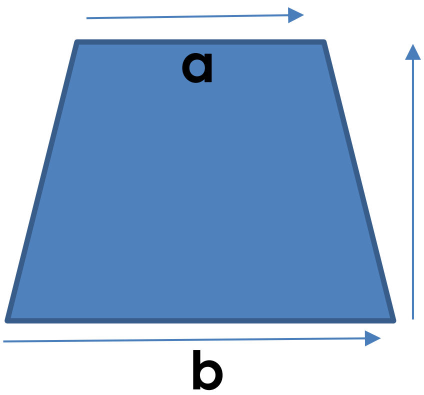
Formulas for area

Area of a rectangle = length x width



Area of a triangle = (base x height) ÷ 2

Area of a parallelogram = base x height



Area of a trapezium = $\frac{(a + b) \text{ x height}}{2}$

Probability

Probability is the maths of chance. A probability is a number that tells you how likely (probable) something is to happen. Probabilities can be written as fractions, decimals or percentages.

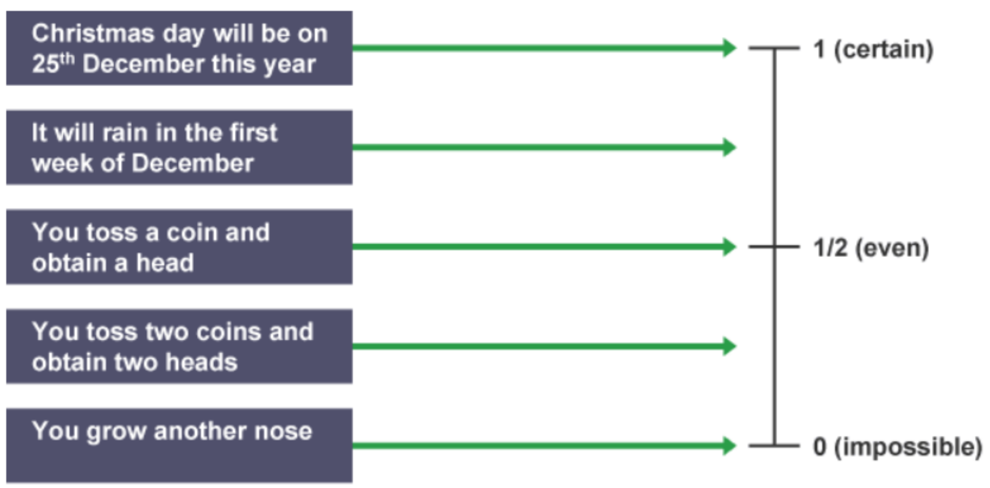
Where we cannot predict for certain what might happen, we can use terms such as: very likely, likely, possible, unlikely, very unlikely instead.

To calculate probability, we need to follow three simple steps:

- Identify an event with at least one possible outcome (rolling a 6 on a die)
- Find the number of outcomes that can happen from the event (six total outcomes because there are six numbers on a die)
- Divide the total number of events by the total number of possible outcomes (one event divided by the six possible outcomes that could occur. This results in a fraction of 1/6).

The probability scale

You can use a probability scale, starting at 0 (impossible) and ending at 1 (certain) to represent different events.



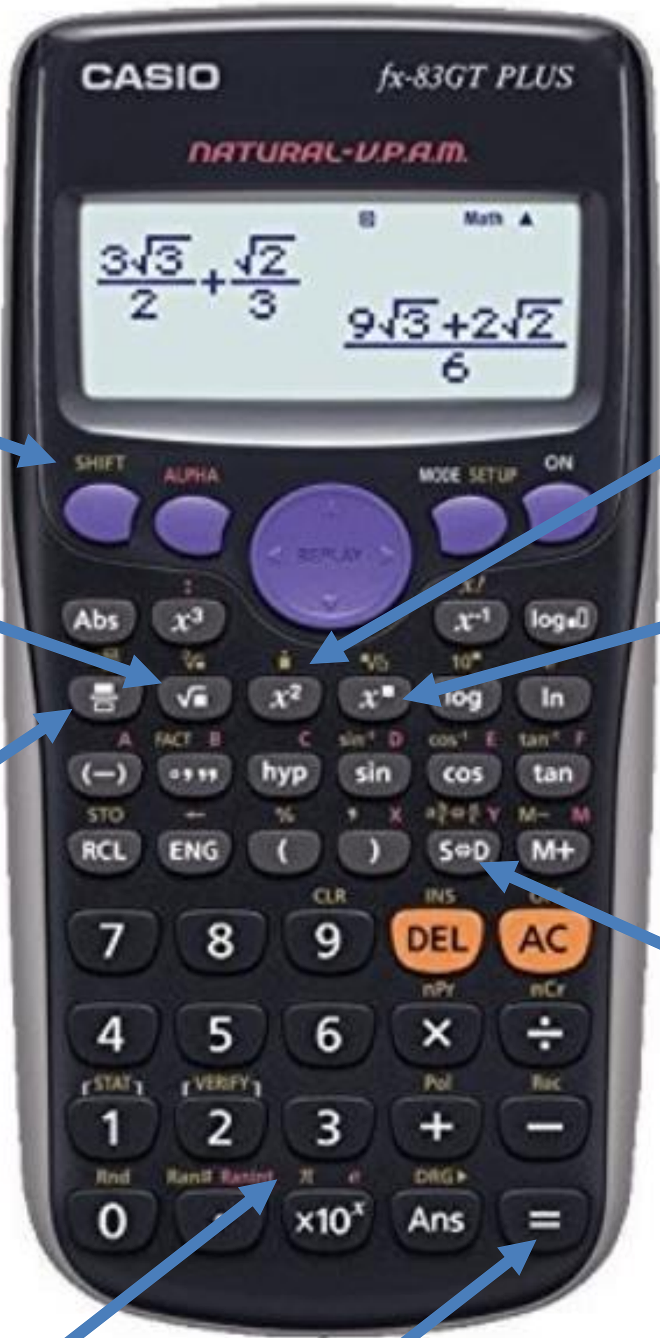
<u>Using a calculator</u>

To access any of the yellow functions you need to press the shift button first

The x^2 button is used to square a number. Eg 15^2 we would press 15 and then this button and then equals

To square root a number we press this √ button and then put the number you wish to square root.

For any power larger than 3, we use the $x^{\blacksquare}$ button. Eg 10^4 we would press 10, this button and then 4. Then equals



To get a fraction we press this button – and use the up and down keys to fill in the numbers.

If an answer comes out as a fraction and we want it as a decimal or whole number we press the S↔D button

To get the pi button π, we need to press shift and then this one as it is in yellow.

To get an answer we press the equals button.

Financial literacy

Financial literacy is the possession of the set of skills and knowledge that allows an individual to make informed and effective decisions with all of their financial resources.

In general, there are four main uses for money: **Spending, Investing, Saving, Giving Away**. Finding the right balance among these four categories is essential, and a budget can be a very useful tool to help you accomplish this.

Financial literacy vocabulary words

1. Annual percentage rate → Annual percentage rate, or **APR**, is the yearly interest rate charged on borrowed money. The rate is expressed as a percentage and indicates how much interest the borrower will pay over the course of a year.

2. Asset → An asset is any resource that holds value. In other words, assets contain value that can be converted into money. An individual, company, or country can own or control assets, which include things like cash, investments, art, technology, or property.

3. Budget → A budget is a plan for using income. It tracks how much income a person receives and details how that money will be allocated to pay for expenses, build savings, and meet financial goals.

4. Comparison shopping → Comparison shopping is a strategy that consumers can use to save money on purchases. It consists of comparing the prices of similar products to determine which is least expensive.

5. Credit score → A credit score is a three-digit number that represents how likely a borrower is to repay a debt. It is calculated based on the information in a borrower's credit report and ranges from 300 to 850. Borrowers with higher scores are viewed as more likely to repay debt obligations and are thus more likely to be approved for credit and receive lower interest rates.

6. Income → Income is money received through sources such as employment, investments, or business transactions. There are two ways to measure income: gross income and net income. Gross income is the total amount that's earned before expenses, taxes, and other costs. Net income is what remains after these expenses are deducted.

7. Interest → Interest is the percentage of a loan that lenders charge borrowers. There are two primary kinds of interest: simple interest and compound interest. Simple interest is calculated exclusively on the initial amount of money borrowed, while compound interest is calculated based on the loan principal plus the interest that accumulates each period. (see the next page for how we use this in school)

8. Need vs. want → One of the most basic concepts of personal finance is being able to differentiate between needs and wants. A "need" is defined as an essential expense, such as food or housing. A "want" is an expense that would be nice to have but isn't essential, such as designer clothing.

Simple and Compound interest

Simple interest is **a quick and easy method of calculating the interest charge on a loan**. Simple interest is determined by multiplying the daily interest rate by the principal by the number of days that elapse between payments.

For example,

£2000 is borrowed at 2.5% simple interest for 3 years

To work out how much would be needed to pay back after the 3 years we need to;

1) Work out 2.5% of the initial amount borrowed
2.5% of £2000
0.025 x 2000 = £50

2) Multiply this amount by three as it is borrowed over 3 years.
£50 x 3 = £150

3) Add this interest onto the initial amount to get the final amount that needs to be paid back
£2000 + £150 = £2150

With **Compound Interest**, you work out the interest for the first period, add it to the total, and then calculate the interest for the next period. There is a formula which can be applied to calculate this.

So, using the same amounts as above but for compound interest: £2000 is borrowed at 2.5% compound interest for 3 years

The initial amount borrowed or invested

We do: $£2000 \times 1.025^3$

Amount of years

As the amount is increased we start with 100% and add on the 2.5%.
100% as a decimal is 1
2.5% as a decimal is 0.025

So, the final amount to be paid back would be £2153.78

Maths vocabulary

A

Acute angle – An angle measuring less than 90°

Add/addition – To join two or more quantities to get the sum or total

Adjacent – Next to

Algebra – An area of maths where unknown quantities are represented by letters

Alternate angles – Equal angles within parallel lines that are identified by a Z shape

Angle – The amount of turning between two lines meeting at the same point

Anti-clockwise – The opposite direction to which hands move around a clock

Approximate – To estimate a number, usually through rounding

Arc – A section of the circumference of a circle

Area – The size of the space a surface takes up, measured in units squared

Ascending – Going up

Average – A summary of a set of data, either mode, median and mean

Axis – Reference lines on a graph

B

Bar graph – A graph using bars to show quantities for easy comparison

Bisect – To divide into two equal sections

Box plot – A diagram that uses a number line to show the distribution of data through the minimum, lower quartile, median, upper quartile and maximum

Brackets – Symbols used to enclose an expression, ( )

C

Calculate – Work out, find the value of

Calculator – A device that performs mathematical operations

Capacity – The amount a container can hold

Centimetre – A metric unit for measuring length

Centre – The middle

Certain – Inevitable, will definitely happen

Chance – The likelihood that a particular outcome will occur

Circle – A 2D shape whose edge is always the same distance from the centre

Circumference – The total distance around the outside of a circle

Chord – A straight line joining two points on the circumference of the circle, not through the centre

Clockwise - The direction which hands move around a clock

Common denominator – A denominator which is a multiple of the other denominators

Compasses (pair of) – A mathematical instrument used to draw circles

Cone – A 3D shape with a circular base which tapers to a single vertex at the top

Congruent – Having the same shape and the same size

Continuous data – Data which could have an infinite number of values with a particular range

Coordinates – Pairs of numbers used to show a position of a graph with axes

Corresponding angles– Equal angles within parallel lines that are identified by an F shape

Cross section – The face that results from slicing through a prism

Cube – A 3D shape with 6 square faces

Cuboid A 3D with 3 pairs of rectangular faces

Cube number – A number found by multiply a number by itself 3 times, eg $4^3 = 4 \times 4 \times 4 = 64$

Cylinder – A prism whose cross section is a circle

D

Data – A collection of information

Decagon – A 2D shape with 10 sides

Decimal – A part of a number or a whole, 0.4 or 3.279

Decrease – To make smaller

Degree – The unit with which angles are measured and represented using this symbol, ˚

Denominator – The bottom number of a fraction

Density - The degree of compactness of a substance, found by mass ÷ volume

Descending – Going down

Diagonal – A straight line joining two non-adjacent vertices

Diameter – A line going through a circle edge to edge that passes through the centre

Dice – A cube marked with dots or numbers

Digit – A symbol used to show a number, 1 2 3...

Discrete data - Data which has only a finite number of values

Divide/division – To share equally, ÷

Double – To multiply by 2

E

Edge – The part of a 3D shape where 2 faces meet

Equal to/equals – To have the same value, =

Equation - Two expressions that are equal to each other

Equilateral triangle – A triangle with 3 equal sides and 3 equal angles

Equivalent fractions – Two fractions representing the same proportion

Estimate – To find a close answer by rounding

Even number – A number in the 2x table

Even chance – An outcome shares the same probability of occurring with another

Expression (algebraic) – Made up of terms and operations (algebra)

Exterior angle – The angle formed outside a polygon when a side is extended

F

Face – The flat part of a 3D shape

Factor – A number that divides exactly into another

Formula – A mathematical rule to describe a relationship between quantities

Fraction – A part of a number or a whole, $\frac{3}{4}$

Frequency – The number of times a particular value appears in a set of data

G

Gradient – The slope of a line

Gram – A metric unit for measuring mass

Graph – A drawing or diagram used to record information

H

Half – To divide by 2

Hexagon – A 2D shape with 6 sides

Heptagon – A 2D shape with 7 sides

Highest common factor – The greatest of all the factors shared by a pair of numbers

Horizontal – A straight line parallel to the horizon

Hypotenuse – The longest side of a right-angled triangle

I

Impossible – Will not happen

Improper fraction – A fraction with a larger numerator than denominator

Increase – To make bigger

Index/indices – Numbers or letters raised to a power, 4^2

Inequality – Two amounts not equal to each other, $< \leq \geq >$

Infinite/infinity – Unlimited, goes on forever

Integer – A whole number

Interior angle – An angle inside a polygon

Intersect – The point where two lines cross

Inverse operations – Opposite operations, + inverse to -, x inverse to ÷

Irregular (polygon) – A polygon with different sized sides and angles

Isometric (paper) – equal dimensions between dots

Isosceles triangle – A triangle with 2 equal sides and 2 equal angles

K

Kilogram – A metric unit for measuring mass

Kilometre – A metric unit for measuring length

Kite – A 2D shape with two pairs of equal sides and one pair of opposite angles that are equal

L

Line of symmetry – Divides a shape into two congruent sides

Linear – Arranged in or extending along a straight or nearly straight line.

Litre – A metric unit for measuring capacity (

Lowest common multiple - The smallest of all the multiples shared by a pair of numbers

M

Maximum – The greatest possible value

Mean – An average found by finding the sum of the data and dividing by the number of values

Median – An average found by locating the middle value of an ordered set of data

Metre – A metric unit for measuring length

Midpoint – The middles point between 2 values or 2 coordinates

Millilitre – A metric unit for measuring capacity

Millimetre – A metric unit for measuring length

Minimum – The smallest possible value

Minus – Subtract

Mixed number – A number comprised of an integer and a fraction

Mode – An average found by identifying the value with the highest frequency

Multiply/multiplication – A number is added to itself a number of times, x

Multiple – A number in another number's times table

N

Negative – Below/less than zero/0

Net – A 2D shape that can be folded into a 3D shape

Nonagon – A 2D shape with 9 sides

Number line – A line marked with numbers

Numerator – The top number of a fraction

O

Obtuse angle - An angle measuring more than 90° but less than 180°

Octagon – A 2D shape with 8 sides

Odd number – A number not in the 2x table

Operations – Add, subtract, multiply, divide

Opposite angles – A pair of equal angles directly opposite each other formed by the intersection of 2 straight lines

Origin – Coordinate (0,0)

Outcome – One of the possible results of a probability experiment

Outlier – A value far away from the others in a set of data (also called anomaly)

P

Parallel – Lines that are the same distance apart

Parallelogram – A 2D shape with 2 pairs of parallel lines

Pentagon – A 2D shape with 5 sides

Percent/percentage – A part of a number or a whole. Per cent means out of 100

Perimeter – The distance around the edge of a 2D shape

Perpendicular – Two lines meeting at a right-angle

Pi – Ratio of the circumference to a circle's diameter, π, 3.141592...

Pictogram – A graph using pictures to represent frequency

Pie chart – A graph using a divided circle where each section represents a part of the total

Place value – The value of a digit depending on its place in the number

Plan – A diagram showing the view from directly above

Plane – A flat surface

Polygon – A 2D shape with straight sides

Population – Whole set from which a sample is taken

Positive – Above/greater than zero/0

Prime – a number with only two factors, 1 and itself

Prime factor – A number which is both a factor of something and is a prime number

Prism – A 3D shape with a constant cross section throughout

Probability – The chance that a particular outcome will occur

Product – The result of multiplying

Proportion – A part to whole comparison

Protractor – An instrument used to measure the size of angles

Pyramid - A 3D shape with a polygon base which tapers to a single vertex at the top

Pythagoras – In any right-angled triangle where c is the hypotenuse, $a^2 + b^2 = c^2$

Q

Quadrant – Any quarter of a plane divided by an x- and y-axis

Quadrilateral – A 2D shape with 4 sides

Qualitative data – Non-numerical data

Quantitative data – Numerical data

Quantity – A number of something

R

Radius – The distance from the centre of a circle to its edge

Random – A chance pick from a number of items

Range – The smallest value subtracted from the greatest value

Ratio – Comparative value of 2 or more amounts

Reciprocal – One of two numbers whose product is 1

Rectangle – A quadrilateral with two pairs of parallel sides with different lengths and all vertices are right-angles

Recurring decimal – A decimal which has repeating digits or a repeating pattern of digits

Reflection – A mirror view

Reflex angle – An angle measuring more than 180° and less than 360°

Regular polygon – A polygon with all sides and angles equal

Remainder – The remaining amount after dividing a quantity by a number that is not a factor

Rhombus – A parallelogram with all sides equal

Right-angle – An angle measuring exactly 90°

Right-angled triangle – A triangle with one right-angle

Rotation – To turn an object

Rotational symmetry – When a turning shape has the same outline as the original shape

Round/rounding – Change the number to a more convenient value

S

Sample – A part of the population to be used

Scale factor – The ratio of two corresponding edges on a scaled drawing

Scalene triangle – A triangle with all different sides and all different angles

Scatter diagram – A diagram with coordinates plotted to show the relationship between two variables

Sector – A section of a circle bounded by two radii and an arc

Segment – A section of a circle bounded by a chord and an arc

Semi-circle – Half a circle

Sequence – An ordered set of numbers or objects arranged according to a rule

Set (of data) – A collection of items/values

Similar - Having the same shape but a different size

Simplify (algebra) – To remove brackets, unnecessary terms and numbers

Simplify (fractions) – To reduce the numerator and denominator in a fraction to the smallest numbers possible

Solve/solution – To work out the answer

Sphere – A 3D shape that is perfectly round, a ball

Square – A 2D shape with all equal sides and all angles 90°

Square number – A number that results by multiplying another number by itself

Square root – The opposite of squaring a number

Subtract/subtraction – To take one quantity away from another.

Sum – The result of adding

Surface area – The area of the surface of a 3D shape

Symmetry – An object is symmetrical when one half is a mirror image of the other

T

Tally – Use of sets of 5 marks to record a total, 

Term (sequence) – One of the numbers in a sequence

Tessellation – Patterns of shapes that fit together without any gaps

Tetrahedron – A 3D shape with four triangular faces, a triangular-based pyramid

Three-dimensional (3D) – Having three dimensions, length, width and height

Transformation – A change in position or size

Translation – To move an item in any direction without rotating it

Trapezium – A 2D shape with four sides, two of them being parallel

Tree diagram – A diagram used to display the probability of different outcomes with each branch representing one possible outcome

Triangle – A 2D shape with three sides

Triple/treble – To multiply by three

Two-dimensional (2D) - Having two dimensions, length and width

U

Unit – One

Unit of measure – Standard amount or quantity

V

Variable – Something that varies, represented by a letter in algebra

Venn diagram – A diagram using circles to show relationships between sets

Vertex/vertices – The point where two sides meet, or three or more faces

Vertical – Perpendicular to the horizon

Volume – The amount of space occupied by a 3D object

X

X-axis – The horizontal axis on a graph

Y

Y-axis – The vertical axis on a graph

Y-intercept – Where a line intersects the y-axis

Maths command words

Command words are the words and phrases used in exams and other assessment tasks that tell students how they should answer the question.

The following command words are taken from Ofqual's official list of command words and their meanings that are relevant to Mathematics.

Change…to

Change a value from one unit to another.

Circle

Circle the reason for your answer

Follows a question about congruence. The options will be the congruence conditions SSS, SAS, ASA and RHS.

Circle your answer

Compare…and/to/with

Work out or identify the values required and say which is smaller/larger, etc.

Where appropriate, consider the context when giving your answer.

Complete

Add the missing information to a table or diagram (often statistical).

Construct

Draw accurately.

If told to use compasses, all construction arcs and lines should be shown.

Convert …(in)to

Change a value from one numerical form to another or a measure from one unit to another.

Describe

Use mathematical terminology to define the given information.

Describe (fully) the single transformation that maps...

With enlargement, give the scale factor and centre of enlargement.

With reflection, give the equation of the line of reflection.

With rotation, give the angle, direction and centre of rotation.

With translation, give the translation vector.

This should always be done fully, even if that word is absent from the instruction.

Do not use a graphical method

Algebraic manipulation or interpretation is required.

Does the data support this statement?

Use calculations and/or statistical measures based on the given data to make a decision.

Draw

Give an accurate depiction of a graph, map, diagram, etc.

Draw a sketch of

Give a depiction of a graph, map, diagram, etc, where the important features are identified.

Estimate (a mean from grouped frequency)

Use class midpoints to work out an estimate of the mean.

Estimate (used when the exact or definitive answer cannot be obtained from the information given)

Use the given information to work out the answer.

In this case it is good practice to use/give the exact answer of any calculation and then round the final answer to a sensible degree of accuracy.

Estimate the value of (used with a calculation)

Use approximations to work out a value.

Unless told otherwise, students should round the given values to 1 significant figure.

Evaluate… method and/or claim (Higher Tier only)

Identify which part of the method, calculation or assertion is incorrect or explain why it must be correct.

Express… as (Higher Tier only)

Convert a number from one form to another

Factorise (fully)

Take out any common factors of an expression or convert a quadratic expression into two linear factors.

This should always be done fully, even if that word is absent from the instruction. Use of the word 'fully' is a hint that more than one factor can be taken out.

Give a reason for your answer/choice

Show a calculation and/or written evidence for your answer.

Give a reason why...

Show a calculation and/or written evidence to support the given statement.

Give one/an example to show…

Write one example to substantiate or disprove a given statement.

Give one/an example where…

Write one example that fits the given conditions.

Give working and a reason to support your answer

Both a calculation and a written explanation are needed.

Give your answer as a/in the form…

You may work with values in a different format, but give the answer in the format required.

Give your answer in its simplest form

Cancel any fractions and collect any like terms.

Give your answer in terms of… (Higher Tier only)

The given variable should be the only variable in your answer.

Give your answer in terms of π

Don't use a decimal value of pi, just do the working with the coefficients of pi.

Give your answer to… decimal places/significant figures

Show the full answer in your working, but give the rounded value on the answer line.

How does this affect…

Comment on how your answer to a previous question part is different due to a change to an assumption used.

Is… correct?

Tick a box if given or state ‘yes’ or ‘no’ in your answer.

Is your answer to part… sensible?

Use approximations to check if a previous answer makes sense in the context of the question.

Label

Identify required regions, lengths or axis labels.

List

Write down all qualifying values or items.

Make… (different) criticism(s) of…

Write down the required number of errors or omissions in the given method or diagram.

Mark

Show a position on a map or diagram with the letter or symbol required.

Match each… to…

Join corresponding items in two lists by straight lines.

Measure

Use a ruler to measure a length or a protractor to measure an angle.

Multiply out (and simplify)

Multiply out the bracket(s), collecting like terms where possible.

One has been done for you

The given example shows the format in which the rest of the answers are required.

Plot

Mark the points with a cross.

Practise on this diagram

Put your answer on this diagram (when two diagrams are given for the student to use)

The first diagram can be used for practise, but if both diagrams are attempted the second one will be marked.

Prove that… (Higher Tier only)

Give a formal algebraic proof with each step shown **or** a formal geometric proof with each step shown and justification for each step.

Rearrange… to make… the subject

Write the given formula with a different subject as specified.

Reflect

Draw the image in the correct position.

Rotate

Draw the image in the correct position.

Shade

Show a required region by dark colouring or cross-hatching, etc.

Show all your construction lines

The drawing should be done by standard constructions with all arcs shown.

Show how… could use the data to support her hypothesis (Higher Tier only)

Work with the given information to give calculations and/or statistical measures that support the given hypothesis.

Show that...

Give every step of a process that will lead to the required outcome.

Show working to check…

Show working that helps you decide whether or not the given working was correct and give your decision.

Show working to support your answer

If you have made a decision, give a calculation (and wording where it helps) that shows why you made it.

Simplify (fully)

Collect terms or cancel a fraction.

This should always be done fully, even if that word is absent from the instruction. Use of the word 'fully' is a hint that more than one simplification step will be required.

Simplify your answer

Cancel any fractions and collect any like terms.

Sketch

Give a depiction of a graph, map, diagram, etc, where the important features are identified.

Solve

Find the value(s) that satisfy a given equation or inequality.

State

Write the required information.

State the units of your answer

The correct units must be given to gain full marks (there may be a stand-alone) mark for giving the correct units

Tick a box
Tick the correct statement
Translate

Draw the image in the correct position.

Use

This may be a conversion or formula that will help the student.

Use approximations to...

Unless told otherwise, students should round the given values to one significant figure.

Use the data to...

You should use the given information in your calculation or reason

Use the graph to…

You should get your answer from the graph rather than from calculation.

Use your calculator to…

You are not expected to show the required calculations or how you worked them out

Using part… or otherwise... (Higher Tier only)

You can use a previous answer as part of your method here, but there are other methods where it is not used.

What does this mean/tell you about…

Explain in words the implication of the given information.

What error has… made? (Higher Tier only)

Identify which part of the method or calculation is incorrect.

What mistake has… made?

Identify which part of the method or calculation is incorrect.

Why

Give a calculation and/or written evidence to support the given statement.

Work out

One or more calculations will usually be necessary.

Write

Some work may be needed to fulfil the instruction.

Write down

The answer should be obtainable from the information given, so no work should be needed.

Write down a calculation to support your answer

If you have made a decision, give a calculation that shows why you made it.

Write down your full calculator display

Give your answer as a decimal and write all the digits shown on your calculator. However, as calculators can show many digits, at least 6 digits would be seen as sufficient here.

You may use… to help you

A diagram or table has been given that may be helpful in organising your working, but you do not have to use it.

You must show your working

A correct answer will not receive the marks unless working is given to show how the answer was arrived at.