The Valley School

Learn to believe
Learn to achieve

The Numeracy Strategy
July 2022

The Valley Numeracy Strategy

It is our aim to give all students a secure understanding of basic numeracy skills. Good numeracy skills are essential in the workplace and knowledge is critical for everyday life.
Numeracy is a proficiency that involves confidence and competence with numbers and measures. It requires an understanding of the number system, a repertoire of computational skills and an inclination and ability to solve number problems in a variety of contexts. Numeracy also demands a practical understanding of the ways in which information is gathered by counting and measuring, and is presented in graphs, diagrams, charts and tables.

Aims of The Valley Numeracy Strategy

To raise the profile of numeracy across the school.
To support the transfer of students' knowledge, skills and understanding between subjects by ensuring consistency of practice including methods, vocabulary and notation.
Make numeracy teaching an overt part of every curriculum area where it naturally arises.
Create a positive and attractive environment which celebrates numeracy.
To ensure students meet their expectations and see how Numeracy skills can be used in real-life situations.
To improve students' speed and accuracy in recalling basic number facts, which is an essential skill to free up working memory to solve other problems.
Practice numeracy skills in form lessons each week.
Identify students who require additional support.
Seek opportunities to use topics and examination questions from other subjects in mathematics lessons.
Be aware of the mathematical techniques used in other subjects and provide guidance and training to other departments so that a sound, coherent and consistent approach is used in all subjects, using preferred methods.
Provide information about common misconceptions and errors which may occur during teaching of specific topics.
Provide guidance to other departments on what numeracy skills students are expected to have acquired by any given stage, so that teachers know whether a skill needs teaching for the first time or reinforcing.

Contents

Transfer of Skills

"It is vital that as the skills are taught, the applications are mentioned and as the applications are taught the skills are revisited."

The transfer of skills is something that many students find difficult. It is essential to start from the basis that students realise it is the same skill that is being used; sometimes approaches in subjects differ so much that those basic connections are not made.

Subject areas are more aware of the underlying maths skills and approaches that go with the applications that they use. Some mathematical opportunities across the curriculum are listed below.

Subject	Ideas	Websites
Art	• Use standard measures to find length • Form repeating patterns (tessellations), making use of reflection, rotation and translation. • Use of paint mixing as a ratio context. • Many patterns and constructions in our own and other cultures are based on spatial ideas and properties of shapes, including symmetry. • Perspective and scale • Drawing in 3 dimensions	
Enterprise	• Estimation from spreadsheets • Use of and calculation with money • Use of mathematical vocabulary e.g. sum, profit • Sketching graphs to show change over time • Accurate graph drawing including labelling axes • Sampling and surveying in market research • Designing data collection sheets • Producing and interpreting averages and charts • Costings • Ratio • Formulae • Awareness of sensible answers – approximate calculation including percentages, fractions, multiplication, division	

Subject	Ideas	Websites
Design Technology	• Use standard measures (metric and imperial) • Accuracy of measurement • Use scale and ratio to produce and work from drawings. • Using ruler, compass, protractor correctly • Properties of shape • Drawings in 2 dimension or 3 dimensions, including plans and elevations	
Food Technology	• Estimation of quantities • Measuring quantities • Using recipes as a ratio/proportion context • Reading scales on equipment • Converting between units • Pricing the cost of a meal/product • Addition and subtraction of time • Fractions of amounts	
English	• Interpreting charts, graphs and tables • Sequencing events • Use of fractions and percentages in persuasive writing including misleading graphs • Reading and writing numbers • Grouping/categorising ideas • Problem solving and comparisons • Reading Mathematical vocabulary and technical terms	
Music	• Use addition of fractions in bar music • Use counting for beats • Use graph sketching to demonstrate change over time e.g. • in dynamics over a piece	
PSHE	• The use of primary and secondary data and the interpretation of graphs, charts and tables, helping students to make reasoned and informed decisions and to recognise biased data and misleading representations. • By applying mathematics to problems set in financial and other real-life contexts, students will develop their financial capability and awareness of the applications of mathematics in the workplace.	

Subject	Ideas	Websites
Humanities	• Use mathematical symbols and notation, construct and interpret graphs and charts. • Use grids to identify position (links to co-ordinates and grid references). • The study of maps includes the use of coordinates, angles, direction, position, scale and ratio. • Use scale to interpret maps and diagrams • Use standard measures (metric and imperial) to find length, mass, time, force, temperature area or capacity, especially distance and area. • Use timelines and interpret negative numbers. • Discussing evidence in history or geography may involve measurement, estimation and approximation skills, and making inferences. • Students will make statistical enquiries, for example, in analysing population data to explore and compare lifestyles; they will also use a wide range of measurements and rates of change. • Use fractions and percentages to express and compare proportions	
ICT	• Use mathematical symbols and notation, construct and interpret graphs and charts. • Use formulae to calculate and to interpret data in spreadsheets. • In ICT lessons, students will collect and classify data, enter them into data-handling software, produce graphs and tables, and interpret and explain their results. This work will include the measurement of distance and angle. • Spreadsheet skills, used in modelling and simulations, rely on the numeric, algebraic and graphical skills involved in constructing formulae and generating sequences, functions and graphs.	

Subject	Ideas	Websites
PE	• Use time, height and distance in measurements. • Telling the time, timekeeping • Reading from scales using measuring equipment • Calculation of speed, acceleration, deceleration and graphing of these over time during an action/event • Design data collection sheets. • Collect and record real data, find the averages, compare and draw conclusions. • Sequencing results (decimals, lengths etc.) • Scoring • Directions • Athletic activities use measurement of height, distance and time, and data-logging devices to quantify, explore, and improve performance. • Ideas of counting, time, symmetry, movement, position and direction are used extensively in music, dance, gymnastics, athletics and competitive games. E.g. angles, rotation, planes, axes	
Science	• Use formulae to calculate work, power, mass, density • Rearrange formulae • Use graphs to represent data, interpretation of graphs • Estimating quantities or results of calculations • Use standard measures to find length, mass, time, force, temperature, area or capacity; • Hypothesise before an experiment, consider limitations to findings afterwards • Manipulate numerical data from their experiments and do calculations including averages; • Record results in tables – choose appropriate form and design data collection sheets • Use mathematical symbols and notation, construct and interpret graphs and charts and recognising patterns • Take readings from scales.	

Section 1 – Number

Reading and writing numbers

Students must be encouraged to write numbers simply and clearly. The symbol for zero with a line through it (?) and ones which could be mistaken for 7 (1) should be discouraged.
Most students are able to read, write and say numbers up to a thousand, but often have difficulty with larger numbers. It is now common practice to use spaces rather than commas between each group of three figures. eg. 34 000 not 34,000 though the latter will still be found in many text books and cannot be considered incorrect.

In reading large figures students should know that the final three figures are read as they are written as ***hundreds, tens*** and ***ones.***
Reading from the left, the next three figures are ***thousands*** and the next group of three are ***millions.***

eg. 3 127 251 is three million, one hundred and twenty seven thousand, two hundred and fifty one.

Order of Operations

It is important that students follow the correct order of operations for arithmetic calculations. Most will be familiar with the mnemonic: **BIDMAS.**

Brackets, **I**ndices, **D**ivision, **M**ultiplication, **A**ddition, **S**ubtraction

Note: Indices is another word for powers. It includes squares, cubes, roots, and other higher, fractional and negative powers.

This shows the order in which calculations should be completed. eg 5 + 3 x 4

means	**NOT**	5 + 3 x 4
5 + 12		means 8 x 4
= 17 ?		= 32 **X**

The important facts to remember are that the **B**rackets are done first, then the **I**ndices, **M**ultiplication and **D**ivision and finally, **A**ddition and **S**ubtraction

eg(i) (5 + 3) x 4
= 8 x 4
= 32

eg (ii) $5 + 6^2 \div 3 - 4$
= 5 + 36 ÷ 3 – 4
= 5 + 12 – 4
= 17 – 4
= 13

Care must be taken with **S**ubtraction.

eg 5 + 12 – 4	**or** 5 + 12 – 4	
= 17 – 4	= 5 + 8	
= 13 ✓	**=** 13	**x**

eg 5 –12 + 4	**but** 5 –12 + 4 [1]	
= -7 + 4	= 5 – 16	
= -3 ✓	**=** -11	**x**

For this to be correct it would have to be written**:** 5 – **(**12 + 4**)** so that the bracket is worked out first.

Calculators

Some students are over-dependent on the use of calculators for simple calculations. Wherever possible students should be encouraged to use mental or pencil and paper methods. It is, however, necessary to give consideration to the ability of the student and the objectives of the task in hand. In order to complete a task successfully it may be necessary for students to use a calculator for what you perceive to be a relatively simple calculation. This should be allowed if progress within the subject area is to be made. Before completing the calculation students should be encouraged to make an estimate of the answer. Having completed the calculation on the calculator they should consider whether the answer is reasonable in the context of the question.

Mental Calculations

Some students might be able to carry out the following processes mentally, though the speed with which they do it will vary considerably.

- Recall of addition and subtraction facts up to 20
- Multiplication and division facts for tables up to 12 x 12.

Some students will need the support of manipulatives and resources to use these calculations.
Students should be encouraged to carry out other calculations mentally using a variety of strategies but there will be significant differences in their ability to do so. It is helpful if teachers discuss with students how they have made a calculation. Any method which produces the correct answer is acceptable.

eg 53 + 19 = 53 + 20 – 1

284 – 56 = 284 – 60 + 4

32 x 8 = 32 x 2 x 2 x 2

76 ÷ 4 = (76 ÷ 2) ÷ 2

Written Calculations

Students often use the ‘ **=** ‘ sign incorrectly. When doing a series of operations they sometimes write mathematical sentences which are untrue.

eg 5 x 4 = 20 + 3 = 23 – 8 = 15 ✗ since 5 x 4 ≠ 15

It is important that all teachers encourage students to write such calculations correctly. eg 5 x

4 = 20
20 + 3 = 23
23 – 8 = <u>15</u> ✓

The ‘ = ‘ sign should only be used when both sides of an operation have the same value.
There is no problem with a calculation such as:

43 + 57 = 40 + 3 + 50 + 7 = 90 + 10 = <u>100</u> ✓

✓since each part of the calculation has the same value.

The '≈' (approximately equal to) sign should be used when estimating answers.

eg 2 378 – 412 ≈ 2 400 – 400

2 400 – 400 = <u>2 000</u> ✓

Students should be able to use some pencil and paper methods involving simple addition, subtraction, multiplication and division. Some less able students will find difficulty in recalling multiplication facts to complete successfully such calculations. In these circumstances it may be more useful to use a calculator in your subject to complete the task.

Before completing any calculation, students should be encouraged to estimate a rough value for what they expect the answer to be. This should be done by rounding the numbers to one significant figure and mentally calculating the approximate answer.

After completing the calculation they should be asked to consider whether or not their answer is reasonable in the context of the question.

There is no necessity to use a particular method for any of these calculations and any with which the student is familiar and confident should be used.

The following methods are some with which students may be familiar.

Addition Estimate

3 456 + 975 3 500 + 1 000 = 4 500

```
   3 456
+    975
   4 431
  1  1 1
```

Subtraction

Estimate

8 000 – 3 000 = 5000

```
   7 9 9 1
eg 8 0 0 3
  -2 5 6 9
   5 4 3 4
```

Addition and subtraction of decimals is completed in the same way but reminders may be needed to maintain place value by keeping decimal points in line underneath each other.

Multiplication and Division by 10,100,1000…

When a number is multiplied by 10 its value has increased tenfold and each digit will move one place to the left so multiplying its value by 10. When multiplying by 100 each digit moves two places to the left, and so on… Any empty columns will be filled with zeros so that place value is maintained when the numbers are written without column headings.

The decimal point does not move - the numbers do.

eg. 46 x 100 = 4 600

Th	H	T	U
		4	6
4	6	0	0

The same method is used for decimals. eg.

5.34 x 10 = 53.4

H	T	U	.	t	h
		5	.	3	4
	5	3	.	4	

Empty spaces after the decimal point are not filled with zeros. The place value of the numbers is unaffected by these spaces.

When dividing by 10 each digit is moved one place to the right so making it smaller. eg. 350 ÷

10 = 35

H	T	U	.	t	h
3	5	0	.		
	3	5	.		

eg. 53 ÷ 100 = 0.534

H	T	U	.	t	h
	5	3	.		
		0	.	5	3

When the calculation results in a decimal the ones column must be filled with a zero to maintain the place value of the numbers.

Multiplication

```
       3 2 7
   x     5 3
  ___________
     9 8(2) 1   <----   327 x   3
  1 6(1)3(3) 5 0   <----   327 x 50
   1 7 3 3  1
  ___________
```

Conventional multiplication as set out above may not suit all students and teachers should be aware that other methods may be employed by some students.

eg(i) 327 x 53 Estimate: 300 x 50 = 15 000

X	300	20	7	Total
50	15 000	1000	350	16 350
3	900	60	21	981
Total	15900	1060	371	**17331**

eg(ii) 456 X 24 Estimate: 450 x 20 = 9 000

```
 456            456        9120
 x 20           x  4     + 1824
 9120     +     1824     10 944

 1 1            2 2
```

Multiplying Decimals

- As always, estimate the answer.
- Complete the calculation as if there were no decimal points.
- In the answer insert a decimal point so that there are the same number of decimal places in the answer as there were in the original question.
- Check to see if the answer is reasonable eg (i)

1.2 x 0.3 □ 1 x 0.3 = 0.3

Ignoring the decimal points, this will be calculated as 12 x 3 = 36 and will now need two decimal places in the answer.

□1.2 x 0.3 = 0.36

Similarly:
eg (ii) 43.14 x 3.5 $\approx$ 40 x 4 = 160

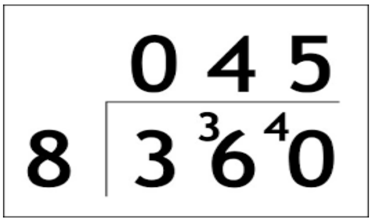
		4	3	1	4	(2 decimal places)			
x					3		5	(1 decimal place)	
	2	1	5	7	0				
1		2		9		4		2	0
1	5	0	9	9	0				

=150.990 (as 3 decimal places are needed in the answer)

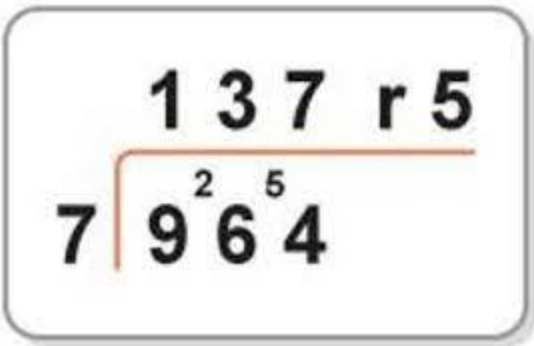
Division

Division is the inverse of multiplication.
Division is sharing things out, making groups of or working out how many times one number goes into another.
Students may need manipulatives or resources to work out these calculations. A multiplication square would also be helpful.
The bus stop division method is a formal written method for dividing numbers. It's also known as short division, so you might have heard of it under that name.
As students start working with increasingly large numbers, they'll no longer be able to divide numbers in their head or with manipulatives. That's where the bus stop division method comes in handy!

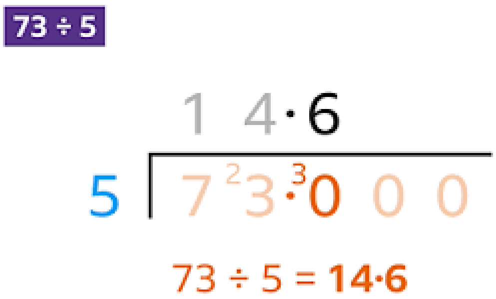
When doing short division, it can be useful to know your times tables. It is also important to be able to work out remainders if values do not divide exactly.
In the calculation 36 ÷ 3 = 12, 36 is the dividend, 3 is the divisor and the quotient is 12.
Set out the division. Write the question in bus stop form.
Starting with the first digit, divide each digit of the dividend by the divisor. Write the answers above the line.
A zero at the start is used as a place holder in the working out to keep it lined up - it is not written in the answer.
If there is a remainder when dividing a digit, carry the remainder to the next digit

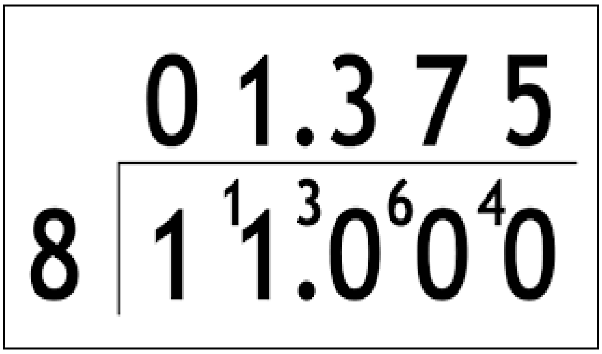


When one number cannot divide completely into another number, there is a remainder.



If there is a remainder when you calculate the last digit, add a decimal point to the number to be divided and a decimal point above that in the answer space. If a decimal number has digits that ends, it is a terminating decimal.





If a digit in the answer is recurring it can be shown in the answer with a dot above the repeating digit.

It is important to think about the remainder in the content of the question.
Can you have 3.2 of a minibus or do you need to book an extra one?

Percentages

Students should be familiar with some operations involving percentages in mathematics lessons. The following is a sample of operations which students may be expected to use in other areas. It is important to reiterate that "per cent" means "out of 100" (compare to century, Cents in a dollar etc.).

Calculating percentages of a quantity

Methods for calculating percentages of a quantity vary depending upon the percentage required. Students should be aware that fractions, decimals and percentages are different ways of representing part of a whole and know the simple equivalents

eg 10% = $^{1}/_{10}$ 12% = 0.12

Where percentages have simple fraction equivalents, fractions of the amount can be calculated.

eg. i) To find 50% of an amount, halve the amount.
ii)To find 75% of an amount, find a quarter by dividing by four and then multiply it by three.

Most other percentages can be found by finding 10%, by dividing by 10, and then finding multiples or fractions of that amount

eg. To find 30% of an amount first find 10% by dividing the amount by 10 and then multiply this by three.
30% = 3x10%
Similarly: 5% = half of 10% and 15% = 10% + 5% Most other percentages can be calculated in this way.

When using the calculator it is usual to think of the percentage as a decimal. Students should be encouraged to convert the question to a sentence containing mathematical symbols. ('of' means X)
eg. Find 27% of £350 becomes
0.27 X £350 =
and this is how it should be entered into the calculator.

Calculating the amount as a percentage

In every case the amount should be expressed as a fraction of the original amount and then converted to a percentage in one of the following ways:

i) What is 15 as a percentage of 60?
(using simple fractions)

$$\frac{15}{60} = \frac{1}{4} = 25\%$$

ii) What is 27 out of 50 as a percentage? (using equivalent fractions)

$$\frac{27 \times 2}{50 \times 2} = \frac{54}{100} = 54\%$$

iii) What is 39 as a percentage of 57?
(Using a calculator)

$$\frac{39}{57} = 39 \div 57 = 0.684 \text{ (to 3 d.p.) } \times 100 = 68.4\%$$

Section 2 – Algebra

The most common use of algebra across the curriculum will be in the use of formulae.

When transforming formulae students will be taught to use the 'balancing' method where they do the same to both sides of an equation.

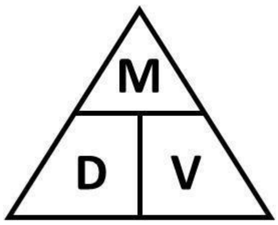
eg (i) $A = lb$ Make b the subject of the formula [÷l]

$$\frac{A}{l} = b$$

However, in some cases triangles can be useful for specific cases.

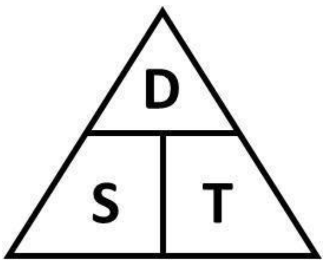
Compound Measures

For example with **Mass, Density and Volume:**



Density = $\frac{\text{Mass}}{\text{Volume}}$, **Mass** = Density x Volume , **Volume** = $\frac{\text{Mass}}{\text{Density}}$

Similarly with **Distance, Speed and Time:**



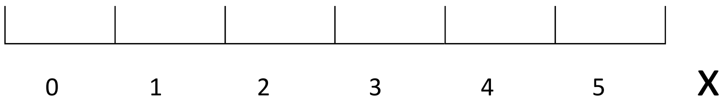
Speed = <u>Distance</u> , **Distance** = Speed x Time , **Time** = <u>Distance</u> Time
Speed

Plotting Coordinates

When drawing a diagram on which coordinates have to be plotted some students will need to be reminded that the numbers written on the axes must be on the lines not in the spaces.

eg

NOT



When reading or plotting coordinates you should use the horizontal axis first and then the vertical one.

Axes

When drawing graphs to represent experimental data it is usual to use the horizontal axis for the variable which has a regular class interval.

eg In an experiment in which temperature is taken every 5 minutes the horizontal axis would be used for time and the vertical axis for temperature.

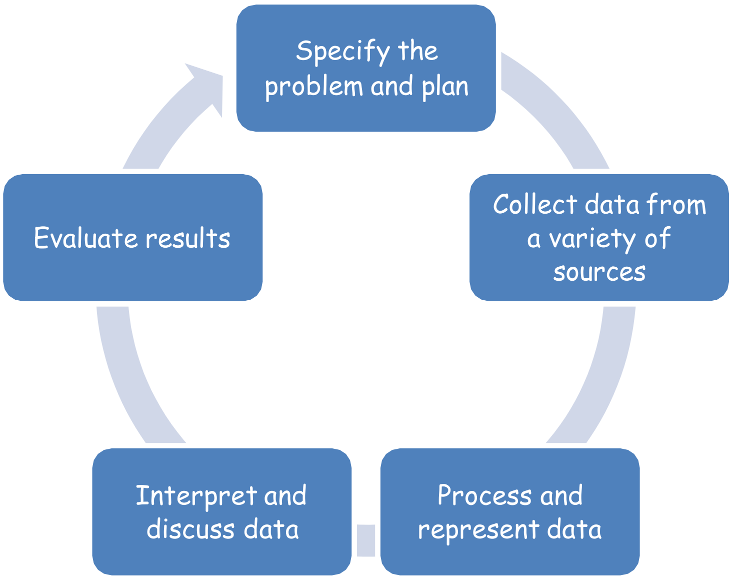
Having plotted coordinates students can sometimes be confused as to whether or not they should join them. If the results are from an experiment then a 'line of best fit' will usually be needed. Further details appear in the following section on Data Handling.

Section 3 – Data Handling

It is important that graphs and diagrams are drawn on the appropriate paper:

- bar charts and line graphs on squared or graph paper.
- pie charts on plain paper.

Any such work needs to be embedded in the **data handling cycle.**



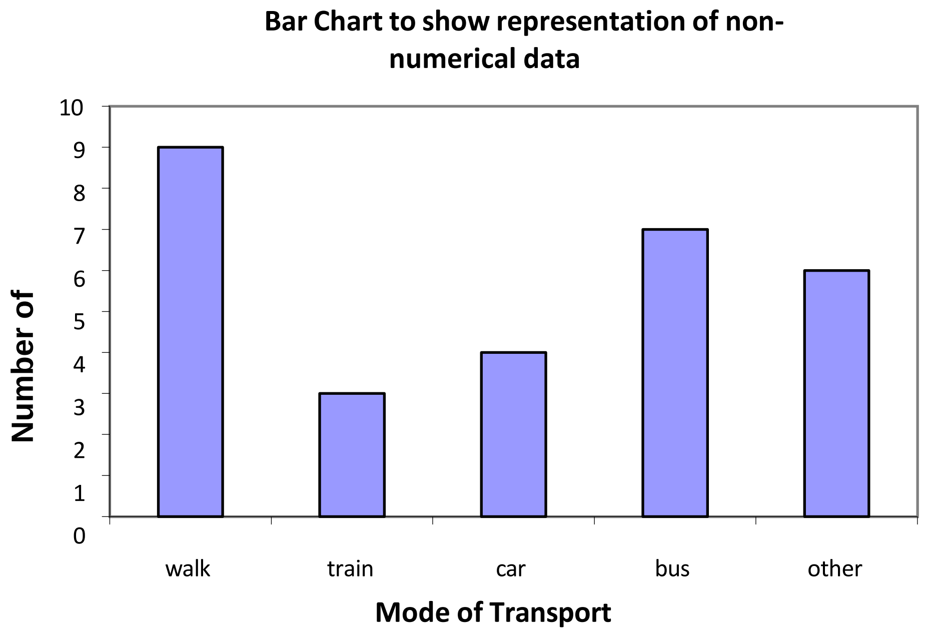
If learners understand this cycle, then they will see how the work they are doing is a part of something bigger, something that will give them the chance to answer questions that they are interested in. Hence the starting point is not 'Let's gather some data' but 'Have we got a problem we want to investigate?

Bar Charts

These are the diagrams most frequently used in areas of the curriculum other than mathematics. The way in which the graph is drawn depends on the type of data to be processed.

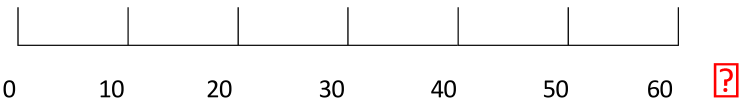
Graphs should be drawn with **gaps between the bars** if the data categories are not numerical (colours, makes of car, names of pop star, etc.). There should also be gaps if the data is numeric but can only take a particular value – DISCRETE DATA (shoe size, KS3 level, etc.). In cases where there are gaps in the graph the horizontal axis will be labelled beneath the columns.

The labels on the vertical axis should be on the lines.

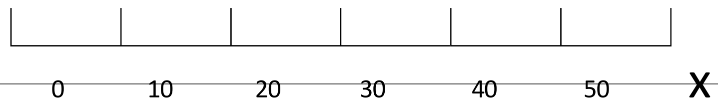


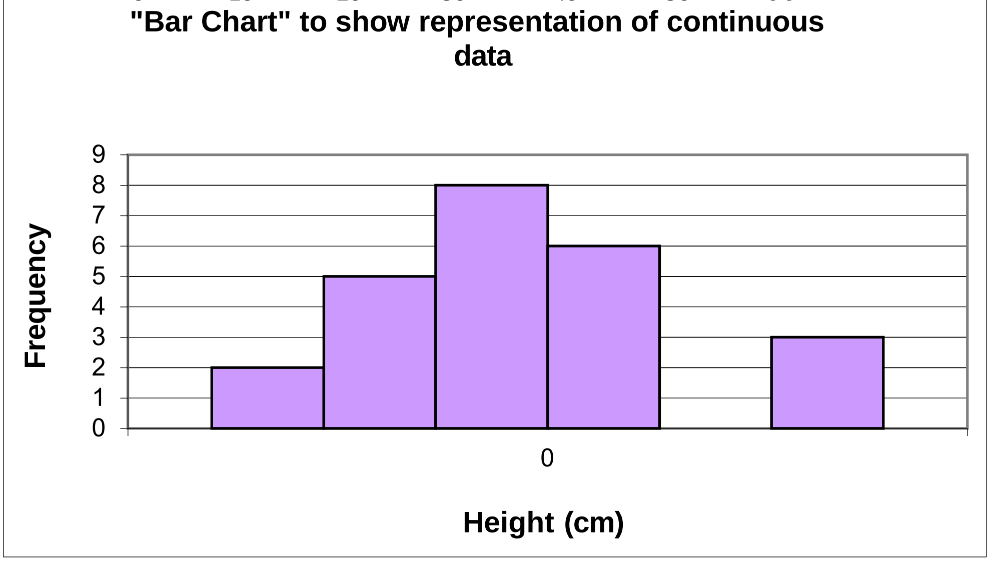
Where the data are CONTINUOUS, eg. lengths, the horizontal scale should be like the scale used for a graph on which points are plotted.

eg



NOT

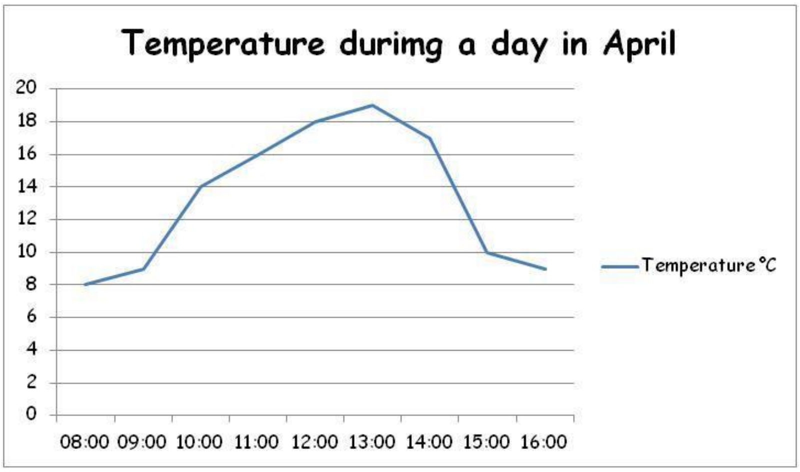




Line Graphs

Line graphs should only be used with data in which the order in which the categories are written is significant.

Points are joined if the graph shows a trend or when the data values between the plotted points make sense to be included. For example the measure of a patient's temperature at regular intervals shows a pattern but not a definitive value.



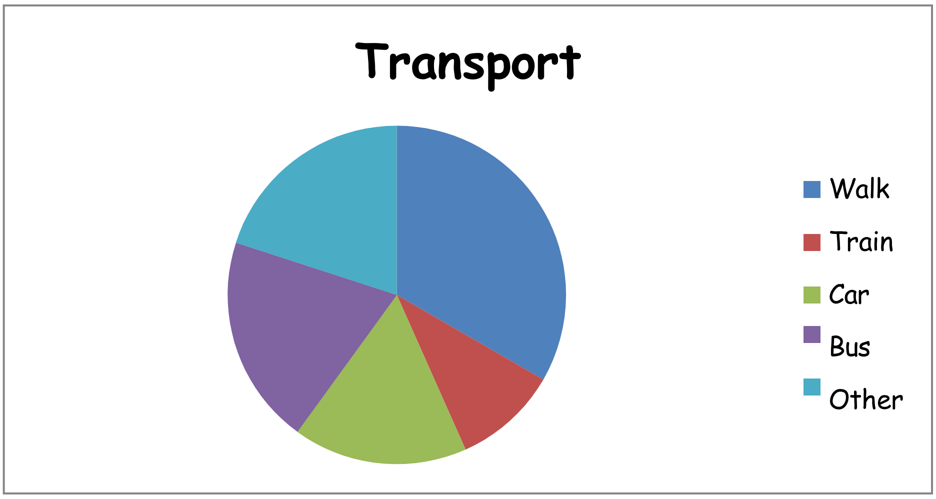
Pie Charts

Pie charts should be used to show how the data is split up between the different categories. The area of the whole circle represents the total number of items.

The way in which students should be expected to work out angles for a pie chart will depend on the complexity of the question. If the numbers involved are simple it will be possible to calculate simple fractions of 360?.

eg. The following table shows the results of a survey of 30 students travelling to school. Show this information on a pie chart.

Mode of Transport	Frequency	Fraction	Angle
Walk	10	$\frac{1}{3}$	120º
Train	3	$\frac{1}{10}$	36º
Car	5	$\frac{1}{6}$	60º
Bus	6	$\frac{1}{5}$	72º
Other	6	$\frac{1}{5}$	72º
Total	**30**	**1**	**360º**



However, with more difficult numbers which do not readily convert to a simple fraction students should first work out the share of 360⍰ to be allocated to **one** item and then multiply this by its frequency.

eg. 180 students were asked their favourite core subject. Each

students has 360 ⍰ 180 = 2⍰ of the pie chart.

Subject	Number of students	Pie Chart Angle
English	63	63 x 2 = 126º
Mathematics	75	75 x 2 = 150º
Science	42	42 x 2 = 84º
Total	180	360º

If the data is in percentage form each item will be represented by 3.6⍰ on the pie. To calculate the angle students will need to multiply the frequency by 3.6.

eg. 43% will be represented by 43 X 3.6 = 154.8⍰
⍰ <u>155⍰</u>

Any calculations of angles should be rounded to the nearest degree only at the **final stage of the calculation.** If the number of items to be shown is 47 each item will need:

360 ⍰ 47 = 7.659574468⍰

This complete number should be used when multiplying by the frequency and then rounded to the nearest degree.

Care needs to be taken when using a pair of **compasses**. Students should hold the pivot (not the arms) when drawing a circle to ensure precision. The pencil must be level with the point of the compass.

Ensure when using a **protractor** that students measure from 0º, not 180º (compare to a ruler – you wouldn't measure a line starting from 30cm!)

Using Data

Range

The range of a set of data is the difference between the highest and the lowest data values. eg. If in an

examination the highest mark is 80% and the lowest mark is 45%, the range is 35% because 80% - 45% = 35%

The range is always a **single number,** so it is **NOT** 45% - 80%

Averages

Three different averages are commonly used:

- **Mean –** is calculated by adding up all the values and dividing by the number of values**.**
- **Median –** is the middle value when a set of values has been arranged in order.
- **Mode -** is the most common value. It is sometimes called the **modal group.**

eg. for the following values: **3, 2, 5, 8, 4, 3, 6, 3, 2,**

Mean $= \frac{3 + 2 + 5 + 8 + 4 + 3 + 6 + 3 + 2}{9} = \frac{36}{9} = 4$

Median **–** is 3 because 3 is in the middle when the values are put in order.

2, 2, 3, 3, 3, 4, 5, 6, 8

Mode **-** is 3 because 3 is the value which occurs most often.

Averages from a frequency table

Number of goals	Frequency	Goals x frequency
0	8	0
1	15	15
2	12	24
3	7	21
4	3	12
5	1	5
Total	46	77

The mode can still be identified as the value with the highest frequency.

Mode = 1 goal (highest frequency)

Median = The total frequency is 46 so the median will be the 23.5th value, that is halfway between the 23rd and 24th value.

There were 15 + 8 = 23 games with 0 or 1 goals scored.

This means that the 23rd value is 1, the 24th value is 2, so the median is 1.5 goals.

The mean is calculated by using the total of the goals x frequency column dividing by the total frequency

Averages from a grouped frequency table

Similar rules apply for continuous data and grouped frequency tables, although our results will be less accurate. We can only find the modal class and the median class rather than an accurate mode and median, and we can only calculate an estimate for the mean. As the variable (x) is now a group, it is necessary to use the middle value of each class interval.

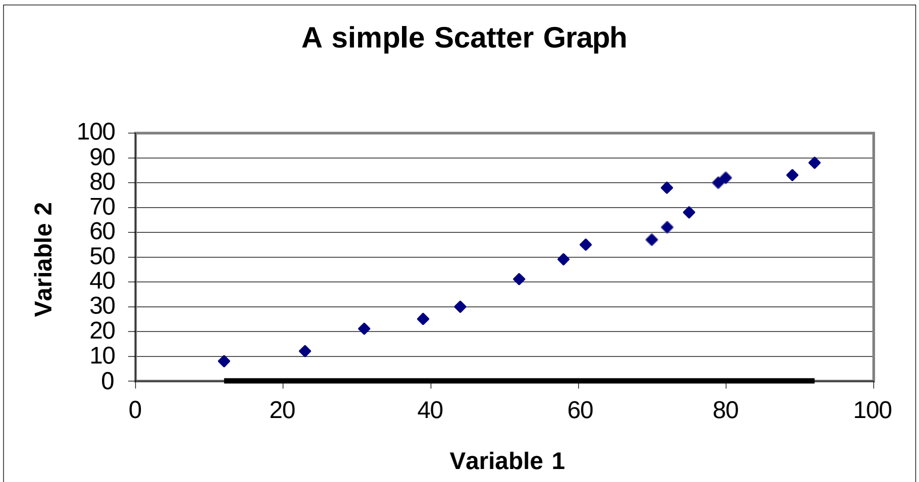
Speed (s mph)	Frequency (f)	Class width (x)	Speed x frequency (fx)
20 ≤ s < 25	4	22.5	90
25 ≤ s < 30	10	27.5	275
30 ≤ s < 35	12	32.5	390
35 ≤ s < 40	315	37.5	562.5
40 ≤ s < 45	9	42.5	382.5
Total (Σ)	50		1700

Estimate for the mean = $\frac{\Sigma fx}{\Sigma f} = \frac{1700}{50}$ = 34 mph

The modal class is 35 ≤ s < 40. The median falls in the class 30 ≤ s < 35.

Scatter graphs

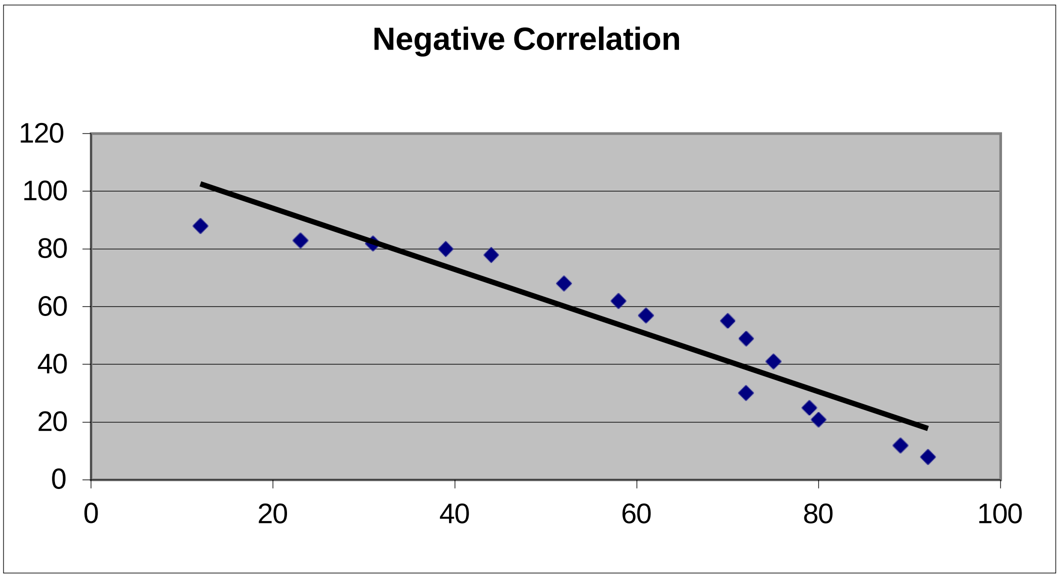
These are used to compare two sets of numerical data. The two values are plotted on two axes labelled as for continuous data. If possible a 'line of best fit' should be drawn.

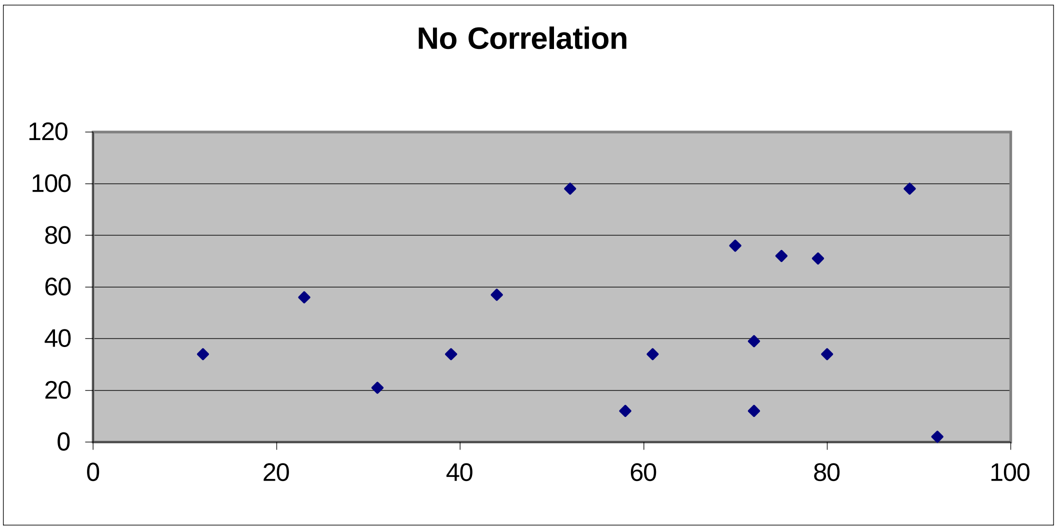


The degree of correlation between the two sets of data is determined by the proximity of the points to the 'line of best fit'

The above graph shows a positive correlation between the two variables. However you need to ensure that there is a reasonable connection between the two, e.g. ice cream sales and temperature. Plotting use of mobile phones against cost of houses will give two increasing sets of data but are they connected?

Negative correlation depicts one variable increasing as the other decreases, no correlation comes from a random distribution of points. See diagrams below.





Spreadsheets, Computer Drawn Graphs & Diagrams

Students throughout the school should be able to use **Excel** or other spreadsheets to draw graphs to represent data. Because it is easy to produce a wide variety of graphs there is a tendency to produce diagrams that have little relevance. Students should always be encouraged to write a comment explaining their observations from the graph.

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

	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	E
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				
15					

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		
15			

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)”

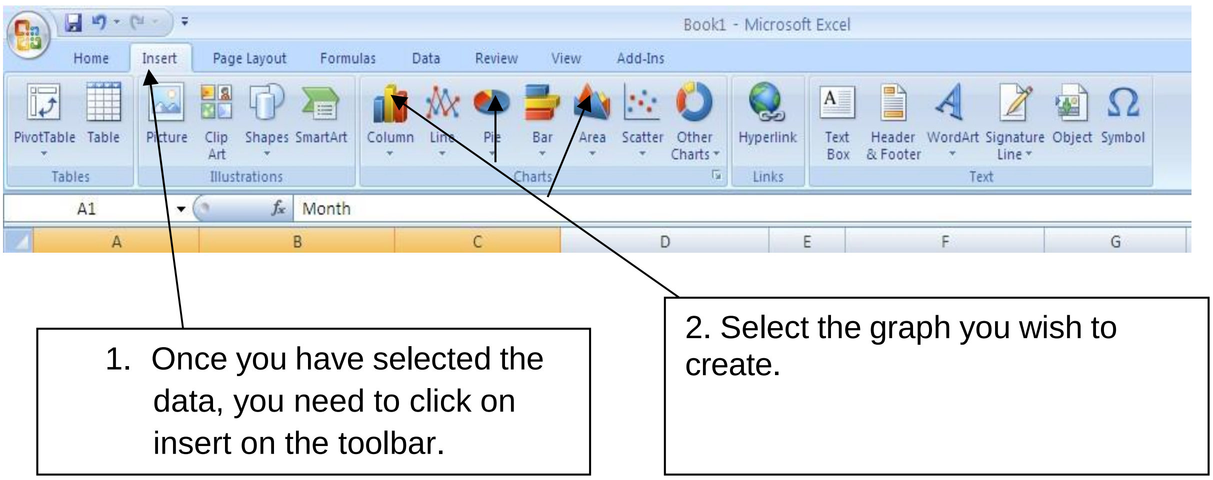
To work out the maximum value of a set of data you need to use “=MAX(_:_)”
Eg. To find out the maximum value for gas that year, you use the formula “=MAX(B2:B13)”

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)”

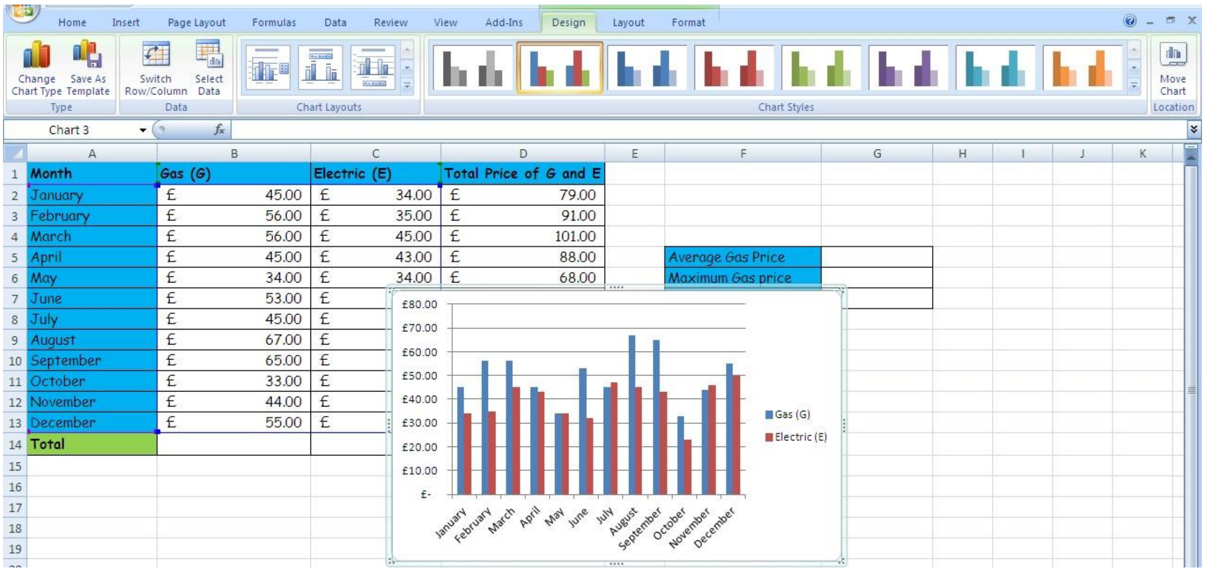
Creating graphs in Excel

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.

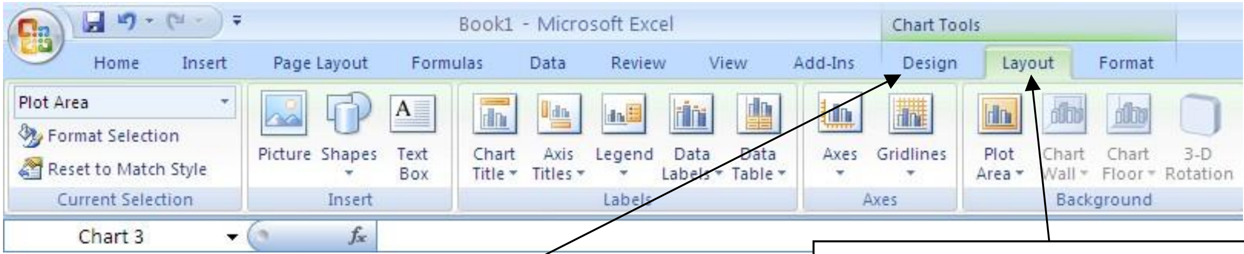
	A	B	C	D
1	Month	Gas (G)	Electric (E)	Total Price of G and E
2	January	£ 45.00	£ 34.00	£ 79.00
3	February	£ 56.00	£ 35.00	£ 91.00
4	March	£ 56.00	£ 45.00	£ 101.00
5	April	£ 45.00	£ 43.00	£ 88.00
6	May	£ 34.00	£ 34.00	£ 68.00
7	June	£ 53.00	£ 32.00	£ 85.00
8	July	£ 45.00	£ 47.00	£ 92.00
9	August	£ 67.00	£ 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				



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

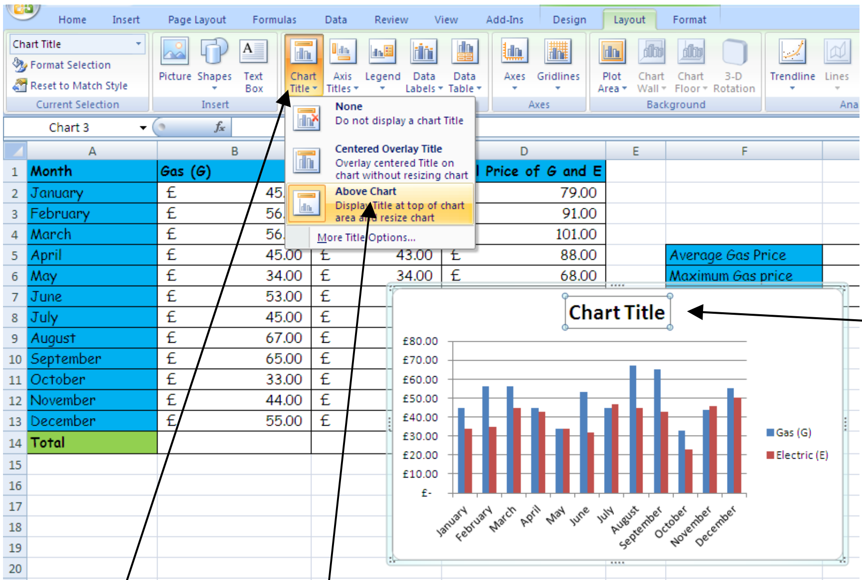


To label the axis, and change the colours of the graph you need to click on the following buttons in the toolbar.



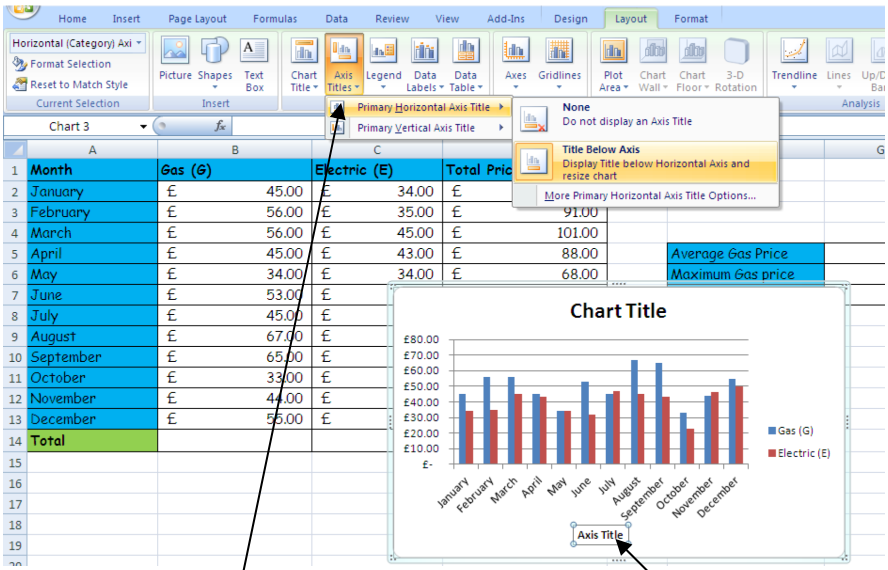
Clicking on the design button will enable you to change the colours of the graph.

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



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 label.

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

Section 4 – Shape, Space and Measure

Shapes

It is important to use correct names of shapes. 2D and 3D shapes and their properties are below.

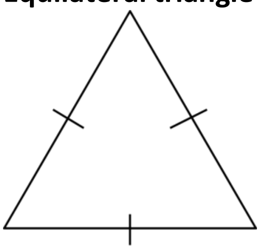
2D Shapes

A polygon is a 2D shape consisting of 3 or more straight sides. A regular polygon has all sides and angles the same size. Specific names of polygons are shown below the table.

Number of sides	Name of polygon
3	Triangle
4	Quadrilateral
5	Pentagon
6	Hexagon
7	Heptagon
8	Octagon
9	Nonagon
10	Decagon

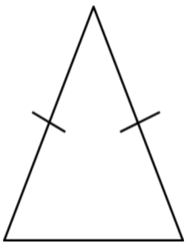
Some triangles have special names:

Equilateral triangle



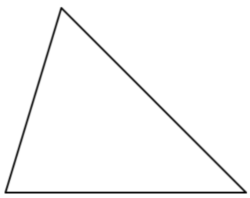
All sides and angles equal.

Isosceles triangle



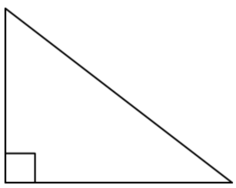
Two sides and two angles are equal.

Scalene triangle



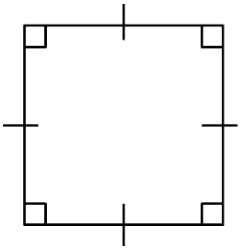
All sides and angles are are different.

Right-angled triangle
One angle is a right angle (90º)



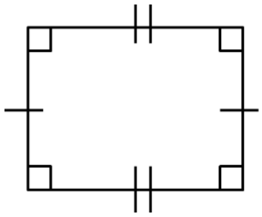
Some quadrilaterals have special names:

Square



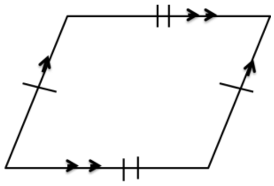
All sides are the same length and all angles are 90º

Rectangle



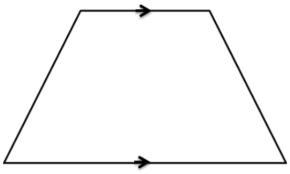
Opposite sides are the same length and all angles are 90º

Parallelogram



Opposite sides are parallel and the same length. Opposite angles are the same.

Trapezium

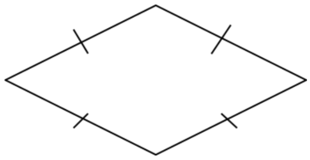


One pair of opposite sides are parallel.

Kite

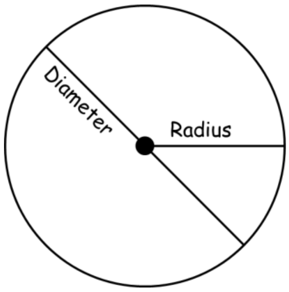
Two pairs of adjacent sides are equal. One pair of opposite angles are equal.

Rhombus (NOT diamond)



All sides are the same length. Opposite angles are equal.

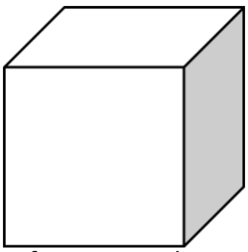
A **circle** has a radius which goes from the centre to the edge, and the diameter which is twice the length of the radius, and goes from side to side passing through the centre.



3D shapes

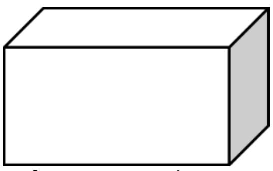
The flat surfaces of a 3D shape are called faces. The lines where two faces meet are called edges. The point (corner) at which edges meet is called a vertex. The plural of vertex is vertices. Some 3D shapes and their properties are below.

Cube



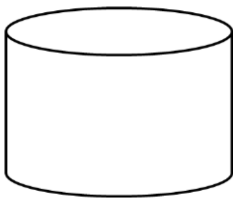
6 faces, 12 edges and 8 vertices.

Cuboid



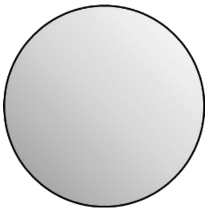
6 faces, 12 edges and 8 vertices.

Cylinder



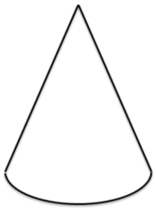
3 faces, 2 edges and no vertices.

Sphere



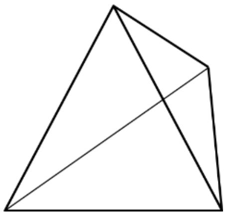
1 face, no edges
and no vertices.

Cone



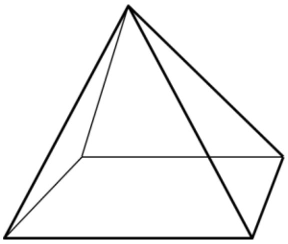
2 faces, 1 edge
and 1 vertex.

Tetrahedron



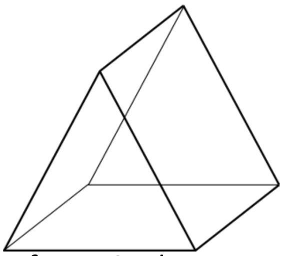
4 faces, 6 edges
and 4 vertices.

Square-based pyramid



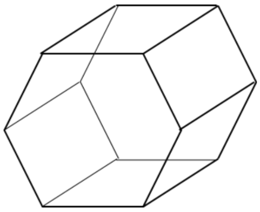
5 faces, 8 edges
And 5 vertices.

Triangular prism



5 faces, 9 edges
and 6 vertices.

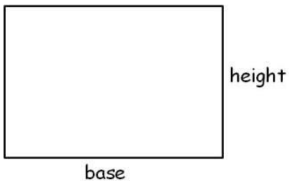
Hexagonal prism

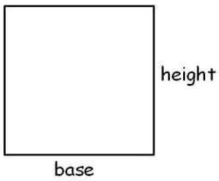


8 faces, 18 edges
and 12 vertices.

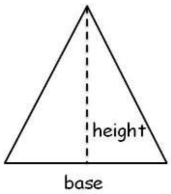
Area

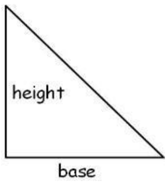
Area of Squares and Rectangles
= base x height



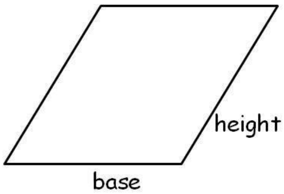


Area of Triangles
= ½ x base x height

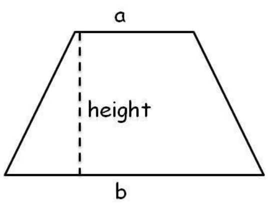




Area of Parallelograms
= base x height



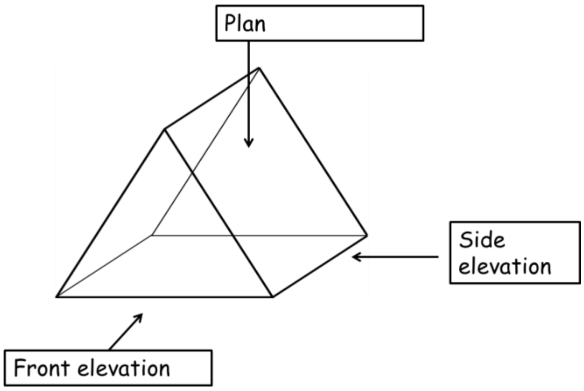
Area of Trapeziums
= ½ x (a + b) x height



Surface Area
Surface area is the area of the surface of a 3D shape. To calculate the surface area, calculate the area of every face of the shape, then add those areas together.

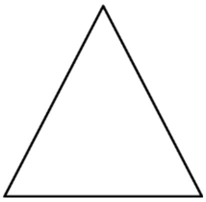
Plans/elevations

Plans and elevations can be drawn for any 3D shape.

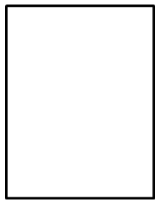


The view from above is called the plan:

The view from the front is called the front elevation:



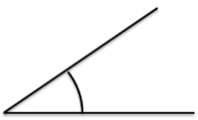
The view from the side is called the side elevation:



Angles

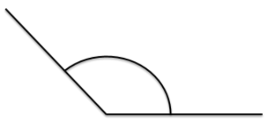
An angle is a measure of a turn. They are measured in degrees, for example, 60º. There are different types of angle.

Acute



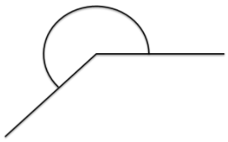
Less than 90º

Obtuse



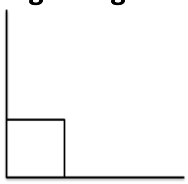
More than 90º but less than 180º

Reflex



More than 180º but less than 360º

Right angle

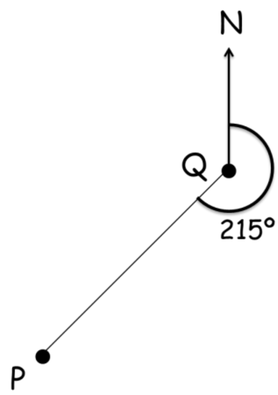


Exactly 90º

Angles are measured using a protractor. It is important to emphasise that you measure from zero.

Bearings

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



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.

Units of measure

The use of metric units of measure is encouraged. The metric system of measurement is based on powers of ten and uses the following prefixes:

- **Kilo-** meaning 1000
- **Centi-** meaning one hundredth
- **Milli-** meaning one thousandth
- **Micro-** meaning one millionth

These prefixes are then followed by a base unit:

- The base unit for length is **metre**
- The base unit for mass is **gram**
- The base unit for capacity is **litre**

Transformations

There are four main 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. 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. 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.

Maths Glossary

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 round 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 units² Ascending –
Going up
Average – A summary of a set of data, either mode, median and mean Axis –
Reference lines on a graph
Bar graph – A graph using bars to show quantities for easy comparison Bisect – To divide into two equal sections
Brackets – Symbols used to enclose an expression, ( ) 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 (10 millimetres) 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 perimeter of the circle
Chord – A straight line joining two points at the edge of the circle, not through the centre Clockwise - The direction which hands move round 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, eg (2,-4) Corresponding angles– Equal angles within parallel lines that are identified by a 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 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, eg 67° 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
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 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
Gradient – The slope of a line
Gram – A metric unit for measuring mass
Graph – A drawing or diagram used to record information 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 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 or a^6 Inequality –
Two amounts not equal to each other, < ≤ ≥ > 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 Kilogram
– A metric unit for measuring mass (1000 grams) Kilometre – A metric unit
for measuring length (1000 metres)
Kite – A 2D shape with two pairs of equal sides and one pair of opposite angles that are equal Line of
symmetry – Divides a shape into two congruent sides
Linear – Has one dimension
Litre – A metric unit for measuring capacity (1000 millilitres)
Lowest common multiple - The smallest of all the multiples shared by a pair of numbers 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 (100 centimetres, 1000 millimetres) 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 - Negative
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
Negative – Below/less than zero/0, -4
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
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) 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, 46% 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 a prime 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, $a^2 + b^2 = c^2$ 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
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, ½ and 2
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
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
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 90º
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 Tally – Use of
sets of 5 marks to record a total, 
Term (n^{th}) – 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 Unit - One
Unit of measure – Standard amount or quantity

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-axis
– The horizontal axis on a graph
Y-axis – The vertical axis on a graph
Y-intercept – Where a line intersects the y-axis