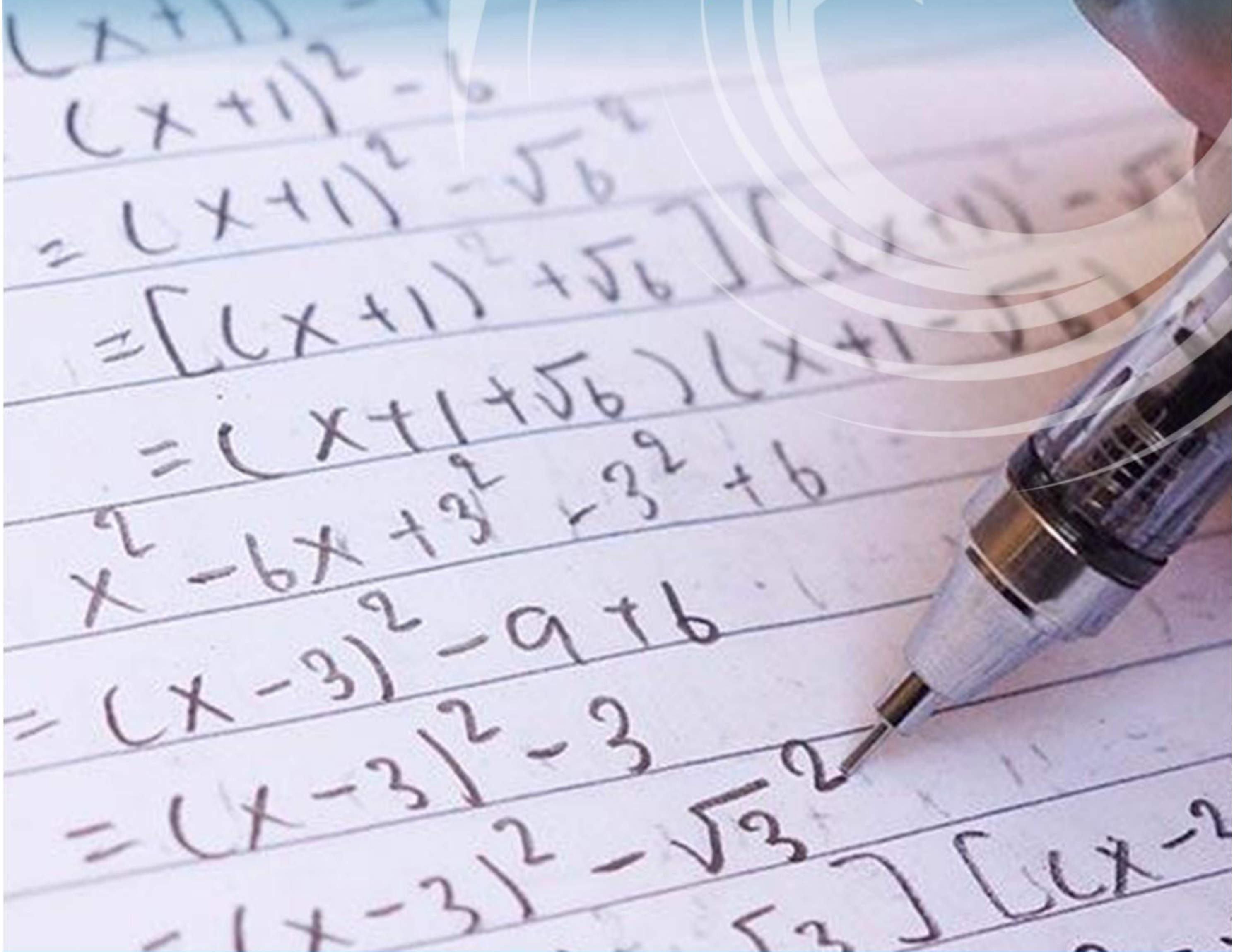
MATHEMATICAL SKILLS

PARENTS/CARERS HANDBOOK



Magna Academy Poole
an Aspirations Academy

Introduction

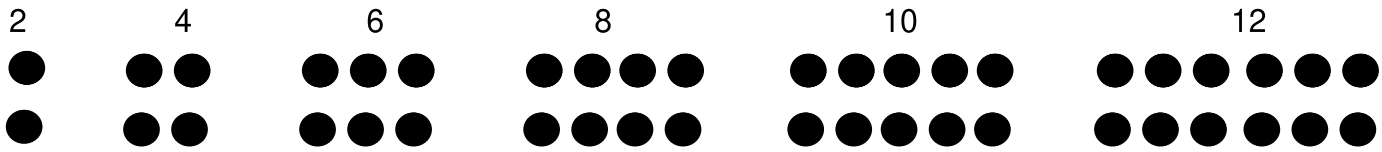
This handbook has been produced to help parents/carers support students in Maths. There are many ways to think about and solve problems in Maths. We have suggested common approaches and strategies that students will be familiar with at Magna Academy. We have focused on key areas and skills in Maths that will be needed across many subjects. Many students will be confident in these areas already, while some may be developing their confidence and others may be working to close significant gaps in these areas.

It is hoped that the guidance in this handbook will hopefully make it easier for parents/carers to support students with general revision and homework.

Contents

Even and Odd Numbers

Even numbers always ended in 0, 2, 4, 6 or 8.
Even numbers can always be divided exactly by 2.
The dot pattern of even numbers can be drawn in pairs.

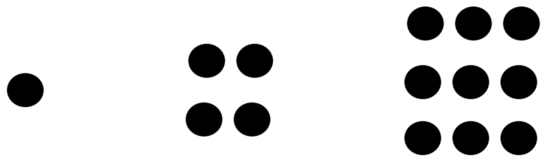


Odd numbers always ended in 1, 3, 5, 7 or 9.
Odd numbers **cannot** be divided exactly by 2.

Square numbers

When a number is multiplied by itself the answer is referred to as a square number.
We use an index of ^{2} to show a squared number.
For example,

1 squared = $1^2 = 1 \times 1 = 1$
2 squared = $2^2 = 2 \times 2 = 4$
3 squared = $3^2 = 3 \times 3 = 9$



The dot pattern of the square number will always form a square.

To reverse the process of squaring a number, we SQUARE ROOT (the symbol for a square root is √ on a calculator and $\sqrt{\ }$ when handwritten)

For example,
The square root of 1 = $\sqrt{1} = \pm 1$
The square root of 4 = $\sqrt{4} = \pm 2$
The square root of 9 = $\sqrt{9} = \pm 3$
The square root of 16 = $\sqrt{16} = \pm 4$

Multiples and Factors

The multiples of a number are simply the results for the multiplication table of that number.

For example, the multiples of 5 are:
5, 10, 15, 20, 25, 30, 35, 40, 45, to 50, 55, 60, 65, 70, 75......

Factors are numbers which divide exactly into a given number.

For example,
Factors of 20 are: 1, 2, 4, 5, 10, 20
Factors of 32 are: 1, 2, 4, 8, 16, 32
Factors of 56 are: 1, 2, 4, 7, 8, 14, 28, 56

We can check all factors as each factor has a pair eg for factors of 20 the pairs are 1x20, 2x10, and 4x5

When you divide by a factor the answer must be a whole number, not a decimal.

Students often get multiples and factors mixed up. An easy way to remember is this:

MANY MULTIPLES, FEWER FACTORS.

Prime Numbers

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47 are the prime numbers up to 50.

A Prime number is a number that has exactly 2 factors. No more or no less than 2 factors.
These 2 factors will always be the number 1 and the number itself.

Common mistakes on this question are 1, 9, 15, 21, 27.

BIDMAS

BIDMAS is an acronym for the order in which we carry out calculations. The letters stand for:

B rackets	( ) any maths within brackets in a calculation must be done first
I ndices	then Indices e.g. 3^2 then x, ÷ before +, -
D ivision	
M ultiplication	If you only have x, ÷ you just go from left to right.
A ddition	
S ubtraction	If you only have +, - you just go from left to right.

For example:

$3 + 4 \times 6 = 3 + 24 = 27$

$8 - (10 - 2) = 8 - (8) = 0$

$8 + 6 \div 3 - 2 \times 2 = 8 + 2 - 2 \times 2 = 8 + 2 - 4 = 10 - 4 = 6$

Some scientific calculators display brackets as you enter calculations to help you.

Put brackets in to get the calculations YOU want, not what the calculator thinks you want.

BIDMAS is used throughout mathematics.
As well as applying BIDMAS to positive, whole numbers as above it is also used in:

- Fractions
- Decimals
- Negative numbers
- Algebra

Fractions

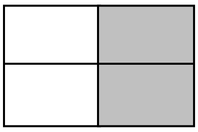
A fraction is a way of being able to write a quantity that is not exactly a whole number.
You may cut a cake up into four equal size pieces and eat just one of pieces - you would have eaten ¼ of the cake. The written fraction has 2 parts:

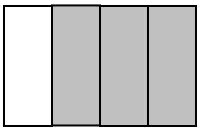
1	=	Numerator	=	How may equal parts are needed
4		Denominator	=	How many equal parts the whole is divided into

Some fractions *look different* but actually have the *same value*.
These are called **equivalent fractions.**

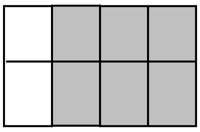
For example:

$\frac{1}{2}$ is the same as $\frac{2}{4}$





$\frac{3}{4}$ is the same as $\frac{6}{8}$



Equivalent fractions can be found much quicker by writing the multiples of the numerator and the denominator respectively.
For example:

$$\frac{3}{4} = \frac{6}{8} = \frac{9}{12} = \frac{12}{16} = \frac{15}{20} = \frac{18}{24} = \frac{21}{28}$$

To find an equivalent fraction that is simpler we do the opposite and look at the factors of the numerator and denominator.
To make the equivalent fraction the simplest possible we should choose the highest factor that is common to both numbers.

Eg. Write $\frac{8}{12}$ as a fraction in its simplest form. Common factors of 8 and 12 are 2 and 4

4 is the highest of these factors so we divide top and bottom by 4

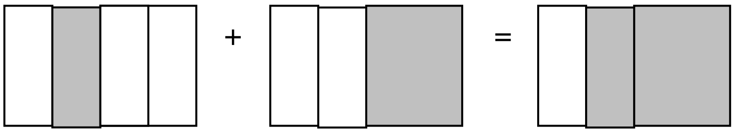
$$\frac{8\ (\div 4)}{12\ (\div 4)} = \frac{2}{3}$$

Adding and Subtracting fractions

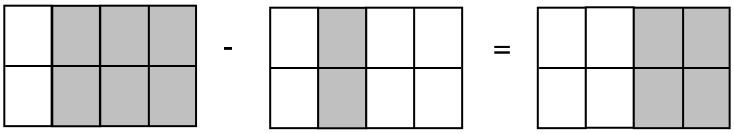
When we add or subtract fractions with the same denominator we simply add or subtract the numerators.

For example:

$\frac{1}{4} + \frac{2}{4} = \frac{3}{4}$

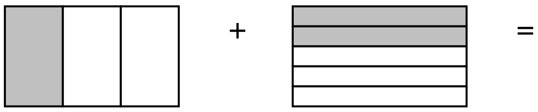


$\frac{6}{8} - \frac{2}{8} = \frac{4}{8}$



When the denominators are different we cannot add or subtract immediately as we are trying to add/ subtract different sized pieces.
For example:

$\frac{1}{3} + \frac{2}{5} =$



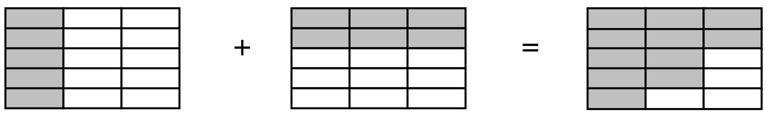
So first we must find the equivalent fractions for 1/3 and 2/5 until we find 2 equivalent fractions with the same denominator

$\frac{1}{3} = \frac{2}{6} = \frac{3}{9} = \frac{4}{12} = \frac{5}{\mathbf{15}}$

$\frac{2}{5} = \frac{4}{10} = \frac{6}{\mathbf{15}}$

so $\frac{1}{3} + \frac{2}{5}$ becomes:

$\frac{5}{15} + \frac{6}{15} = \frac{11}{15}$



Multiplying and Dividing fractions

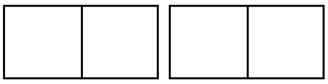
Multiplying fractions is done very easily.
You simply multiply the numerators and then multiply the denominators.
For example

$$\frac{6}{8} \times \frac{2}{3} = \frac{12}{24}$$

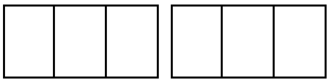
$$\frac{3}{5} \times \frac{5}{6} = \frac{15}{30}$$

Dividing is a little harder. Think of what you are doing when you divide whole numbers.
$6 \div 2 = 3$
You are finding out how many groups of 2 you can take out of 6.
You do the same with fractions.

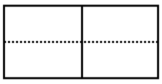
$2 \div \frac{1}{2} = 4$ There are 4 halves in 2 wholes



$2 \div \frac{1}{3} = 6$ There are 6 thirds in 2 wholes



$\frac{1}{2} \div \frac{1}{4} = 2$ There are 2 quarters in 1 half



Of course, not all questions are as easy as those above. So there is a short cut to help.

We turn the second fraction upside down and multiply instead of divide.

$\frac{1}{2} \times \frac{4}{1} = \frac{4}{2} = 2$ ($\frac{4}{2}$ means $4 \div 2 = 2$)

$\frac{5}{11} \div \frac{3}{4}$ becomes $\frac{5}{11} \times \frac{4}{3} = \frac{20}{33}$

Long Multiplication

Under the new syllabus all students must be shown the traditional long multiplication style of answering these questions.

This is where we multiply by the units and the tens separately, then add the two rows together.

To calculate 158 × 67:

First, multiply by 7 (units):

```
 158
x 67
____
1106
```

Then add a zero on the right-hand side of the next row. This is because we want to multiply by 60 (6 tens), which is the same as multiplying by 10 and by 6.

Now multiply by 6:

```
 158
x 67
____
1106
9480
```

Now add your two rows together, and write your answer.

```
  158
 x 67
_____
 1106
 9480
_____
10586
```

So the answer is **10586.**

Most can do this but our students that are below school ready will find this approach difficult. An alternative way that students find much easier is by using the windows/grid method.

For example

6 x 15 needs a 1 by 2 window/grid

	10	5
2	20	10

This allows the number 15 to be split into its component parts of 10 and 5.
The numbers around each box are then multiplied.

To get the answer to 2 x 15 we add the numbers inside the boxes together = 30

15 x 32 need a 2 by 2 window/grid

	10	5
30	300	150
2	20	10

= 300 + 150 + 20 + 10 = 480

Decimals

A decimal is another way of expressing a part of a whole number.

You find the equivalent decimal to a fraction by dividing the numerator by the denominator.
For example:

$\frac{1}{2} = 1 \div 2 = 0.5$ $\frac{3}{4} = 3 \div 4 = 0.75$

We can multiply with decimals using the windows/grid method.
But before we do this we must 'ignore the decimal point'

4.3 x 2.1 becomes 43 x 21

	40	3
20	800	60
1	40	3

= 800 + 60 + 40 + 3 = 903

But we had 2 decimal places in the question – one in the first number and one in the second number. So we must put these <u>2 decimal</u> places back in to make an answer of 9.<u>03</u>
CHECK YOUR ANSWER 4 x 2 = 8 so 9.03 could be correct.

2.2 x 3.54 becomes 22 x 354

	20	2	
300	6000	600	= 6600
50	1000	100	= 1100
4	80	8	= 88

= 7788

Putting back in <u>3 decimal</u> places – one from the first number and 2 from the second number – the answer becomes 7.<u>788</u>

CHECK YOUR ANSWER 2 x 4 = 8 so 7.788 could be correct.

Percentages

The word percentage means 'out of 100'.

One of the things that percentages are used for is comparisons – say in a test.
For example
If I scored 65 out of 100 marks in a test
The fraction would be $\frac{65}{100}$
The decimal would be 65 ÷ 100 = 0.65
The percentage would be 65% (0.65 x 100)

The percentage could be worked out by taking the decimal 0.65 and multiplying by 100.
This is because a decimal represents a quantity out of 1 whole and the percentage takes the quantity out of 100. Therefore, a percentage is 100 times bigger than a decimal.

So let's apply this to a more difficult situation.

If I scored 18 out of 32 marks in a test
The fraction would be $\frac{18}{32}$
The decimal would be 18 ÷ 32 = 0.5625
The percentage would be 56.25% (0.5625 x 100)

There are also times when we need to find a percentage of an amount.
If you have a calculator this is quite easy but the same method can be used with pen and paper.
You first of all divide by 100 to find 1% (remember that to divide by 100 in our heads we need to move all the digits in our number 2 places to the right along our number line).
Then you multiply that answer by the percentage you wish to know.
For example:

Find 32% of £50
1% = 50 ÷ 100 = 0.5
so 32% = 0.5 x 32 = £16

Find 72% of 82g
1% = 82 ÷ 100 = 0.82
so 72% = 0.82 x 72 = 59.04g

	70	2	
80	560	160	5760
2	140	4	144

= 5904 then put the decimals back in = 59.04

Ratio

Ratio is a way of comparing sizes. For example, if one object is twice the size of another we can write this in a ratio which would look like

1:2

This means that the 1st object is ½ the size of the 2nd object and
The 2nd object is twice the size of the 1st object.
Some examples of situations this ratio could refer to are:

£5 and £10
20g and 40g
16 girls and 32 boys

These ratios can be simplified in exactly the same way as equivalent fractions, by looking for the highest common factor. So

£5: £10	HCF = 5	therefore it becomes	£1: £2
20g:40g	HCF = 20	therefore it becomes	1g:2g

If Anne had £10 and her Brother had £30 we could put this in the ratio 10:30 or 1:3.

UNITS MUST BE THE SAME E.g. 200g and 3Kg would be 200:3000 becoming 1:15
Sometimes we have to calculate with ratios.

For example:
If I wanted to make concrete, I have to mix cement and sand in the ratio 1:4.
I need to make 50kg of concrete. How much sand and cement do I need?

Well there is 1-part sand and 4 parts cement which makes 5 equal parts in total.
Therefore, to find 1 part of 50kg I need to calculate 50 ÷ 5 = 10kg
To find 4 parts I multiply the 1 part by 4. 10 x 4 = 40kg
So I need 10kg of cement and 40kg of sand.
I want to share £77 in the ratio 2:5 between Adam and Betty.

Well there are 2 parts for Adam and 5 parts for Betty so that's 7 equal parts in total.
Therefore, to find 1 part of £77 I need to calculate 77 ÷ 7 = £11
To find 2 parts I multiply the 1 part by 2. 11 x 2 = £22
To find 5 parts I multiply the 1 part by 5. 11 x 5 = £55
So Adam gets £22 and Betty gets £55.

Negative Numbers – Multiplying and Dividing

Negative numbers tell us how far we have gone below 0.
Common uses of negative numbers are temperature and money.

Multiplying Negatives follows these rules.

5 x 2 means 5 lots of 2 so

| | | | | | | | | | = 10

5 x –2 means 5 lots of –2 so

-| -| -| -| -| -| -| -| -| -| = -10

4 x –3 means 4 lots of –3 so

-| -|-| -|-| -| -|-| -| -|-| -| = -12

-4 x 2 means 2 groups of –4 so

-| -|-|-| -|-| -|-| = -8

as you can see above: **a negative number x a positive number = a negative number**

for -4 x –3 follow the pattern

3 x –3 = -9
2 x –3 = -6
1 x –3 = -3
0 x –3 = 0
-1 x –3 = 3
-2 x –3 = 6
-3 x –3 = 9
-4 x –3 = 12

As the first number goes down by 1 the answer increases by 3 each time.

Therefore, **a negative number x a negative number = a positive number**

These 2 rules can also be used when we divide negative numbers.

12 ÷ -3 = -4

20 ÷ -4 = -5

-15 ÷ 5 = -3

-18 ÷ -3 = 6

Negative Numbers – Adding and Subtracting

When adding and subtracting negative numbers we can use a number line to help us. Remembering the basics that adding moves us along the number line to the right and that subtracting moves us along the number line to the left.

When looking at a negative number sum:

The first number (including its sign) informs us of our starting point on the number line.

The 2 middle signs tell us whether to add or subtract

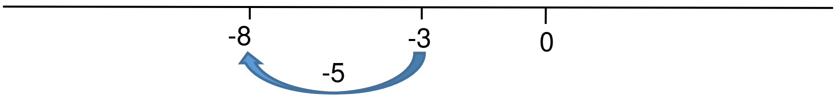
If the 2 signs are the same we add

If the 2 signs are different we subtract.

The last number (without its sign) tells us how many spaces to move.

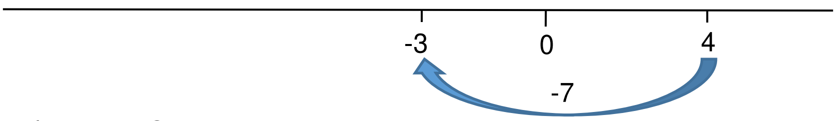
For example:

$^{-}3 + {}^{-}5$ says to start at $^{-}3$ (first number including sign)
The + and $^{-}$ in the middle are different so subtract
We must move 5 spaces (the last number alone)



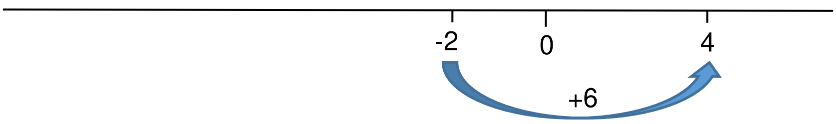
So $^{-}3 + {}^{-}5 = {}^{-}8$

$4 + {}^{-}7$ says to start at 4 (first number including sign)
The + and $^{-}$ in the middle are different so subtract
We must move 7 spaces (the last number alone)



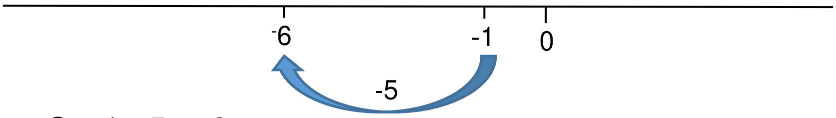
So $4 + {}^{-}7 = {}^{-}3$

$^{-}2 - {}^{-}6$ says to start at $^{-}2$ (first number including sign)
The - and $^{-}$ in the middle are the same so add
We must move 6 spaces (the last number alone)



So $^{-}2 - {}^{-}6 = 4$

$^{-}1 - 5$ says to start at $^{-}1$ (first number including sign)
The - and $^{+}$ in the middle are different so subtract
We must move 5 spaces (the last number alone)



So $^{-}1 - 5 = {}^{-}6$

Short Division

Divide 432 by 8. This says “how many 8s are in 432?” students use the bus stop method.

$$\begin{array}{r|l} & 54 \\ \hline 8 & 432 \end{array}$$

8s into 4 will not go; 8s into 43 go 5 times.
Put the 5 above the 3
5 x 8 = 40 so take 40 away from the 43 to leave 3
Put the 3 next to the 2 to make 32.
8s into 32 go 4 times. Put the 4 above the 2.
So 432 ÷ 8 = 54

There are cases where there will be a remainder. For example, divide 4205 by 4

$$\begin{array}{r|l} & 1051 \\ \hline 4 & 4205 \end{array}$$

4s into 4 go once
Put the 1 above the 4
4s do not go into 2 so put the 2 next to the 0 and add a 0 above the 2.
4s into 20 go 5 times so put the 5 above the 0
4s into 5 go once so put a 1 above the 5.
1 x 4 = 4 so take 4 away from the 5 to leave a remainder of 1.
So 4205 ÷ 4 = 1051 remainder 1.

As your child becomes more able they will add decimal places after the 4205 and carry forward any remainders as they did in the earlier stages of the calculation.
So 4205 is the same as 4205.00, so we can continue like this

$$\begin{array}{r|l} & 1051.25 \\ \hline 4 & 4205.00 \end{array}$$

Put the remainder of 1 next to the first 0 after the decimal place
4s into 10 go 2 times so put the 2 above the 0
2 x 4 = 8 so take 8 away from 10 to get 2.
Put this 2 next to the next zero to make 20.
4s into 20 go 5 times, so put this above.
So 4205 ÷ 4 = 1051.25

Long Division

Students are now taught the traditional method of long division. As with long multiplication some students find this difficult and will resort to using the chunking method (based on repeated subtraction)

Traditional method:

This is a similar method to 'short' division, but, rather than writing the remainder at the top each time, we work it out underneath.

To calculate 748 divided by 51,

First, set the sum out as shown:

```
51)748
```

We work out 74 divided by 51, and write the answer (1) above the 4.

1 × 51 = 51, so we write this underneath 74.

Subtract 51 from 74 to get the remainder (23).

```
     1
51)748
   -51
  ----
    23
```

We now bring down the next digit (8) and write it on the end of the 23.

```
     1
51)748
   -51
  ----
    238
```

We now work out 238 divided by 51, and write the answer (4) above the 8. You use estimation skills here: 51 is roughly 50 and 4 × 50 = 200. You can work out 51 × 4 = 204 separately.

We write 204 underneath the 238 and subtract to find the remainder. There are no more digits to bring down, so we have our answer:

```
     14
51)748
   -51
  ----
    238
   -204
   ----
     34
```

So the answer is **14 remainder 34.**

Chunking method:

For example: How many packs of 24 can we make from 560 biscuits?

We start by asking how many lots of 24 can be subtracted from 560. 10 lots would be 240, so 20 lots would be 480 (should 10 lots be too many in other cases, can we subtract 5 lots, etc.?).

24 | 560
  - 480   24 x ***20***
    80
  - 72   24 x ***3***
    8

Answer: 23 Remainder 8

The key is to record the number of lots down the side, as adding these at the end provides the answer.

Children need to be reminded about **key facts** (‘ready reckoners’), in the above case:
24 x1= ; 24 x 2= ; 24 x 10 = ; 24 x 5 =

As children become more able they will be encouraged to express remainders as fractions or decimals:

So 560 ÷ 24 = 23 remainder 8
We can write this as 23 8/24

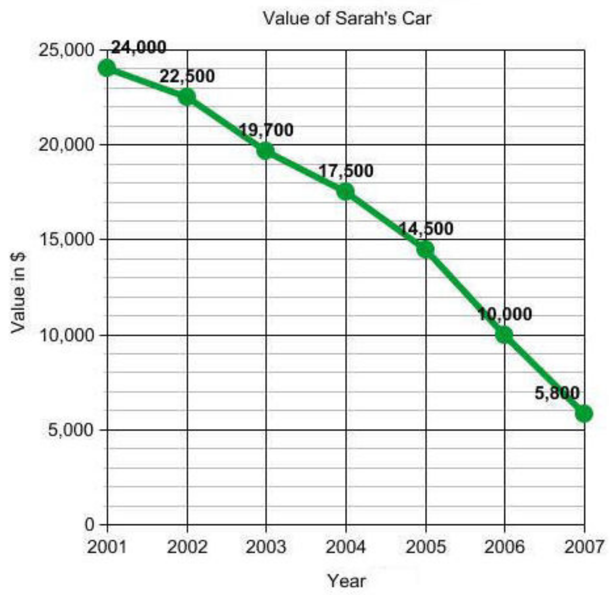
↖ 8 out of a possible group of 24

Axes, Scales and Coordinates

A graph is a picture of numerical information. See example below.

There are 2 axes: the horizontal axis (x axis) and the vertical axis (y axis).

The point at which these axes meet/cross is called the origin.



Both of these axes should <u>always be labelled</u> (in our case year and value in $) and there should be a heading at the top of the graph ("value of Sarah's Car").

When drawing a graph, a sensible scale (the spacing between the labels on the axis) should be chosen. The scale should be such that the graph fills the page without going over the page or being squashed into a corner. Number labels should always be equally spaced.

In our example every year on the x axis and in $5000 steps on the y axis.

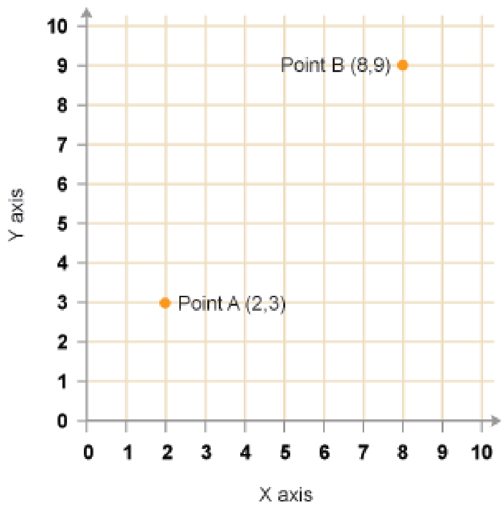
The *coordinates* say where the points are on a graph.

Coordinates are written as two numbers, separated by a comma and contained within round brackets. For example, (2, 3), (5, 7) and (4, 4)

The **first** number refers to the **x** coordinate.

The **second** number refers to the **y** coordinate.

When describing coordinates, always count from the origin. For example, to describe the position of point A, start at the origin and move two squares in the horizontal (x) direction. Then move three squares in the vertical (y) direction. The coordinates of point A are therefore (2, 3) and point B are (8,9)



Continuous and Discrete Data

When we collect numerical data it falls into one of two categories, discrete or continuous.

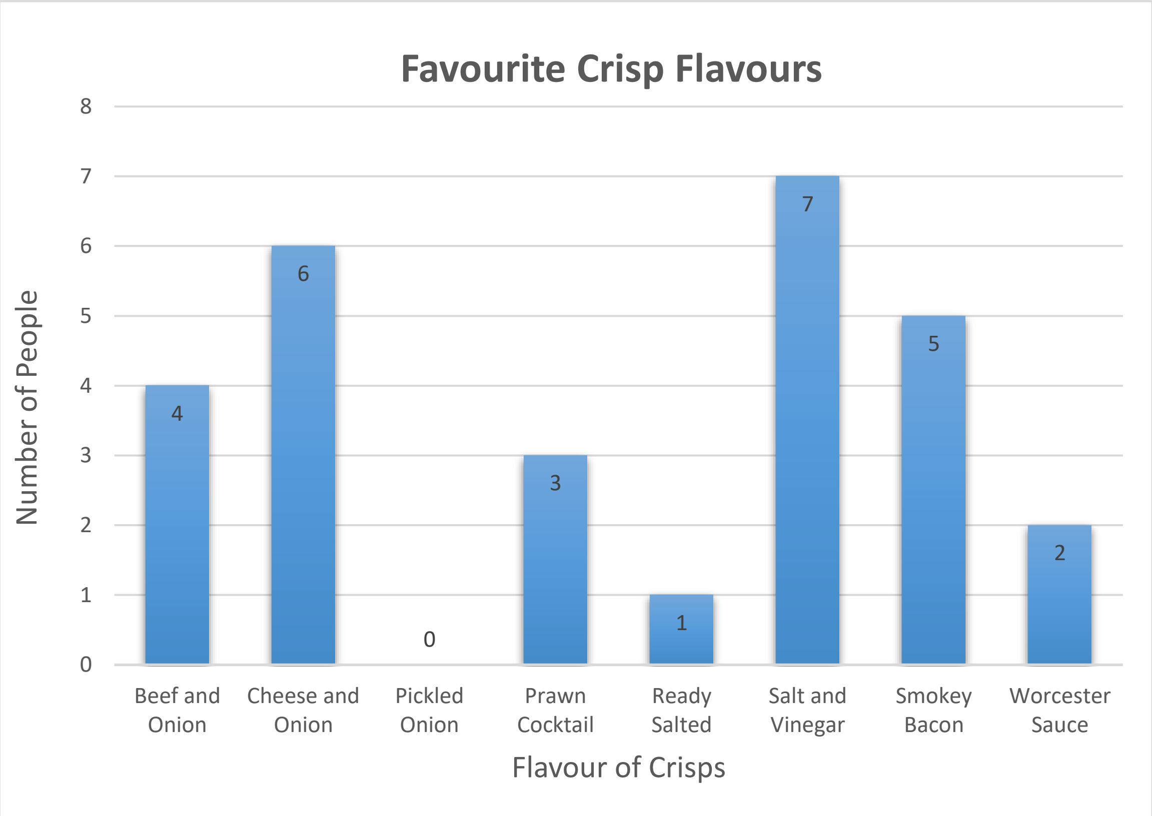
Discrete data is data that is separate, it can be counted e.g., number of students (you can't have 0.4 of a student), shoe size (there is no shoe size 5.7), etc.

Continuous data is data that can be measured. It is continuous with no gaps e.g., weight, height, distance, time, etc.

Bar Charts

A bar chart is a chart with rectangular bars with lengths proportional to the values that they represent or the "frequency". The bars can be plotted vertically or horizontally.

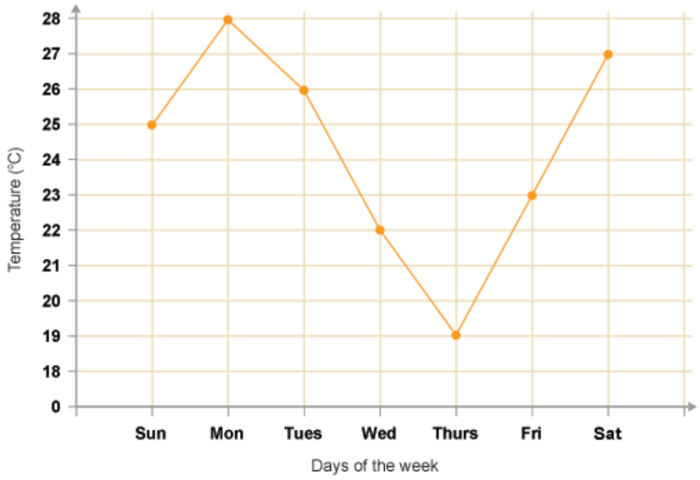
Bar charts are used for discrete data which has discrete values and so should have gaps between the bars.



Line Graphs

A line graph is often used to **show a trend** over a number of days or hours. It is plotted as a series of points, which are then joined with straight lines. The ends of the line graph do not have to join to the axes. The axes are always labelled **on the line**.

The line graph below shows the midday temperature over a period of 7 days. You can see that both the days of the week and the temperatures are labelled on the lines of the graph paper.

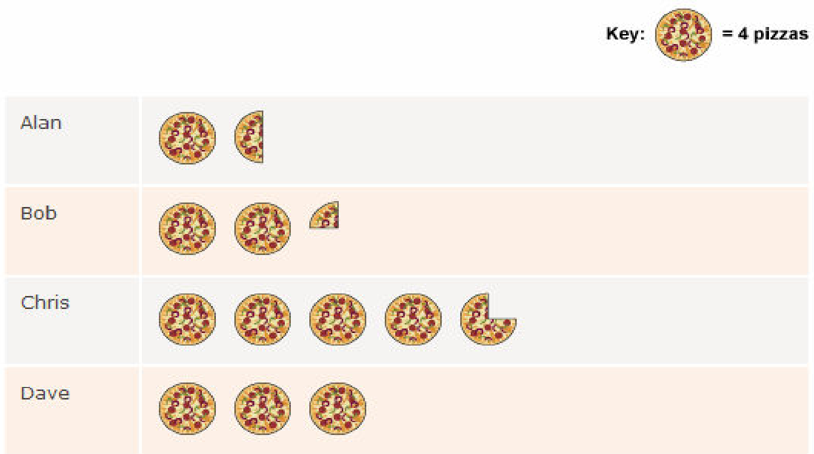


At a glance you can see that the temperature was at its highest on Monday and that it started to fall in the middle of the week before rising again at the end of the week.

Pictograms

A diagram that represents quantities as pictures is called a pictogram. It is very important that every pictogram is accompanied by a key to inform us how many items each picture represents.

e.g, This pictogram shows the number of pizzas eaten by four friends in the past month:



The key tells you that one pizza on the pictogram represents 4 pizzas eaten, so Alan ate 4 + 2 = 6 pizzas.

Pie Charts

Pie carts are another way of showing numerical data in picture form. They use different size sectors of a circle to represent the data proportionally.

In this example we will work through how to calculate the angles at the centre of the pie chart.

Traffic Survey 31 January 2008

Type of vehicle	Number of vehicles
Cars	140
Motorbikes	70
Vans	55
Buses	5
Total vehicles	270

To draw a pie chart, we need to represent each part of the data as a proportion of 360, because there are 360 degrees in a circle.

To work out how many degrees are represented by each vehicle we do

$360 \div 270 = 1.3^{o}$ per vehicle

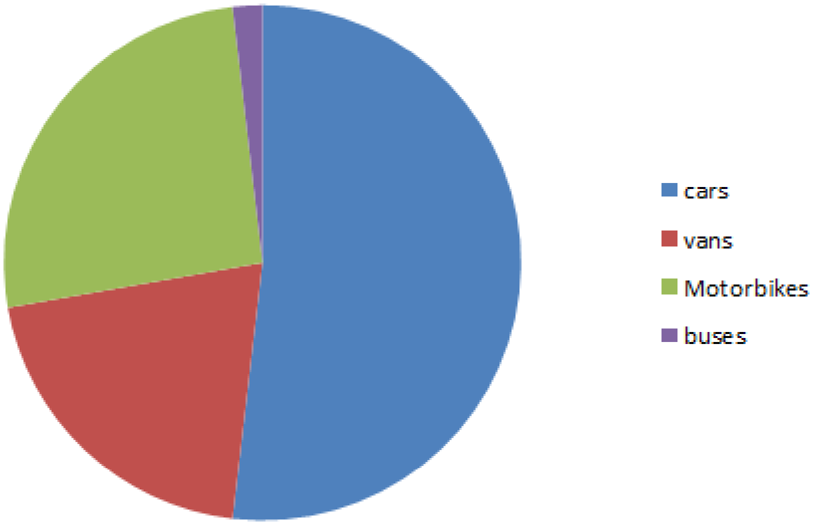
If 55 vehicles are vans, we can then multiply the degrees that represent 1 vehicle by 55 = $1.3^{o} \times 55 = 73$ degrees.

This will give the following results:

Traffic Survey 31 January 2008

Type of vehicle	Number of vehicles	Calculation	Degrees of a circle
Cars	140	$(^{360}/_{270}) \times 140$	= 187
Motorbikes	70	$(^{360}/_{270}) \times 70$	= 93
Vans	55	$(^{360}/_{270}) \times 55$	= 73
Buses	5	$(^{350}/_{270}) \times 5$	= 7

This data is represented on the pie chart below.



You should always remember to label the sectors of the pie chart. This can be done in a key as above or directly on the pie chart itself

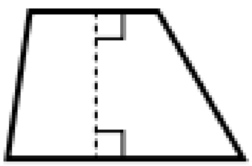
Plane Shapes

The triangle (3 sides) – there are 3 types:

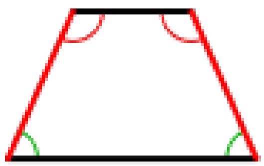
Equilateral triangle, all sides the same length and all angles 60°
Isosceles triangle, 2 sides the same length and 2 angles the same
Scalene triangle, all sides and all angles are different sizes

Quadrilateral (4 sides) – the main quadrilaterals are:

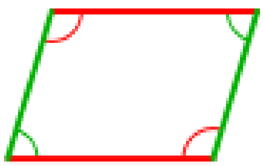
Square, all sides are the same length and all angles are 90°
Rectangle, opposite sides are the same length and all angles are 90°



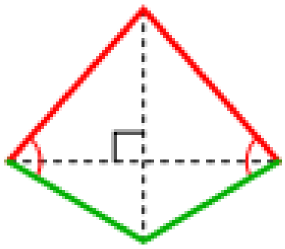
Trapezium
One pair of parallel lines



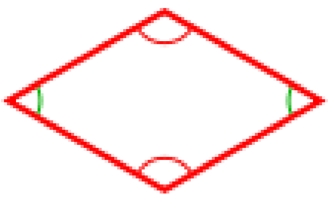
Isosceles Trapezium
One pair of parallel lines, 2 sides same length, 2 pairs of equal angles



Parallellogram
Opposite sides the same length, opposite angles the same.



Kite
2 pairs of equal sides
Side angles the same



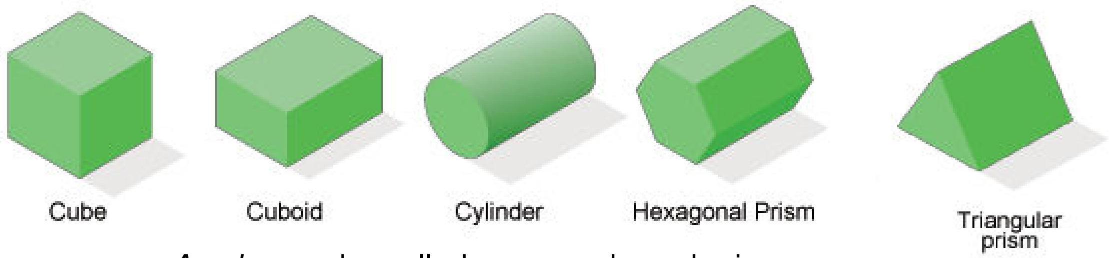
Rhombus
4 sides of equal length
opposite angles the same size

Pentagon (5 sides)
Hexagon (6 sides)
Octagon (8 sides)
Decagon (10 sides)

Solid Shapes

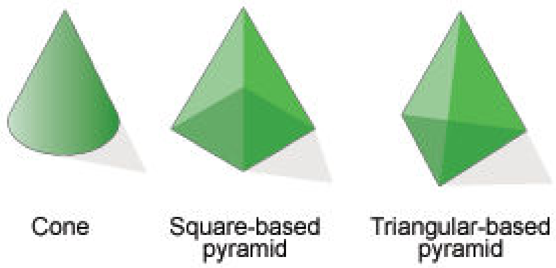
Sphere – a ball shape

Prisms – a prism has the same shape all along its length. The shape that runs throughout the prism gives the shape its name. Some examples are:



A cube can be called a square based prism
A cuboid can be called a rectangular based prism

Pyramids – a pyramid sits on a flat base and comes up to a point. The shape of the base gives the name to the type of pyramid. Some examples are:



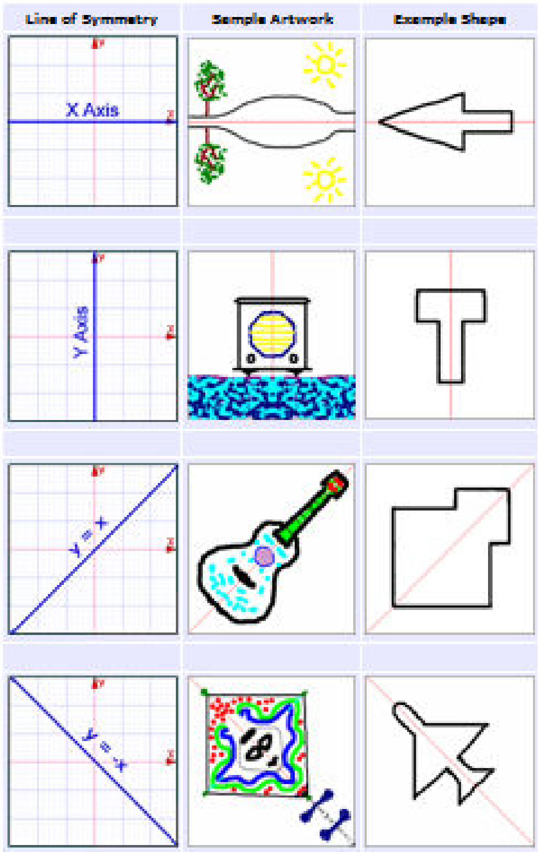
A cone can be called a circular pyramid

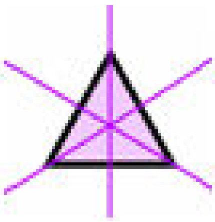
Reflections and Symmetry

The simplest symmetry is Reflection Symmetry (sometimes called *Line Symmetry* or *Mirror Symmetry*). It is easy to recognise, because one half is the reflection of the other half.

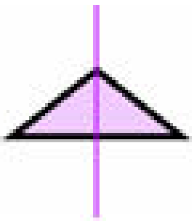
The Line of Symmetry (also called the Mirror Line) does not have to be up-down or left-right, it can be in any direction. But there are four common directions, and they are named for the line they make on the standard XY graph.

See these examples

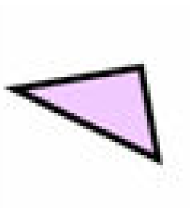




Equilateral Triangle
3 lines of symmetry



Isosceles Triangle
One line of symmetry

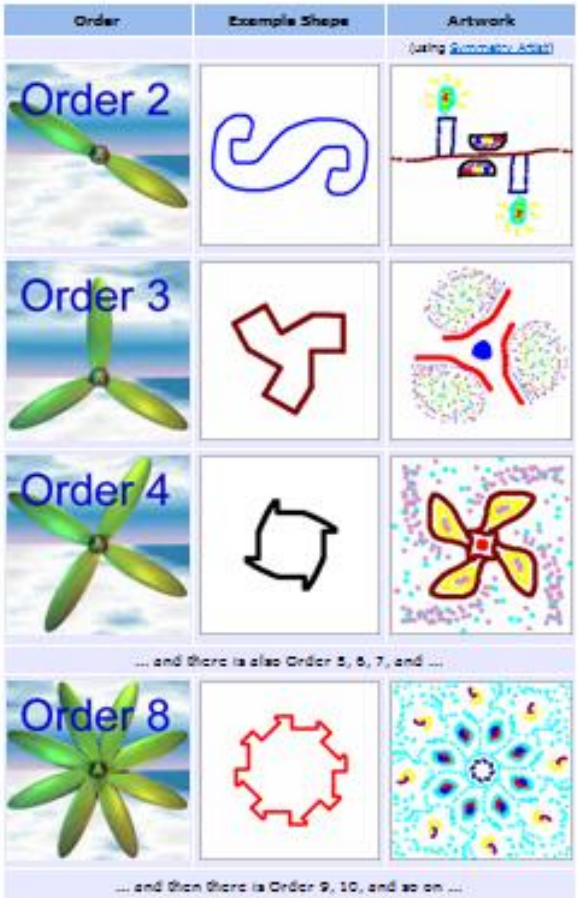


Scalene Triangle
No lines of symmetry

Rotational Symmetry

An object with rotational symmetry is an object that looks the same after a certain amount of rotation. An object may have more than one rotational symmetry. How many matches there are as you go once around is called the “Order”.

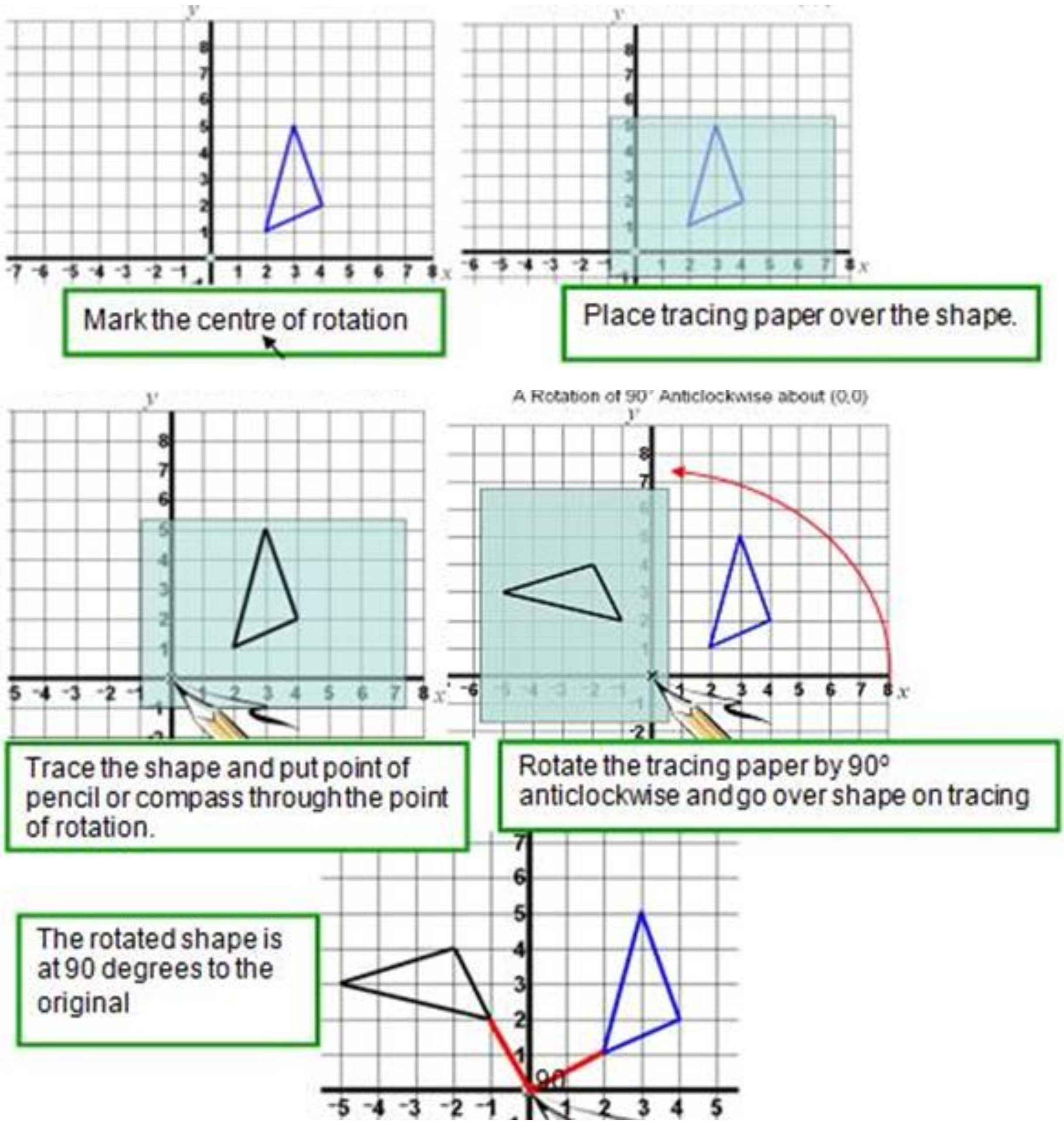
For example



Rotation

A rotation is the circular movement of a shape in either a clockwise or anticlockwise direction. The movement is described by giving the direction of the movement and the angle the object is moved through; we are also given the centre of rotation.

An example of how to do this is given on the next page.
It shows a rotation of 90º anticlockwise through a centre of rotation of (0,0)



Translation

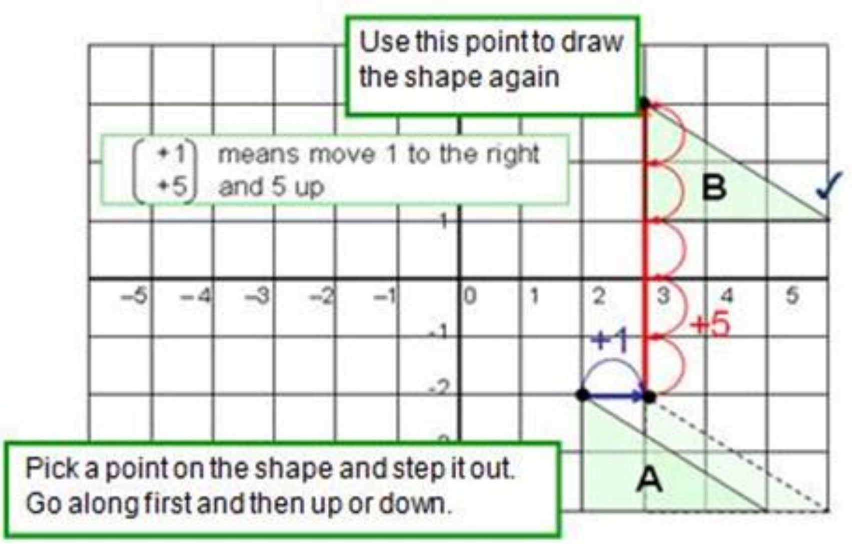
Translating a shape means to move a shape. This can only be done in two directions, horizontally and vertically. The movement of a translation is described by a vector.

The number on the top of the vector describes the horizontal movement
A positive number moves the shape to the right and a negative number moves it to the left.

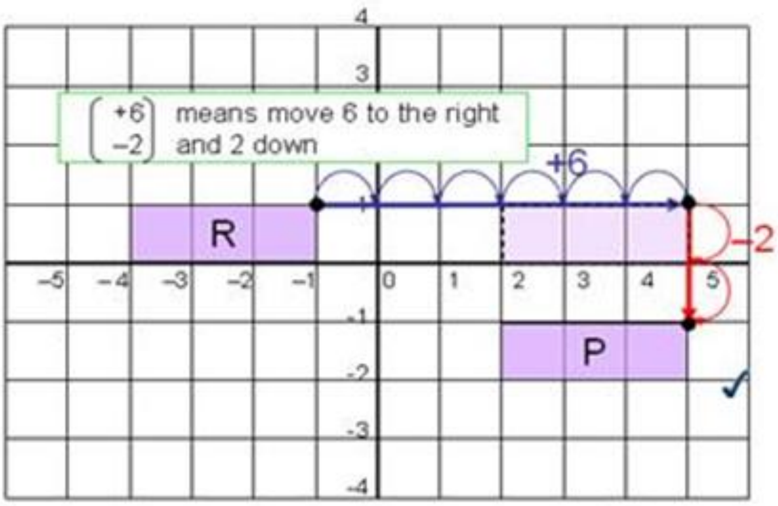
The number on the bottom of the vector describes the vertical movement.
A positive number moves the shape to the up and a negative number moves it down.

For example

a) Translate triangle A by the vector $\begin{pmatrix} +1 \\ +5 \end{pmatrix}$ Label the new triangle B.

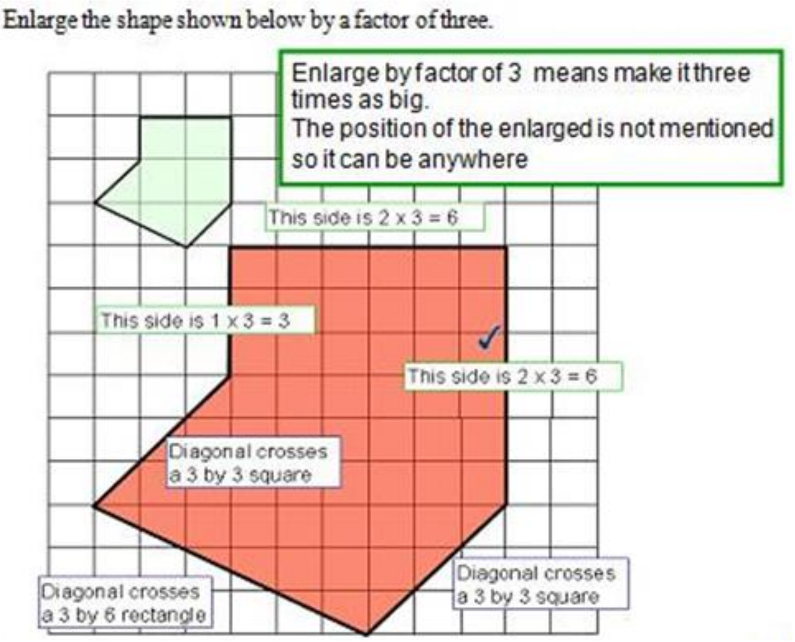


b) Translate rectangle R by the vector $\begin{pmatrix} +6 \\ -2 \end{pmatrix}$ Label the new rectangle P.



Enlargement

In its simplest form an enlargement changes the size of a shape. The new size of the shape is dictated by its scale factor. So a scale factor of 2 will make a shape twice as big, a scale factor of 3 will make it 3 times as big etc. If the scale factor is a fraction the enlarged shape will actually be smaller. Therefore, a scale factor of ½ will make a shape half its original size. For example



At a more advance level the position of the new enlarged shape is also needed. This is dictated by the centre of enlargement. To use the centre of enlargement, you need to measure the distance from the centre to each vertex (corner) of the shape. If there is a scale factor of 2 you now double these values, scale factor 3 triple value etc.
Here is an example of a fractional scale factor with a centre of enlargement of (0,0)