Numeracy across the Curriculum

Numeracy Essentials Guide for Teachers and Parents

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Introduction

Aims of this booklet:

- To enable all teachers and parents to adopt a common approach to numeracy methods across all curriculum areas.

- To enable students to easily recognise the numeracy skills required for their work and ensure consistency in the methods they use.

- To enable parents to build confidence in currently taught methods in order to support their child in numeracy across all curriculum areas.

How to use this Booklet:

- This booklet highlights the importance of ensuring numeracy skills are taught through all curriculum areas, together with indicating how teachers should ensure aspects of numeracy are identified in their planning and highlighted to students.

- The numeracy methods section breaks down the key skills into the 4 core areas of numeracy. Examples are used to show the current widely used methods. In most cases there is more than one method. Teaching staff and parents should be guided by the method which the child feels most confident with, rather than insisting on one particular strategy.

- This guide is not supposed to be exhaustive, but as a guide to current methodology. All topics are not covered, if any further information or support is required; please contact your school's Numeracy Coordinators (Miss A McCabe or Miss L Tisdale) or any member of the math's department.

Our School Vision:

Respect Believe Achieve

Ofsted

Framework for School Inspection – Descriptors for an Outstanding School:

- *There is excellent practice that ensures that all students have high levels of literacy and mathematical knowledge, understanding and skills appropriate to their age.*
- *The teaching of reading, writing, communication and mathematics is highly effective and cohesively planned and implemented across the school curriculum.*
- *The school's actions have secured improvement in achievement for disadvantaged students, which is rising rapidly, including in English and mathematics*
- *Students make substantial and sustained progress throughout year groups across many subjects, including English and mathematics, and learn exceptionally well.*
- *Students acquire knowledge and develop and apply a wide range of skills to great effect in reading, writing, communication and mathematics. They are exceptionally well prepared for the next stage in their education, training or employment.*

"The maths they are taught at school does not necessarily overlap with the maths that can best help them later in life. **Among 16 to 24 year olds who passed their GCSEs with a C or above, only 24% were at the adult equivalent – Level 2** "(Department for Business Innovation and Skills. 2012. "Skills for Life Survey 2011).

Numeracy and the Individual

There is substantial evidence that low numeracy skills are associated with poor outcomes:

- **Employment**
  People with poor numeracy skills are more than twice as likely to be unemployed
- **Wages**
  Recent data by the OECD show a direct relationship between wage distribution and numeracy skills
- **Health**
  In OECD and UK basic skills reports, the correlation between poor numeracy and poor health is clear; data from the British Cohort Studies have shown that there is also a link between depression and poor numeracy
- **Social, emotional and behavioral difficulties**
  Children with these problems are more likely to struggle with numeracy, even taking into account factors such as home background and general ability
- **School exclusions**
  Pupils beginning secondary school with very low numeracy skills but good literacy skills have an exclusion rate twice that of pupils starting secondary school with good numeracy skills
- **Truancy**
  14-year-olds who have poor maths skills at 11 are more than twice as likely to play truant
- **Crime**
  A quarter of young people in custody have a numeracy level below that expected of a 7-year-old, and 65% of adult prisoners have numeracy skills at or below the level expected of an 11-year-old.
  Poor numeracy is also a problem in its own right. It can affect people's confidence and self-esteem. Research from a review of adult up-skilling in numeracy by the Department for Business, Innovation and Skills has demonstrated that improving numeracy directly contributes to growth in personal and social confidence

The Digital Age

The digital age presents us with more numerical data than ever before and puts a new premium on numeracy skills.

Computers can do the mathematical processing for us, but we need good numeracy in order to use them effectively – to enter the right data and decide whether the answer seems approximately right.

Right now around 90% of new graduate jobs require a high level of digital skills (Race Online 2012), and digital skills are built on numeracy.

The numeracy programme will aim to prepare students for everyday life through regular practical application of mathematics across a diverse range of activities and contexts delivered by all curriculum areas.

The policy will ensure that:

- All classroom teachers and support staff have responsibility for promoting numeracy within their specialist subject.
- Staff are given appropriate training to ensure that Numeracy opportunities are addressed within lessons.
- Where pertinent, classroom teachers support the whole school's management of numeracy through highlighting numeracy in schemes of learning and delivering numeracy content using consistent formulas, terms and methods.
- School Leaders and numeracy ambassadors rigorously monitor and review how effectively teachers are developing students’ Numeracy skills and identify priorities for Numeracy within their subject areas.
- Numeracy ambassadors promote the numeracy within their subject areas and ensure they are a key feature of day to day learning and teaching.

Essentials of Numeracy: Day to Day Learning and Teaching

The teaching of numeracy should not be considered an ‘add on’ in lesson planning and any numeracy opportunity that arises should be addressed.

In addition to mathematics lessons, students should be supported across the curriculum in the four essentials of numeracy:

- 1. Numbers
- 2. Operations and Calculations
- 3. Handling Information
- 4. Shape, Space and Measures

Liverpool Counts Quality Mark.

In 2017, Cardinal Heenan is working towards being awarded the "Liverpool Counts Quality Mark" award.

- The Liverpool Counts Quality Mark is part of a varied programme of strategies targeted at improving maths results for the city's children.

- The specific remit of the Quality Mark is to tackle the negative attitudes which are prevalent in many areas of our society towards numeracy and mathematics.

- We aim to challenge these widely held views and promote a culture where people readily understand the impact good numeracy skills and mathematics qualifications can have on the social, financial, health and employment aspects of their lives.

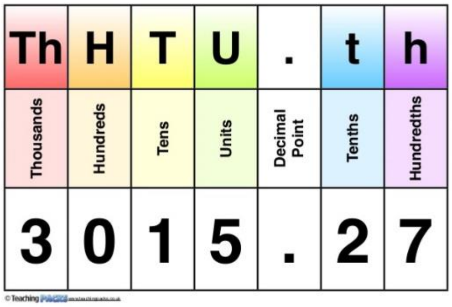
- We also aim to support teachers and other adults in our schools to encourage pupils to make connections in their numeracy and mathematics lessons to real life contexts and with other areas of their school experiences.

COMMON METHODOLOGY

NUMBER

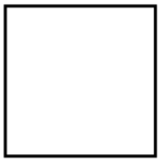
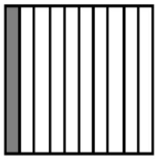
Place Value

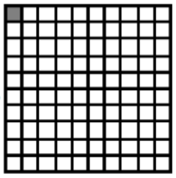
- Every number can be 'partitioned' into its component parts



Th	H	T	U	.	t	h
Thousands	Hundreds	Tens	Units	Decimal Point	Tenths	Hundredths
3	0	1	5	.	2	7

e.g.
3015.27 = 3000 + 10 + 5 + 0.2 + 0.07

If this is 1 unit  then this is 1 **tenth** or 0.1 

and this is 1 **hundredth** or 0.01. 

0.1 = 1 tenth 1/10, tenths are the first column after the decimal point. There are ten tenths in a whole.

0.01 = 1 hundredth 1/100. There are ten hundredths in a tenth.

Always ensure the columns are lined up. Line up the decimal point on top of each other.

```
e.g.        123.49            NOT 123.49
   +         36.4                     36.4
            ______
```

Square numbers

Square numbers are the result of multiplying a number by itself.
e.g. 1 x 1 = 1,
2 x 2 = 4,
3 x 3 = 9 and so on

These are written using powers e.g. 4 x 4 = 4^2

The first 15 square numbers that pupils will be required to identify are;

1 4 9 16 25 36 49 64 81 100 121 144 169 196 225

They can be used in many aspects of mathematics, including finding area of circles.

Pupils are required to know that the inverse operation for squaring a number is the square root √.

e.g. √1 = ±1
√4 = ±2
√9 = ±3 and so on…

-4 x -4 = 16 Therefore √16 can be -4 as well as 4.

Estimation and rounding

We can use rounded numbers to give us an approximation. We can then use this to estimate the answer to a calculation. This allows us to check that our answer is sensible. We generally round using the first non-zero digit i.e. 1st significant figure.

Rounding Whole Numbers

To round a number, we must first identify the number of places to which we want to round. Then look at the next digit on the right (the "check digit") - if it is 5 or more round up, if below 5 the number stays the same.

Example Round 48 753 to the nearest thousand.

8 is the digit in the thousands column - the check digit (in the hundreds column) is 7, so round up.

48 753 = 49 000 to the nearest thousand

Rounding to Decimal Places

Example Round 1.56359 to 2 decimal places

The second number after the decimal point is a 6 - the check digit is a 3, so keep the 6 the same.

1.56359

= 1.56 to 2 decimal places

Rounding to Significant Figures

Numbers can also be rounded to a given number of significant figures.
Start with the first non-zero number. This is the 1st significant figure.

Example Round 0.15273 to 2 significant figures

The first significant figure is 1 in the tenths place
The second significant figure is 5 in the hundredths place

0 . 1 52 7 3
↗ ↖
1st 2nd

We then look at the check digit and decide whether to round the 5 up or keep it the same. It is 2 so keep the 5 the same.

= 0 . 1 5 to 2 significant figures

Example Round 28 987 to 2 significant figures

The first significant figure is 2 in the tens thousands place
The second significant figure is 8 in the thousands place

28 987
↗ ↖
1st 2nd

We then look at the check digit and decide whether to round the 5 up or keep it the same. It is 9 so round the 8 up. We need to keep the size of the number so we use 0's as place holders

= 29 000 to 2 significant figure

OPERATIONS AND CALCULATIONS

Addition and Subtraction, Multiplication and Division,

Addition

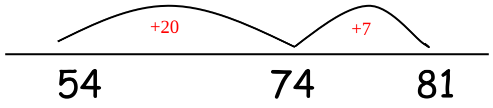
Mental strategies – There are a number of strategies to complete mentally

Example Calculate 54 + 27

Method 1 Add tens, then add units, then add together

50 + 20 = 70   4 + 7 = 11   70 + 11 = 81

Method 2 This can also be written on a number line, adding 20 to 54, and then 7 to 74.

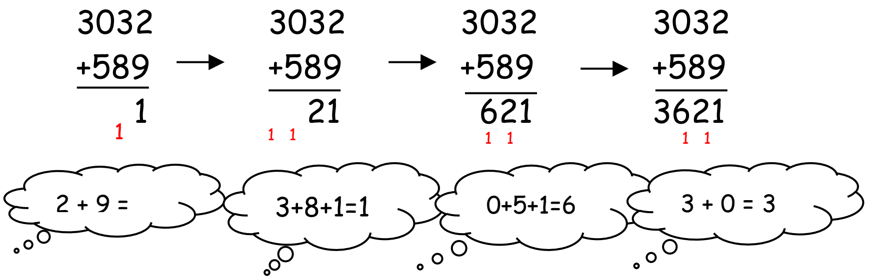


Written Method

When adding numbers, ensure that the numbers are **lined up** according to place value. Start at right hand side, write down units, and carry any tens as 1.

Example I spend £3032 a year on my car loan. My insurance is £589. How much is this in total?

METHOD 1



Subtraction

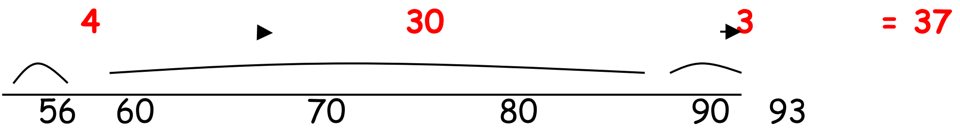
Traditional Column Method can be used, but 'Number Line' Method can be linked to Addition, to also complete Subtraction. This links with Partitioning too!

Mental/Written Strategies

Example **Calculate 93 - 56**

Method 1 Counting on a Number line

Count on from 56 until you reach 93. This can be done in several ways e.g.



Column Method

Example 1 4590 - 386

Example 2 Subtract 692 from 14597

$$\begin{array}{r} 45\overset{8}{\cancel{9}}{}^{1}0 \\ -\ 386 \\ \hline 4204 \\ \hline \end{array}$$

$$\begin{array}{r} 1\overset{3}{\cancel{4}}{}^{1}597 \\ -\ \ 692 \\ \hline 13905 \\ \hline \end{array}$$

'Borrow from the person next door.'

Multiplication of Whole Numbers

The times tables up to the 12's should be known. These can be used to find any other multiplication sum.

Mental Strategies

You should use the times tables up to 12 x, to help you answer harder questions

Example Find 39 x 6

Method 1

30 x 6
= 180

9 x 6
= 54

180 + 54
= 234

Method 2

40 x 6
=240

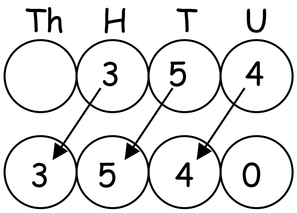
40 is 1 too
many so take
away 6x1

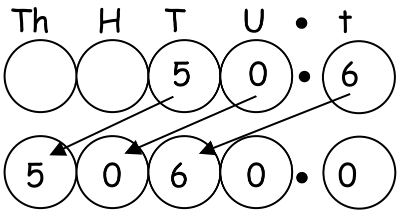
240 - 6
= 234

Multiplying by multiples of 10 and 100

To multiply by **10** you move every digit ***one*** place to the left.
To multiply by **100** you move every digit ***two*** places to the left.

Example 1 (a) Multiply 354 by 10 (b) Multiply 50.6 by 100





354 x 10 = 3540

50.6 x 100 = 5060

(c) 35 x 30

To multiply by 30, multiply by 3, then by 10.

35 x 3 = 105
105 x 10 = 1050

so 35 x 30 = **1050**

(d) 436 x 600

To multiply by 600, multiply by 6, then by 100.

436 x 6 = 2616
2616 x 100 = 261600

so 436 x 600 = **261600**

We can also use these rules for multiplying decimal numbers.

Example 2 (a) 2.36 x 20 (b) 38.4 x 50

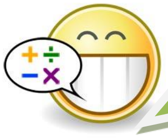
2.36 x 2 = 4.72
4.72 x 10 = 47.2

so 2.36 x 20 = 47.2

38.4 x 5 = 192.0
192.0x 10 = 1920

so 38.4 x 50 = 1920

Multiplying larger numbers



There are a number of methods including mental methods like those above. The most commonly taught method is now the grid method. If a student is confident at column multiplication, and is always accurate, they should continue to use this method. If mistakes occur, they should try grid method.

Example

There are 35 seats in a row, and 37 rows of seats. Work out if there are enough seats for 1100 people, or will more rows need to be added?

Method 1

Grid Multiplication – This is now the most consistently used method at Secondary level. It uses the smaller multiples to build up larger multiplication sums.

- ✓ Partition the numbers into tens and units.
- ✓ Multiply the values 'on the edges',
- ✓ Add up the boxes.

X	30	7
30	=30 x 30 **=900**	= 7 x 30 **=210**
5	=30 x 5 **=150**	=7 x 5 **= 35**

= 900 +210

= 1110

= 150+35

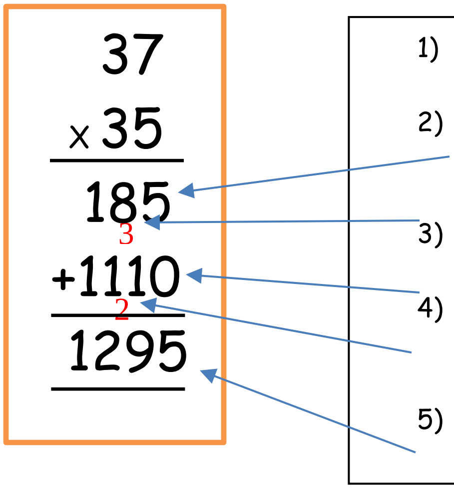
= 185

1110 + 185 = 1295

Method 2

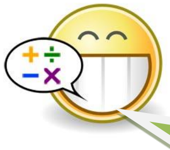
Long Multiplication - This has recently been re-introduced as the desired written formal method from 2015

37 x 35



1) The larger number is placed on the top row and both numbers are correctly lined up.
2) Start by multiplying everything on the top by the units on the bottom (5 x 7 = 35, put the 5 down and carry the 3).
   (5 x 3) + 3 (that was carried) = 18
3) Multiply by the 10's on the bottom. Therefore to signify the size of the number put a 0 down in the units column.
4) Multiply everything on the top by the tens on the bottom (3 x 7 = 21, put the 1 down and carry the 2.
   (3x3) + 2 = 11
5) Finally add the 2 answers

Division



To divide by **10** you move every digit ***one*** place to the right.
To divide by **100** you move every digit ***two*** places to the right.

Written Method for other Division

Example 1 There are 192 students in first year, shared equally between 8 classes. How many students are in each class?

$$\begin{array}{rl} & \,2\,4 \\ 8 & \overline{)\,1^{1}9^{3}2} \end{array}$$

There are 24 students in each class

1. Set up the calculation by putting the number you are dividing by on the outside of the “bus stop”
2. How many 8’s can go into 1? Zero. This means that 1 is carried to the following number.
3. How many 8’s can go into 19? 2 (2 x 8 = 16) 3 left over. This is then carried to the following number.
4. How many 8’s can go into 32? 4 (4 x 8 = 32) No remainders so the calculation can be finished.

Example 2 Divide 4.74 by 3

$$\begin{array}{rl} & 1\,.\,5\,8 \\ 3 & \overline{)\,4\,.\,{}^{1}7\,{}^{2}4} \end{array}$$

When dividing a decimal number by a whole number, the decimal points must stay in line.

Example 3 A jug contains 2.2 litres of juice. If it is poured evenly into 8 glasses, how much juice is in each glass?

$$\begin{array}{rl} & 0\,.\,2\,7\,5 \\ 8 & \overline{)\,2\,.\,{}^{2}2\,{}^{6}0\,{}^{4}0} \end{array}$$

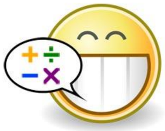
Each glass contains
<u>**0.275 litres**</u>

If you have a remainder at the end of a calculation, add a zero onto the end of the decimal and continue with the calculation.

Order of Calculation (BIDMAS)

What is the answer to 2 + 5 x 8 ?

Is it 7 x 8 = 56 or 2 + 40 = 42 ?
The correct answer is **42**.



The rule means Brackets should be done first.

(B)rackets
(I)ndices
(D)ivide
(M)ultiply
(A)dd
(S)ubract

Scientific calculators use this rule automatically, some basic calculators may not, so take care in their use.

Example 1 15 – 12 ÷ 6 BIDMAS tells us to divide first
= 15 – 2
= 13

Example 2 (9 + 5) x 6 BIDMAS tells us to work out the brackets first
= 14 x 6
= 84

Example 3 18 + 6 ÷ (5-2) **Brackets first**
= 18 + 6 ÷ 3 Then divide
= 18 + 2 Now add
= 20

Negative Numbers:

Adding a negative number is the same as subtracting.

Subtracting a negative number is the same as adding.

Using a number line:

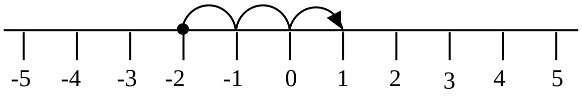
To ADD count to the right. →

To SUBTRACT count to the left. ←

Examples:

1. -2 +3

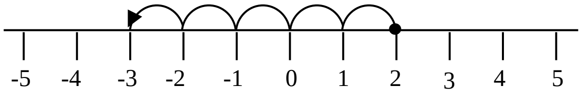
Start at -2
Move 3 places to the right



-2 +3 =1

2. 2+ (-5)

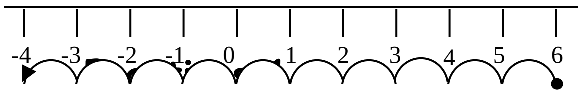
=2 -5
Start at 2
Move 5 places to the left



2 + (-5) = 3

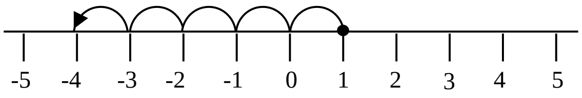
3. 6 - 10

Start at 6
Move 10 places to the left



6 -10 = -4

4. -4 - (-5)
= -4 +5
Start at -4
Move 5 places to the right



-4 - (-5) = 1

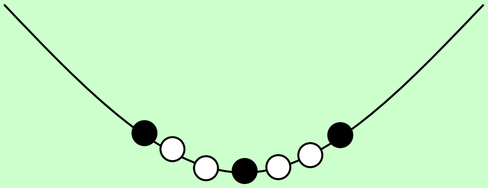
Fractions

Fractions are used to give a proportion of another value or to state how much of a total something is. For example $\frac{1}{4}$ of my salary goes on my mortgage.

Understanding Fractions

Example

A necklace is made from black and white beads.

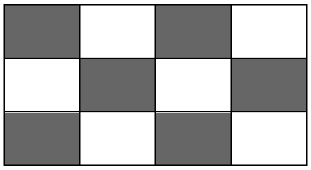


What fraction of the beads are black?

There are 3 black beads out of a total of 7, so $\frac{3}{7}$ of the beads are black.

Equivalent Fractions

What fraction of the flag is shaded?



6 out of 12 squares are shaded.

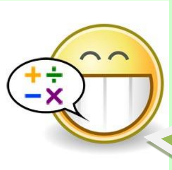
So $\frac{6}{12}$ of the flag is shaded. (6 twelfths)

It could also be said that $\frac{1}{2}$ the flag is shaded.

$\frac{6}{12}$ and $\frac{1}{2}$ are **equivalent fractions**.

Simplifying Fractions

Equivalent fractions can be simplified as shown below:



The top of a fraction is called the **numerator**; the bottom is called the **denominator**. Both must be whole numbers. To simplify a fraction, divide the **numerator** and **denominator** of the fraction by the **Highest Common Factor** (HCF).

Example 1

(a)

$$\overset{\div 5\ (\text{HCF})}{\frac{20}{25} = \frac{4}{5}}$$

÷5 (HCF)

(b)

$$\overset{\div 8\ (\text{HCF})}{\frac{16}{24} = \frac{2}{3}}$$

÷8 (HCF)

This can be done again and again until the numerator and denominator are the smallest possible numbers - the fraction is then said to be in its <u>simplest form.</u>

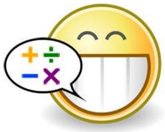
Think of a pizza, 2/3 or pizza is the same as 4/6 of a pizza, only that the slices are bigger or smaller!

Example 2

Simplify $\frac{72}{84}$

$$\frac{72}{84} = \frac{36}{42} = \frac{18}{21} = \frac{6}{7}\ \text{(simplest form)}$$

Calculating Fractions of a Quantity



Fractions share amounts into equal parts.

So to find $\frac{1}{2}$ divide by 2, to find $\frac{1}{3}$ divide by 3, to find $\frac{1}{7}$ divide by 7 etc.

Example 1 Find $\frac{1}{5}$ of £150

$\frac{1}{5}$ of £150 = £150 ÷ 5 = **£30**

To find a unit fraction (e.g. ¼) divide by the bottom number.

Example 2 Find $\frac{5}{7}$ of 28

To First find $\frac{1}{7}$ of 28 then x 5

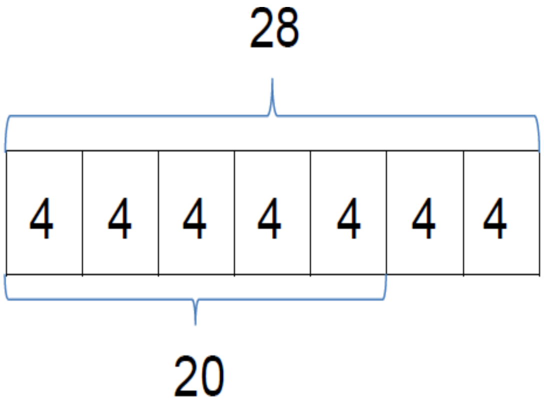
Calculations

28 ÷ 7 = 4

5 x 4 = 20

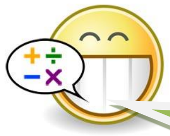
Therefore $\frac{5}{7}$ of 28 = 20

Bar Model Method



Percentages

Percentage means 'out of 100'. We divide or multiply to make any value out of 100 to write as a percent. They are widely used to give a way of comparing one value out of another. They can be used by shops (sales & discounts), banks (interest rates), and the government (tax rates).



The key percentage building blocks can be used to 'build up' any percentage. They are 100% (all of the amount), 50%, 25%, 10%, 5% and 1%. It is vital to know these to get any harder percentage.

Building Blocks

To get any of the building blocks, divide the amount by the following:

100% - All of the amount you start with

50% - divide by 2

25% - divide by 4 or find 50% and divide by 2

10% - divide by 10

1% - divide by 100.

Some people find using the fraction equivalent easier if they understand e.g.

25% of £640 = $\frac{1}{4}$ of £640 = £640 ÷ 4 = **£160**

Finding Percentages

Real life link: Percentages are used in a variety of places in real life, such as sales in shops, tax on wages and interest on loans, mortgages and bank accounts.

Non- Calculator Methods

Example *An Xbox game decreases by 30% from £45. How much will I save?*

Step 1) 'Build the percentage' - 30%= 10% + 10% + 10%

Step 2) Find the percentages. 10% of £45 = 45 ÷ 10

= £4.50

(As there are 10 lots of 10% in 100%).

Step 3) Add the amounts together. £4.50+£4.50+£4.50 = **£13.50**

So **30% of £45 = £13.50**

Example 2 *A £1,200 holiday to Disneyland has a 6% saving for 1 week only, how much will I save?*

Step 1) 'Build the percentage' - 6%= 5% + 1%

Step 2) Find the percentages. 10% of £1,200 = 1200 ÷ 10

= £120

5% of £1,200= 120 ÷ 2 (Half of 10%)

= £60

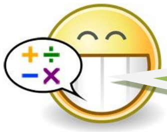
1% of £1,200 = 1200 ÷ 100 = £12

(as there are 100 lots of 1% in 100%)

Step 3) Add the amounts together. £60 + £12 = £72

So **6% of £1200 = £72**

Expressing a quantity as a percentage



To find a number as a percentage of another number, first make a fraction, this can then be expressed as a percentage by finding that fraction of 100%.

Example 1 There are 30 students in Class 3M. 18 are girls.
What percentage of Class 3M are girls?

OR $\frac{18}{30} \times 100 = 60$

60% of 3M are girls

Example 2 James scored 36 out of 44 his biology test. What is his percentage mark?

Score = $\frac{36}{44} \times 100 = 81.818..\% =$ **82% (rounded)**

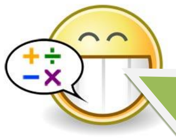
Example 3 Equivalent Fraction Method

In class 2K, 14 students had brown hair, 6 students had blonde hair, 3 had black hair and 2 had red hair. What percentage of the students were blonde?

Total number of students = 14 + 6 + 3 + 2 = 25
6 out of 25 were blonde

$$\frac{6}{25} \overset{\times 4}{=} \frac{24}{100}$$ = **24% were blonde**

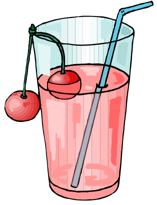
Ratio



When quantities are to be mixed together, the ratio, or proportion of each quantity is often given. The ratio can be used to calculate the amount of each quantity, or to share a total into parts.

Writing Ratios

Example 1



To make a fruit drink, 4 parts water is mixed with 1 part of cordial.

The ratio of water to cordial is 4:1

(said "4 to 1")

The ratio of cordial to water is 1:4.

Order is important when writing ratios.

Example 2

In a bag of balloons, there are 5 red, 7 blue and 8 green balloons.

The ratio of red : blue : green is 5 : 7 : 8

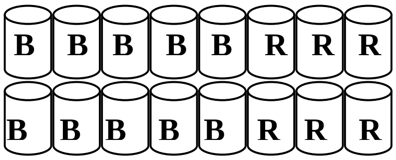
Simplifying Ratios

Ratios can be simplified in much the same way as fractions.

Example 1

Purple paint can be made by mixing 10 tins of blue paint with 6 tins of red. The ratio of blue to red can be written as 10 : 6

It can also be written as 5 : 3, as it is possible to split up the tins into 2 groups, each containing 5 tins of blue and 3 tins of red.



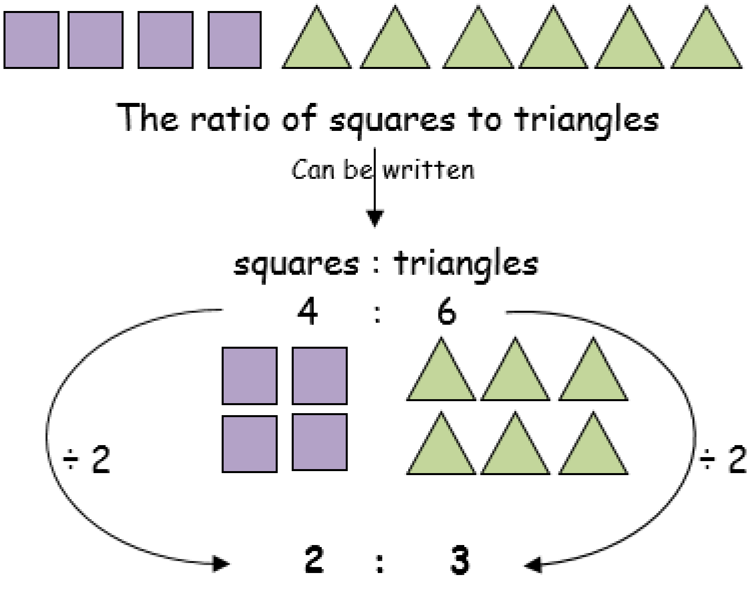
Blue:Red =10:6

= 5:3

To simplify a ratio, divide each figure in the ratio by the highest number that goes into both numbers.

Simplifying Ratios (continued)

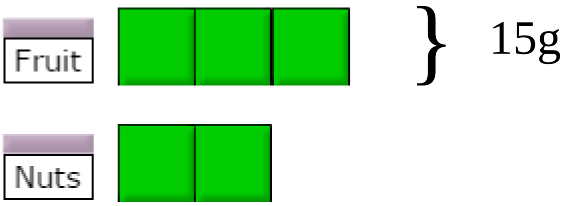
Example 2



Ratios can be simplified just like fractions by dividing both by the highest common factor

Using ratios

The ratio of fruit to nuts in a chocolate bar is 3 : 2. If a bar contains 15g of fruit, what weight of nuts will it contain?



3 equal parts is 15g. Therefore 1 equal part is worth 5g.

So the chocolate bar will contain 10g of nuts.

Sharing in a given ratio

Lauren and Sean earn money by washing cars. By the end of the day they have made £90. As Lauren did more of the work, they decide to share the profits in the ratio 3:2. How much money did each receive?

Step 1 Add up the numbers to find the total number of parts

3 + 2 = 5

Step 2 Divide the total by this number to find the value of each part

90 ÷ 5 = £18

Step 3 Multiply each figure by the value of each part

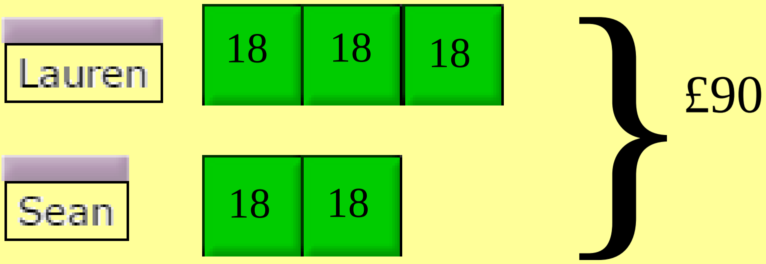
3 x £18 = £54
2 x £18 = £36

Step 4 Check that the total is correct

£54 + £36 = £90 √

Lauren received £54 and Sean received £36

OR



Money & Decimal Places

All calculations of money need to be written down to 2 decimal places (to the nearest penny) this could mean that we need to round numbers:

Example 1 Round £1.525 to 2 decimal places

The second number after the decimal point is a 2 - the check digit is a 5, so round up.

1.525

= £1.53 to 2 decimal places

We may also need to put in zeros to show our answers to 2 decimal places:

Example 2 Calculate the total cost of the following items

Pencil	20p
Pen	40p
Rubber	30p
Ruler	75p
Sharpener	25p

Total cost = 190p
= £1.90 to 2 decimal places

Never use pounds and pence together e.g £1.90p ×

Either £1.90 or 190p

Problem solving – best buy

When comparing items you need to calculate the same amount in order to compare.

Which supermarket has the best buy?

ASDA

500g for 50p

Sainsbury's

£1.20 for 1kg

TESCO

3kg is £3.20

MORRISONS

Buy 2 for £1.00. One bag is 500g

÷ 500

500g	50p
1g	0.10p

÷ 500

÷ 1000

1000g	120p
1g	0.12p

÷ 1000

÷ 3000

3000g	320p
1g	0.11p

÷ 3000

÷ 1000

1000g	100p
1g	0.10p

÷ 1000

You can see from our calculations above that ASDA and Morrison's are both the best buy at 10p per gram.

Which offer is the best value?

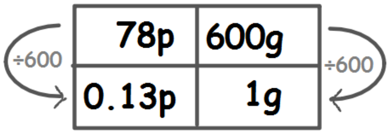
To work this out we need to work out the 'price per one' of something. This can be 100g, 1kg, 1 unit etc. The quantity or amount of each product needs to be the same for a comparison.

Look at the following special offers.

'Swarbricks'	Brown's Bread	Wheaty Bake
600g	800g	790g
78p per loaf	£1.20	98p
3 for 2	20% extra free	10% discount

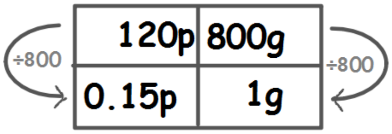
a) Which offers the best value for money per gram of bread without the special offer?

Swarbricks: =



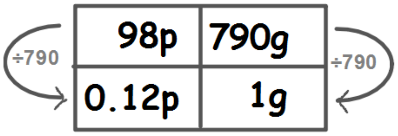
78p	600g
0.13p	1g

Brown's Bread =



120p	800g
0.15p	1g

Wheaty Bake =



98p	790g
0.12p	1g

Wheaty Bake is the best value for money at 0.12p per gram

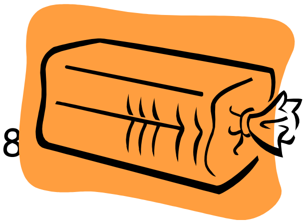
b) Which offers the best value for money per gram of bread with the special offer?

Swarbricks: 3 for the price of 2
Cost = 2 x 78
= 156p
Grams = 3 x 600g
= 1800g

Cost per gram =

÷1800	156p	1800g	÷1800
	0.09p	1g	

Brown's Bread 20% extra free
Cost = 120p
Grams = 800g + (20% of 8
= 800g + 160g
= 960g



Cost per gram =

÷960	120p	960g	÷960
	0.13p	1g	

Brown's Bread: 10% extra free
Cost = 98p – (10% of 98p)
= 98p – 9.8p
= 88.2p
Grams = 790g

Cost per gram =

÷790	88p	790g	÷790
	0.11p	1g	

The Swarbrick's special offer is the best value for money.

SHAPE, SPACE AND MEASURES TIME

Time

Time may be expressed in 12 or 24 hour

12-hour clock

Time can be displayed on a clock face, or digital clock.

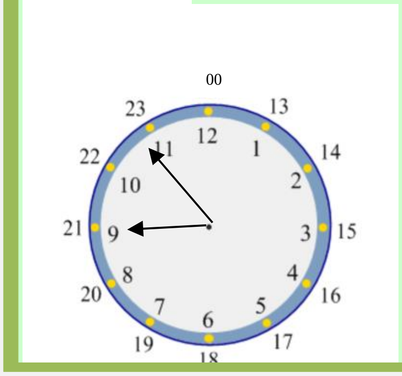
When writing times in 12 hour clock, we need to add a.m. or p.m. after the time.

a.m. is used for times between midnight and 12 noon (morning)

p.m. is used for times between 12 noon and midnight (afternoon / evening).

24-hour clock

In 24 hour clock, the hours are written as numbers between 00 to 23. Midnight is expressed as 00:00 NOT 24:00. After 12 noon, the hours are numbered 13, 14, 15 … etc.



Examples

9:55 am	is	09:55 hours
3:35 pm	is	15:35 hours
12:20 am	is	00:20 hours
02:16 hours	is	2:16 am
20:45 hours	is	8:45 pm

Time Periods

It is essential to know the number of months, weeks and days in a year, and the number of days in each month.

Time Facts

In 1 year, there are: 365 days (366 in a leap year)
52 weeks
12 months

These clocks both show fifteen minutes past five, or quarter past five.

The number of days in each month can be remembered using the rhyme:

“30 days hath September,
April, June and November,
All the rest have 31,
Except February alone,
Which has 28 days clear,
And 29 in each leap year.”

Interpreting Timetables – Change to appropriate timetable

Destination	Time	Time	Time	Time	Time	Time	Time	Time	Time
Thurso Business Park	0645	0745	0905	1005	1105	1205	1305	1405	1505
Olrig Street Job Centre	0650	0750	0910	1010	1110	1210	1310	1410	1510
Halkirk Sinclair Street	0705	0805	0925	1025	1125	1225	1325	1425	1525
Watten Post Office	0718	0818	0938	1038	1138	1238	1338	1438	1538
Haster Fountain Cottages	0725	0825	0945	1045	1145	1245	1345	1445	1545
Wick Somerfield bus terminal	0730	0830	0950	1050	1150	1250	1350	1450	1550
Wick Business park	0735	0835	0955	1055	1155	1255	1355	1455	1555
Wick Tesco Store	0736	0836	0956	1056	1156	1256	1356	1456	1556
Wick Airport Terminal	0741	0841	1001	1101	1201	1301	1401	1501	1601

Examples of Questions:

a) I want to be at Wick Airport by 2:30pm. What time must I catch the bus at Olrig Street Job Centre?

2:30pm is shown as 1430 h on the timetable
The most suitable bus arrives at Wick Airport at 1401 h
This leaves Olrig Street Job Centre at **1310 h**

b) The 0745 bus from Thurso Business Park is running 6 minutes late. What time does it reach Wick Tesco Store?

Add 6 minutes to the arrival time at Wick Tesco Store
This is 0836 h. It arrives at **0842 h**

How long does the first bus journey from Halkirk to Wick Business Park take?

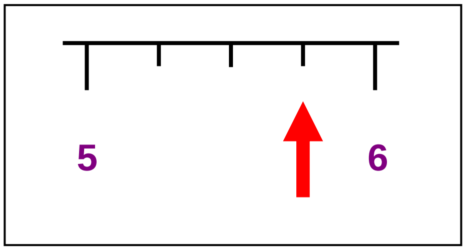
The bus leaves Halkirk at 0705 h and arrives at Wick Business Park at 0735 h.

The journey time is **30 minutes.**

Measurement

Reading scales

Scale 1



In this scale the difference between 5 and 6 is 1, and the space has been divided into 4, so each division represents 1 ÷ 4 = 0.25.

The arrow is pointing to 5 + 0.25 + 0.25 + 0.25 = 5.75

Scale 2 - a speedometer

The difference between 50 and 60 is 10 and the space has been divided into 2, so each division represents 10 ÷ 2 = 5.
The arrow is pointing to 50 + 5 = 55

Converting between units

The table shows some of the most common equivalences between different units of measure. Make sure you know these **conversions**.

Length	Mass	Capacity
	1 tonne = 1000kg	
1 km = 1000m	1kg = 1000g	
1m = 100cm = 1000mm	1g = 1000mg	1l = 100cl = 1000ml
1cm = 10mm		1cl = 10ml

To convert from a larger unit to a smaller one, **multiply**.
To convert from a smaller unit to a larger one, **divide**.

Worked example

We know that 1m = 100cm

So, to convert from m to cm we multiply by 100, and to convert from cm to m we divide by 100.

Eg: 3.2m = **320cm** (3.2 x 100 = 320)
400cm = **4m** (400 ÷ 100 = 4)

Metric and imperial units

Imperial measures are another unit of measure. These days we have mostly replaced them with **metric units**, but despite our efforts to 'turn metric'; we **still use many imperial units in our everyday lives.** It is therefore important that we are able to calculate **rough equivalents** between **metric and imperial units**.

Here are some conversions that you will need to know:

1 inch is approximately 2.5cm

1 foot is approximately 30cm

1kg is approximately 2.2 pounds

8km is approximately 5 miles

(1km is approximately 5/8 mile, and 1 mile is approximately 8/5km)

Worked example

We know that 1 mile is approximately 1.6 km.

To convert from miles to km, we multiply by 1.6.

To convert from km to miles, we divide by 1.6.

E.g. 20 litres = 32 km (20 x 1.6 = 32)

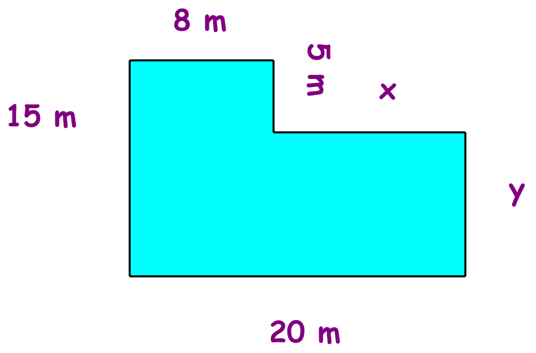
80 km/hr = 50 mph (80 ÷ 1.6 = 50)

Perimeter

The perimeter of a shape is the length of its boundary or outside edges.

Think of a play area, if I walk around the edge of the play area; the distance I walk is called the perimeter.

Example - A plan of a play area is shown below:



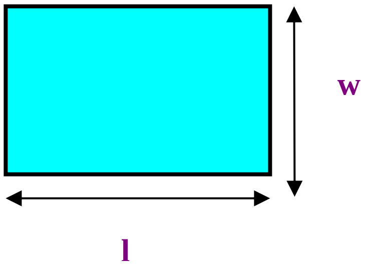
a) Calculate the length of x and y
The length of the play area is 20m, so x = 20 - 8 =12m.The width of the play area is 15m, so y = 15 - 5 = 10m.

b) Calculate the perimeter of the play area.
Perimeter = 20 + 15 +8 + 5 + 12 + 10
= 70 m

Area (always measured in units^2)

Area of a rectangle

Area = l x w

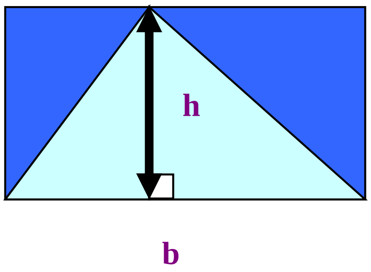


The area of a rectangle is its length multiplied by its width.

The formula is: **area = length x width**

Area of a triangle

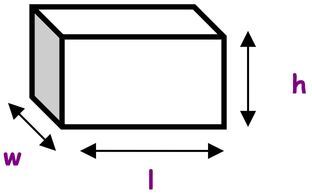
Look at the triangle below:



If you multiplied the base by the **perpendicular (at a right angle to)** height, you would obtain the area of a rectangle. The area of the triangle is **half the area of the rectangle.** So to find the area of a triangle, we multiply the **base by the perpendicular height and divide by two.** The formula is:

Area = (base x height) ÷ 2

Volume/Capacity (always measured in units³)

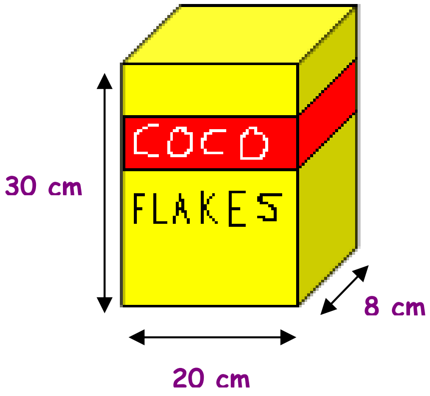


Volume is the space inside a 3D shape

Volume of a cuboid = length x width x height

For example:

The volume of this cereal packet is 20 x 30 x 8 = 4800 cm^3



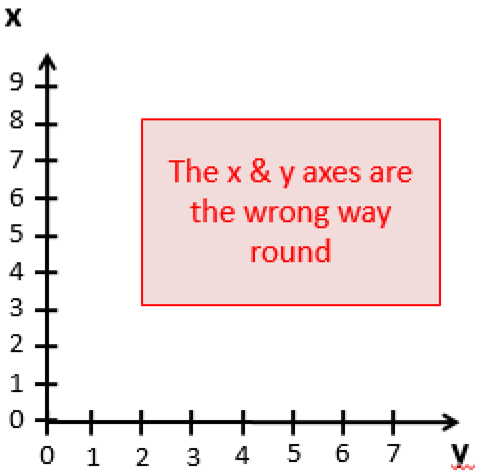
Volume can also be measured in Litres. 1000cm^3 = 1 Litre

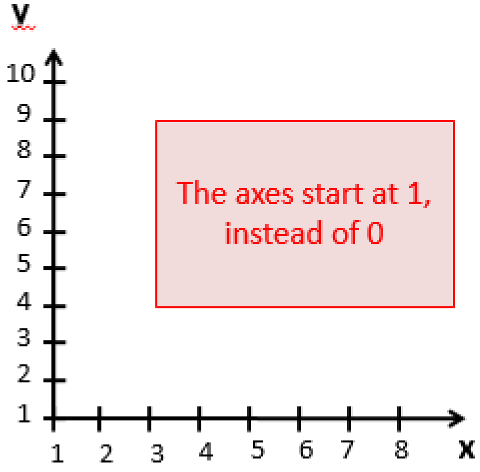
STATISTICS

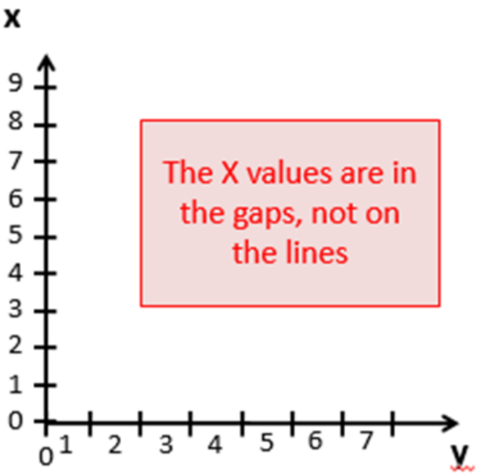
Rules for drawing or plotting a graph

1. Always use a pencil and ruler to draw the axes.
2. Always think about which type of graph is best to use. (e.g. scatter graph, line graph, time series, etc)
3. Always try to fill the graph paper with my graph by choosing a suitable scale.
4. Always put the units on the axes
5. Always label both axes (measurement or 'x' and 'y')
6. Always plot the points accurately using crosses.
7. Always put a title on the graph.
8. Always draw a smooth curve or a straight line (with a ruler) where appropriate. Scatter Graphs require a 'Line of Best Fit'.

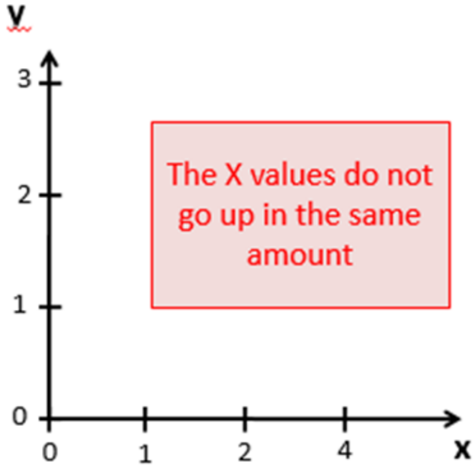
Common Graph Misconceptions



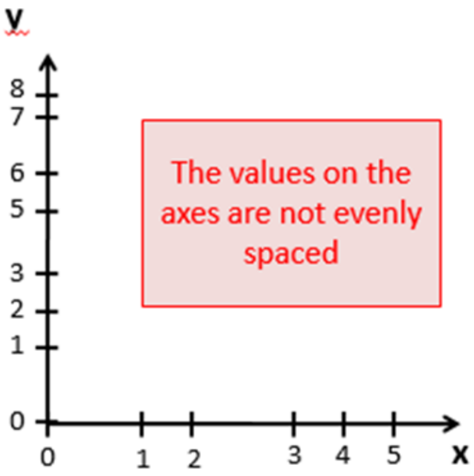




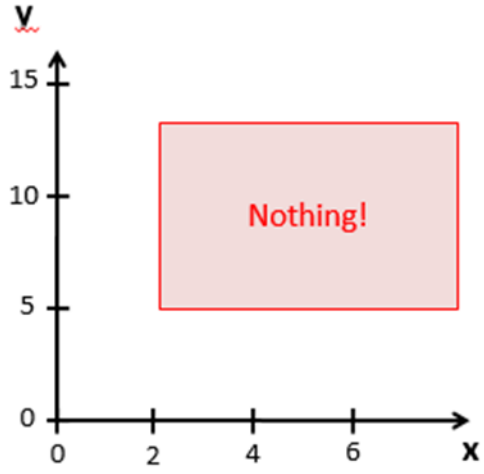
The X values are in the gaps, not on the lines



The X values do not go up in the same amount



The values on the axes are not evenly spaced



Nothing!

Data Tables

It is sometimes useful to display information in graphs, charts or tables.

Example 1 The table below shows the average maximum temperatures (in degrees Celsius) in Barcelona and Edinburgh.

	J	F	M	A	M	J	J	A	S	O	N	D
Barcelona	13	14	15	17	20	**24**	27	27	25	21	16	14
Edinburgh	6	6	8	11	14	17	18	18	16	13	8	6

The average temperature in June in Barcelona is 24°C

Frequency Tables are used to present information. We group large amounts of data into group or intervals.

Example 2 Homework marks for Class 4B

27 30 23 24 22 35 24 33 38 43 18 29 28 28 27
33 36 30 43 50 30 25 26 37 35 20 22 24 31 48

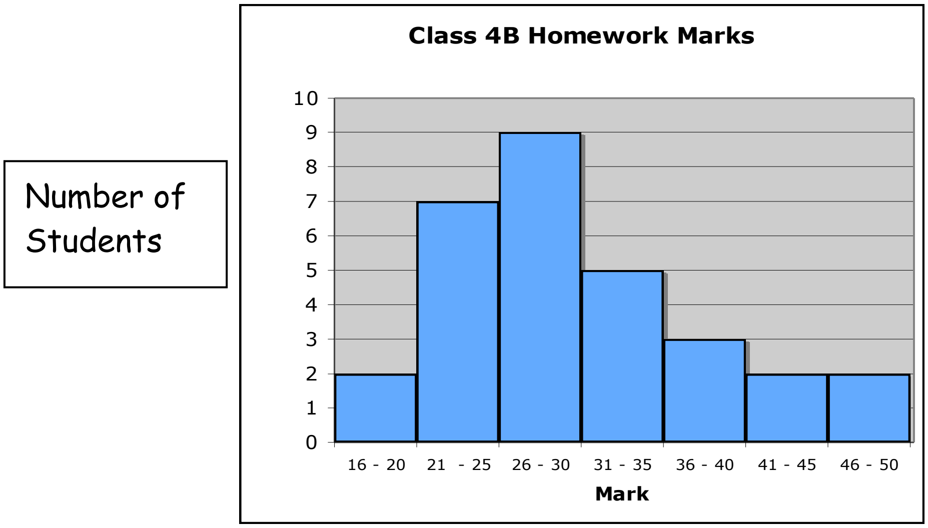
Mark	Tally	Frequency
16 - 20	||	2
21 - 25	|||| ||	7
26 - 30	|||| ||||	9
31 - 35	||||	5
36 - 40	|||	3
41 - 45	||	2
46 - 50	||	2

Each mark is recorded in the table by a tally mark.
Tally marks are grouped in 5s to make them easier to read and count.

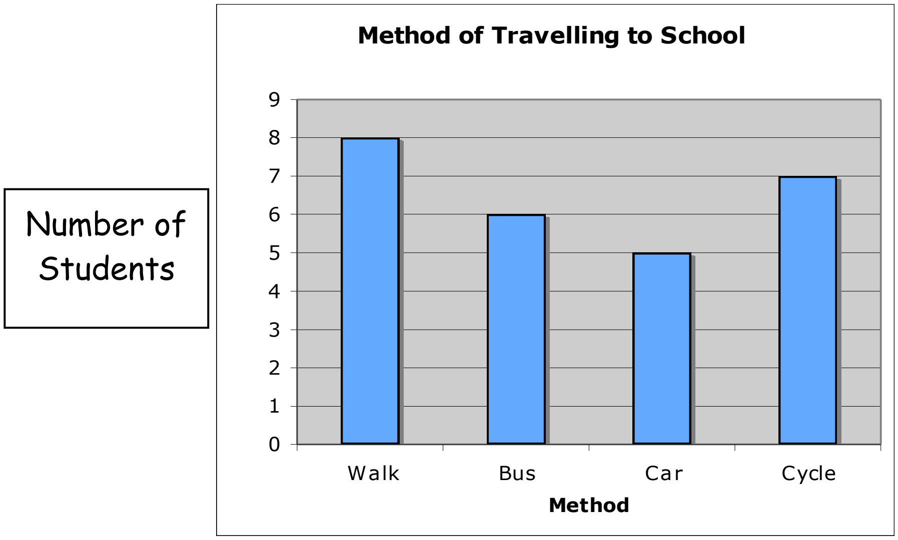
Frequency Diagrams and Bar Chart

Bar graphs are often used to display data. The horizontal axis should show the categories or class intervals, and the vertical axis the frequency.

Example 1 The **frequency diagram** graph below shows the homework marks for Class 4B.



Example 2 A Bar chart to show how students travel to school



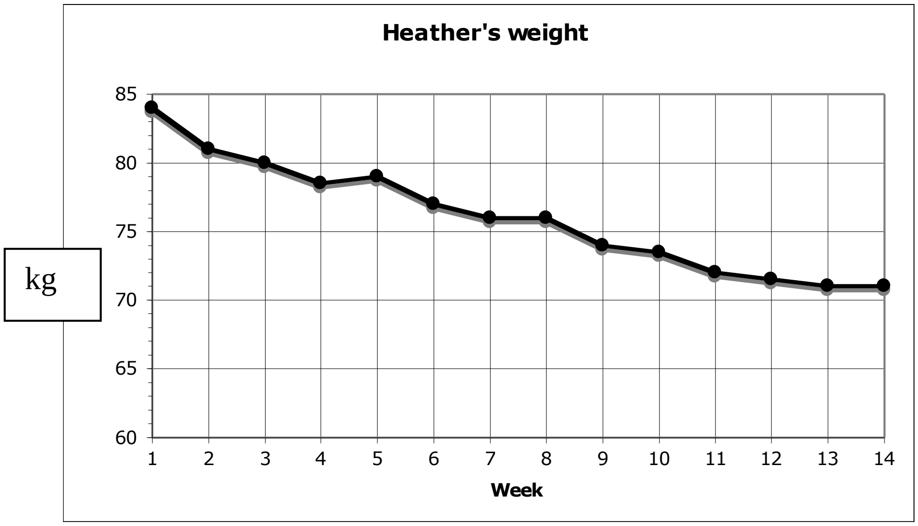
NOTICE this bar chart has gaps between as they are categories not groups. Continuous data (can take any value) is put into a frequency diagram, which has NO gaps.

Line Graphs

(*Time Series is a type of Line Graph which involves time.)

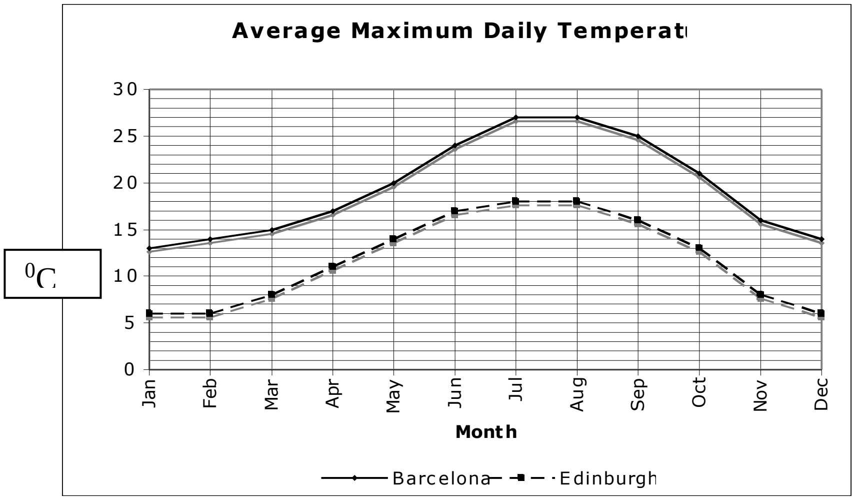
Line graphs consist of a series of points which are plotted, then joined by a line. The trend of a graph is a general description of what it shows.

Example 1 The graph below shows Heather's mass over 14 weeks as she follows an exercise programme.



The trend of the graph is that her weight is decreasing.

Example 2 Graph of temperatures in Edinburgh and Barcelona.

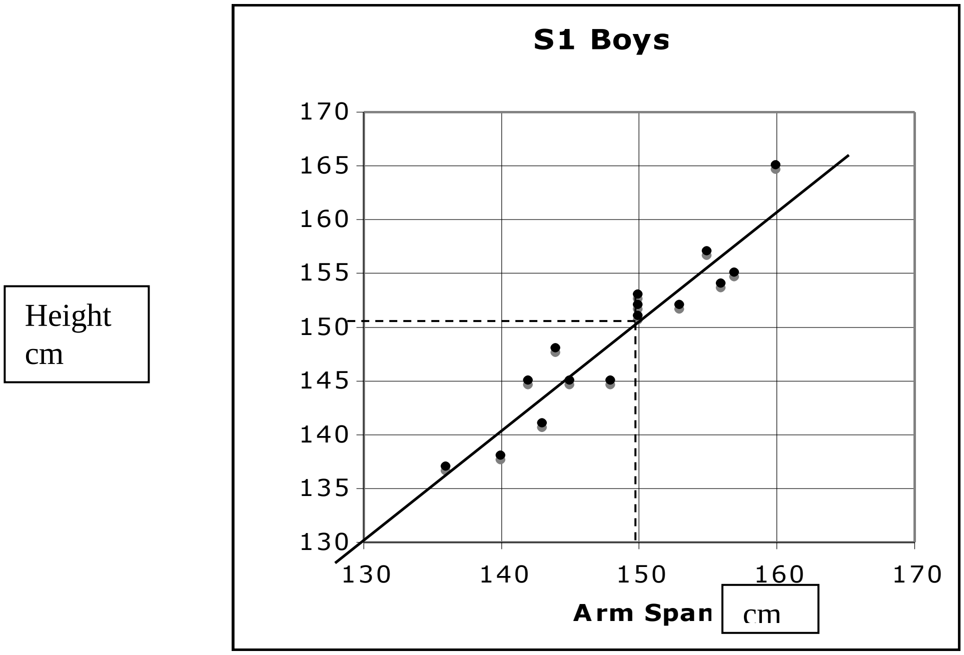


Scatter Graphs

A scatter diagram is used to display the relationship between two variables.
A pattern may appear on the graph. This is called a **correlation**.

Example The table below shows the height and arm span of a group of year 7 boys. This is then plotted as a series of points on the graph below.

Arm Span (cm)	150	157	155	142	153	143	140	145	144	150	148	160	150	156	136
Height (cm)	153	155	157	145	152	141	138	145	148	151	145	165	152	154	137



The graph shows a general trend, that **as the arm span increases, so does the height. This graph shows a <u>positive correlation.</u>**

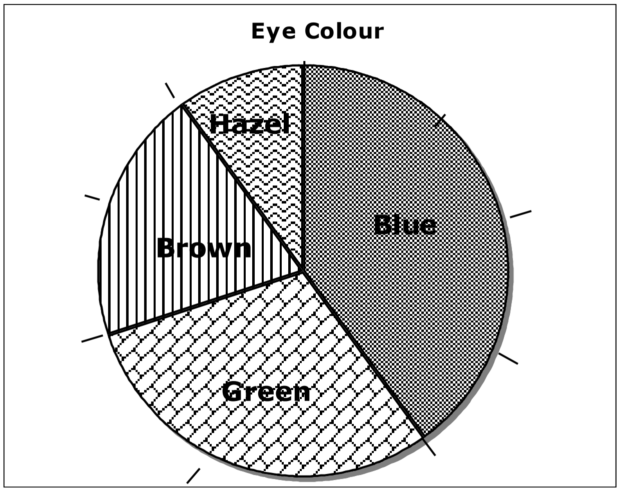
The line drawn is called the **line of best fit**. This line can be used to provide estimates. For example, a boy of arm span 150cm would be expected to have a height of around 151cm.

Note that **in some subjects**, axes may need to start from zero.

Pie Charts

A pie chart can be used to display information. Each sector of the chart represents a different category. The size of each category can be worked out as a fraction of the total using the number of divisions or by measuring angles.

Example 30 students were asked the colour of their eyes. The results are shown in the pie chart below.



How many students had brown eyes?

The pie chart is divided up into ten parts, so students with brown eyes represent $\frac{2}{10}$ of the total.

$\frac{2}{10}$ of 30 = 6 so 6 students had brown eyes.

If no divisions are marked, we can work out the fraction by measuring the angle of each sector.

The angle in the brown sector is 72°.

so the number of students with brown eyes

$= \frac{72}{360} \times 30 = 6$ students.

If finding all of the values, you can check your answers - the total should be 30 students.

Drawing Pie Charts

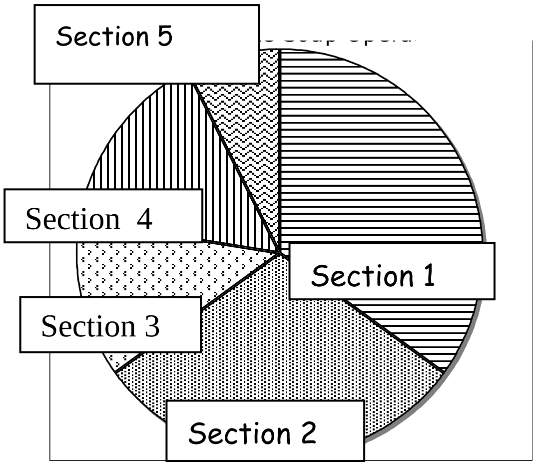
On a pie chart, the size of the angle for each sector is calculated as a fraction of 360°.

Example: In an essay, the number of marks gained on an assignment is 80 . This is split into Q1, Q2 etc. Draw a pie chart to illustrate the information.

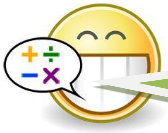
Section of Paper	**Number of people**	**Angle Size**
Section 1	28	28 x 4.5 = 126°
Section 2	24	24 x 4.5 = 108°
Section 3	10	10 x 4.5 = 45°
Section 4	12	12 x 4.5 = 54°
Section 5	6	6 x 4.5 = 27°

Total Marks = 80 Total Angle Size =360°

360 ÷ 80 = 4.5 'This is the multiplier.'



Averages



To provide information about a set of data, the average value may be given. There are 3 different types of **average** value – the mean, the median and the mode.

You can remember it by the following rhyme:

> **"HEY DIDDLE DIDDLE, THE MEDIAN'S IN THE MIDDLE, YOU ADD AND DIVIDE FOR THE MEAN. THE MODE IS THE ONE YOU SEE THE MOST, THE RANGE IS THE DIFFERENCE BETWEEN."**

Mean is found by adding all the data together and dividing by the number of values.

Median is the middle value when all the data is written in numerical order (if there are two middle values, the median is half-way between these values).

Mode is the value that occurs most often.

Range is the range of a set of data is a measure of spread. = Highest value – Lowest value

Example The temperature each day, over 2 weeks is recorded in °C. Find the mean, median, mode and range of the results.

7, 9, 7, 5, 6, 7, 10, 9, 8, 4, 8, 5, 7, 10

$$\text{Mean} = \frac{7+9+7+5+6+7+10+9+8+4+8+5+7+10}{14}$$

$$= \frac{102}{14} = 7.285\ldots$$

Mean = 7.3°C to 1 decimal place

Ordered values: 4, 5, 5, 6, 7, 7, 7, 7, 8, 8, 9, 9, 10, 10

Median = 7 °C

7 is the most frequent temperature, so **Mode = 7 °C**

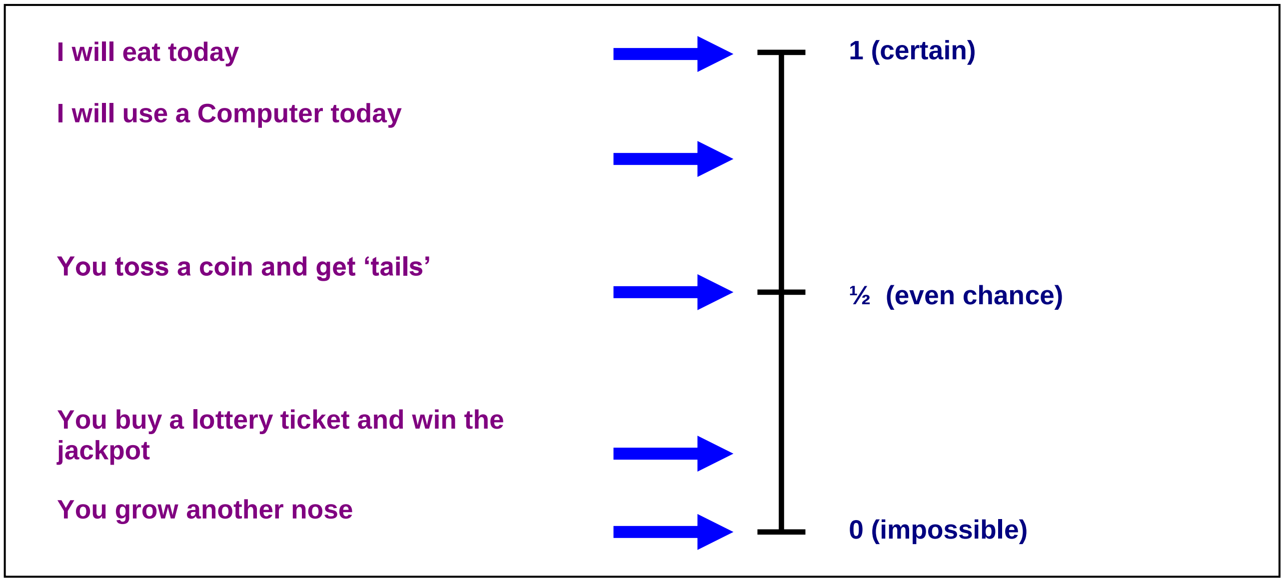
Range = 10 – 4 = 6

Probabilities

We often make judgments as to whether an event will take place, and use words to describe how probable that event is.
For example, we might say that it is likely to be sunny tomorrow, or that it is impossible to find somebody who is more than 3m tall, or it is unlikely I will win the lottery.

The probability scale

In maths we use numbers to describe probabilities. Probabilities can be written as fractions, decimals or percentages. We can also use a probability scale, starting at 0 (impossible) and ending at 1 (certain).



**When we throw a die (plural: dice), there are six possible different outcomes. It can show either 1, 2, 3, 4, 5 or 6.
But how many possible ways are there of obtaining an even number? Clearly, here are three: 2, 4 and 6.
We say that the probability of obtaining an even number is 3/6 (= 1/2 or 0.5 or 50%)**

NOTE: NEVER WRITE PROBABILITY AS A RATIO.

The probability of an outcome = $\frac{\text{number of ways the outcome can happen}}{\text{total number of possible outcomes}}$

Example 1

How many outcomes are there for the following experiments? List all the possible outcomes.

a) Tossing a coin.

There are two possible outcomes (head and tail).

b) Choosing a sweet from a bag containing 1 red, 1 blue, 1 white and 1 black sweet.

There are four possible outcomes (red, blue, white and black).

c) Choosing a day of the week at random.

There are seven possible outcomes (Sunday, Monday, Tuesday, Wednesday, Thursday, Friday and Saturday).

Glossary of Terms

a.m.	(ante meridiem) Any time in the morning (between midnight and 12 noon). am is after midnight
Add; Addition (+)	To combine 2 or more numbers to get one number (called the sum or the total) Example: 12+76 = 88
Approximate	An estimated answer, often obtained by rounding to nearest 10, 100 or decimal place.
Area	Amount of surface
Average	Mean, Median and Mode
Bar Chart	One of the ways of presenting data in the form of a graph or chart.
Calculate	Find the answer to a problem. It doesn't mean that you must use a calculator!
Cuboid	Rectangular prism - see triangular prism
Cylinder	Circular prism – see triangular prism
Data	A collection of information (may include facts, numbers or measurements).
Decimal places	Places to the right of the decimal point. The first number to the right is the first decimal place.
Denominator	The bottom number in a fraction (the number of parts into which the whole is split).
Difference (-)	The amount between two numbers (subtraction). Example: The difference between 50 and 36 is 14 50 – 36 = 14
Division (÷)	Sharing a number into equal parts. 24 ÷ 6 = 4
Double	Multiply by 2.

Equals (=)	Makes or has the same amount as.
Equivalent fractions	Fractions which have the same value. Example $\frac{6}{12}$ and $\frac{1}{2}$ are equivalent fractions
Estimate	To make an approximate or rough answer, often by rounding.
Evaluate	To work out the answer.
Even	A number that is divisible by 2. Even numbers end with 0, 2, 4, 6 or 8.
Factor	A number which divides exactly into another number, leaving no remainder. Example: The factors of 15 are 1, 3, 5, 15.
Frequency	How often something happens. In a set of data, the number of times a number or category occurs.
Greater than (>)	Is bigger or more than. Example: 10 is greater than 6. $10 > 6$
Least	The lowest number in a group (minimum).
Less than (<)	Is smaller or lower than. Example: 15 is less than 21. $15 < 21$.
Line Graph	One of the ways of presenting data in the form of a graph or chart.
Maximum	The largest or highest number in a group.
Mean	The arithmetic average of a set of numbers (see p32)
Median	Another type of average - the middle number of an ordered set of data (see p32)
Minimum	The smallest or lowest number in a group.
Minus (-)	To subtract.
Mode	Another type of average – the most frequent number or category (see p32)
Most	The largest or highest number in a group (maximum).

Multiple	A number which can be divided by a particular number, leaving no remainder. Example Some of the multiples of 4 are 8, 16, 48, 72
Multiply (x)	To combine an amount a particular number of times. Example 6 x 4 = 24
Negative Number	A number less than zero. Shown by a minus sign.
Numerator	The top number in a fraction.
Odd Number	A number which is not divisible by 2. Odd numbers end in 1 ,3 ,5 ,7 or 9.
Operations	The four basic operations are addition, subtraction, multiplication and division.
Order of operations	The order in which operations should be done. BIDMAS (see p9)
Outcome	An event that can happen
p.m.	(post meridiem) Any time in the afternoon or evening (between 12 noon and midnight) pm is past midday
Percentage of	The percentage of the original price.
Percentage reduction	The percentage of the original price that has been taken off.
Perimeter	Distance around the outside edge
Pie Chart	One of the ways of presenting data in the form of a graph or chart.
Place value	The value of a digit dependent on its place in the number. Example: in the number 1573.4, the 5 has a place value of 100s, 5 x 100 = 500

Prime Number	A number that has exactly 2 factors (can only be divided by itself and 1). Note that 1 is not a prime number as it only has 1 factor.
Prism	3-dimensional shape with the same cross section along its length
Probability	How likely something is
Product	The answer when two numbers are multiplied together. Example: The product of 5 and 4 is 20.
Remainder	The amount left over when dividing a number.
Scatter Graph	One of the ways of presenting data in the form of a graph or chart.
Share	To divide into equal groups.
Significant Figure	The first non-zero figures in a number which give the most information about the size of the number.
Sphere	A 3D Solid circular shape
Stem & Leaf Diagram	Different ways of presenting data in the form of a graph or chart.
Sum	The total of a group of numbers (found by adding).
Table	Different ways of presenting data in the form of a graph or chart.
Timetable	A table showing the times that someone or something is planned to arrive and depart.
Total	The sum of a group of numbers (found by adding).
Triangular Prism	3-dimensional shape with a triangular cross section along its length
Volume	Amount of space inside a shape or the amount of space an object takes up