Bridge of Weir Primary School

Gryffe High School

Houston Primary School

Cross Curricular Methodology Maths and Numeracy

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Introduction

This is the 2nd Edition of the Numeracy and Maths methodology document. The aim of this document is to promote the use of common methodologies in numeracy and mathematics across the school in order to improve the educational experience of pupils.

Bridge of Weir and Houston Primaries have also been aware of the Maths Department's methodologies in certain topics for a number of years and have been involved in ongoing discussions and development so that this document reflects joint Primary and High school approaches and methodologies.

It is hoped that this awareness raising will result in all teachers adopting the same approaches thus improving consistency of teaching across the curriculum.

The document also attempts to raise awareness as to when certain topics are covered by the Maths department, as it may well be the case that it is not the Maths department that introduces a particular topic for the first time in High School.

Hopefully this document will help you, or at least encourage you to consult with the Maths Department.

The process is intended to be a collegiate one and your comments, contributions and questions are always welcome.

Place Value

Multiplying by multiples of 10, 100 and 1000

The decimal point is fixed. The decimal point doesn't move. Only the digits move.

To multiply by **10** every digit is moved ***one*** place to the left.

To multiply by **100** every digit is moved ***two*** places to the left.

To multiply by **1000** every digit is moved ***three*** places to the left.

Example 1 (a) 351 × 10

Th	H	T	U
	3	5	1
3	5	1	0

Move one place to the left

(b) 34·67 × 100

Th	H	T	U ·	$\frac{1}{10}$	$\frac{1}{100}$
	3	4	· 6	7	
3	4	6	7 ·		

Move two places to the left

(c) 45 × 50

Most pupils when multiplying by 50 will multiply by 5, then by 10.

45 × 5 = 225

225 × 10 = 2250

Or vice versa.

But don't discourage this →

$$\begin{array}{r} 45 \\ \times 50 \\ \hline 2250 \end{array}$$

Multiply by 10, then by 5

(d) 2·3 × 400

Most pupils when multiplying by 400 will multiply by 4, then by 100.

2·3 × 4 = 9·2

9·2 × 100 = 920

Or vice versa.

Dividing by multiples of 10, 100 and 1000

To divide by **10** every digit is moved ***one*** place to the right.

To divide by **100** every digit is moved ***two*** places to the right.

To divide by **1000** every digit is moved ***three*** places to the right

Example 1 (a) 351 ÷ 10

Th	H	T	U	·	$\frac{1}{10}$
	3	5	1		

3 5 · 1

Move one place to the right

(b) 34·67 ÷ 100

Th	H	T	U	·	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10000}$
		3	4	·	6	7		

0 · 3 4 6 7

Move two places to the right

(c) 45 ÷ 50

Most pupils when dividing by 50 will divide by 5, and then by 10.

45 ÷ 5 = 9

9 ÷ 10 = 0·9

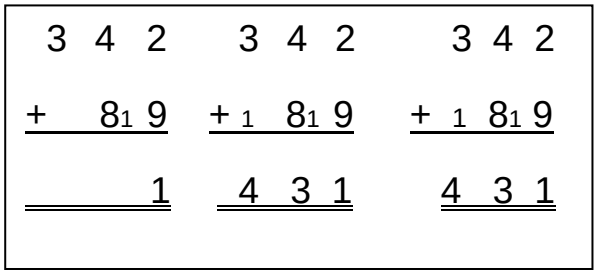
Or vice versa.

Some pupils have great difficulty grasping the process of moving digits and find it easier to “move the decimal point”.

It was agreed (Primary and High school) that teachers should use their professional judgement as to when the “moving point” should be resorted to.

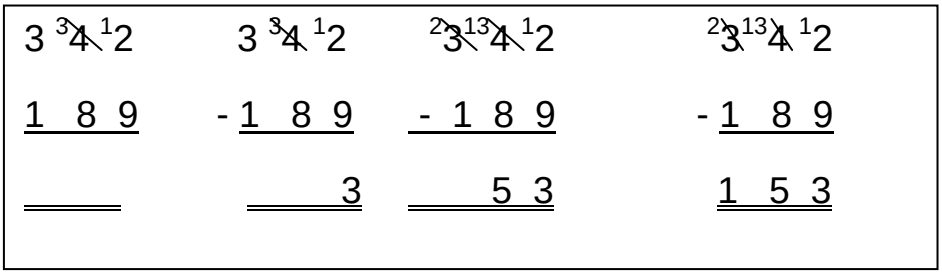
Addition

Carrying tens, hundreds etc. will be done on top of the sum line.



Subtraction

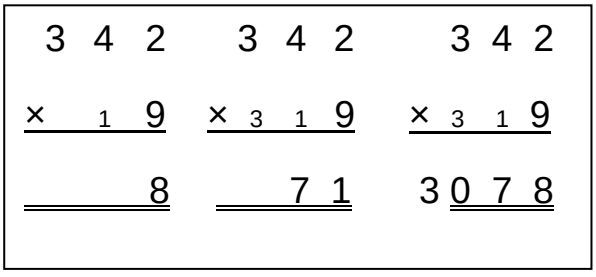
All pupils will subtract by the method of decomposition.



Multiplication

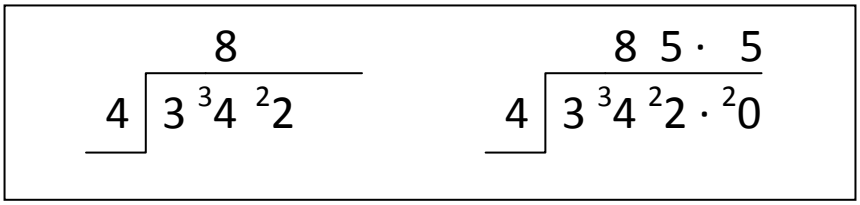
Carrying tens, hundreds etc. will be done on top of the sum line.

Example: 342 × 9



Division

Example: 342 ÷ 4



Time

12 hour clock times should be written with am/pm and dot between hours and minutes e.g.

3.12am 10.15am 7.35pm

24 hour clock times should be written with four numbers with space between hours and minutes e.g.

03 12 10 15 19 35

Calculation of time duration

Use horizontal line broken into stages of time. Stages are broken into minutes and/or hours depending on duration.

In Gryffe we encourage to go to the next hour, then hours, then remaining minutes:

09 15 → 10 00 → 15 00 → 15 34

45min + 5 hrs + 34mins = 5hrs79mins = 6hrs19mins

But pupils can decide on stages e.g.

09 15 → 09 30 → 10 00 → 15 00 → 15 34

15min + 30min + 5hrs + 34mins = 5hrs79mins = 6hrs19mins

Maths Timeline: S1 March/April and S2 March/April. Also S3.

Scientific Notation

(Standard Form)

In Maths scientific notation is written in the form

$a \times 10^n$

where $1 \leq a < 10$ and n is an integer

For example

26 000	would be written as 2.6×10^4
0.000543	would be written as 5.43×10^{-4}
1 000 000	would be written as 1×10^6

Most calculations in Scientific Notation are done using a calculator

e.g. $(3{\cdot}5 \times 10^5) \times (4.7 \times 10^3)$

Maths Timeline:

Scientific Notation – June/August at start of S2

Ratio

Most simplification problems in maths are with 2 terms only. (Only appears Credit level S4 with 3 terms.)

For example:

24 : 6	400g : 2kg
4 : 1	400 : 2000
	1 : 5

Ratio and proportion.

For example:

Cement and sand is to be mixed in the ratio 2 : 3. If you have 8kg of cement how much sand do you require?

$$\begin{array}{ccc} & 2 : 3 & \\ \times 4 & & \times 4 \\ & 8 : 12 & \end{array}$$

12kg of sand is needed

In S1 pupils will also share an amount in a given quantity.

For example:

Share £42 in the ratio 4 : 3.

Total shares	= 4 + 3 = 7
One share	$= \frac{£42}{7}$ = £6
4 shares	= £6 × 4 = £24
3 shares	= £6 × 3 = £18

Maths Timeline:

Ratio – S1 Unit 4 (April/May) for lower ability S2 Unit 2 (November)

Proportion – S2 Unit 2 (November)

Percentages

In Primary pupils do a lot of mental work on percentages. Mostly on multiples of 10 or 5 e.g. 25%, 30%, 15%.

They are taught to calculate 10% first

For example:

40% of £80

10% = £8

40% = £8 x 4 = £32

Establish the concept that per cent "means" out of one hundred so that 1% = $\frac{1}{100}$.

In High School percentage work pupils need to learn to be more flexible, hence the variety of approaches adopted at varying stages and levels of ability by the Maths Department.

The vast majority of pupils can convert simple percentages to fractions and decimal fractions.

e.g. if not 3% $\dashrightarrow \frac{3}{100} \dashrightarrow$ 0·03

Then definitely 25% $\dashrightarrow \frac{25}{100} = \frac{1}{4} \dashrightarrow$ 0·25

50% $\dashrightarrow \frac{50}{100} = \frac{1}{2} \dashrightarrow$ 0·5

75% $\dashrightarrow \frac{75}{100} = \frac{3}{4} \dashrightarrow$ 0·75

These simple equivalences, e.g. 10% = $\frac{1}{10}$, 20% = $\frac{1}{5}$, are important and the best approach of finding, say, 75% of £32 is to find $\frac{3}{4}$ of £32 (÷4 ×3).

The equivalence 20% = $\frac{1}{5}$ (÷ 5) has increased in importance due to VAT.

Ultimately at Credit Level (for most by S4) and in S5 at Intermediate 2 and Higher we would expect pupils to be able to convert a percentage increase/decrease to a decimal multiplier.

e.g. increase of 17.5% = 117.5% = 1.175

decrease of 8% = 92% = 0.92

Percentages

Non Calculator

Well known percentages should be treated as fractions:

50% = $\frac{1}{2}$ 25% = $\frac{1}{4}$ $33\frac{1}{3}$ % = $\frac{1}{3}$

Generally break quantity or amount down to 1% or 10% by division.

Pupils should not be discouraged from using a variety of approaches

Find 3.5% of £80

1% of £80 = £80 ÷ 100 = £0.80

3% of £80 = £0.80 x 3 = £2.40
0.5% of £80 = £0.80 x 0.5 = £0.40
= £2.80

OR many pupils prefer to do the above calculation in pence (but watch units!!).

1% of £80 = 8000p ÷ 100 = 80**p**

3% of £80 = 80p x 3 = 240
0.5% of £80 = 80p x 0.5 = 40
= 280**p**

Calculator

Working should always be shown whether or not a calculator is being used.

Method 1

Find 6.89% of £80

1% = 80 ÷ 100 = 0.8

6.89% = 0.8 x 6.89 = £5.51

Method 2

35% or £80

$= \frac{35}{100} \times £80$ Calculator
$= 0.35 \times £80$ 35 ÷ 100 x 80 = £28
= £28

By S3/S4 the majority of Credit pupils should know that, for example:

87% = 0.87

104% = 1.04

10% depreciation = 90% = 0.9

(ii) Changing a ratio to a percent

Write $\frac{3}{5}$ as a percentage

$\frac{3}{5} \times 100\%$ **Calculator**

$= 0{\cdot}6 \times 100\%$ $\mathbf{3 \div 5 \times 100 = 60\%}$

= 60%

Maths Timeline: Percentages are covered in S1(Jan/Feb) and in S2(Oct/Nov). Also in S3 and S4.

Equations and Formulae

In the Maths Department in Gryffe High school we use the “balancing” approach to solve equations as described on the subsequent pages.

This approach extends to use in all areas. For example, with Pythagoras (as shown), Trigonometry, and in changing the subject of a formula) (also shown).

Setting out of solutions is important. Work should be clear.

Formula

Substitution

Answer with units

The equal symbols should be in a vertical line, one below the other.

=

=

=

Maths Timeline:

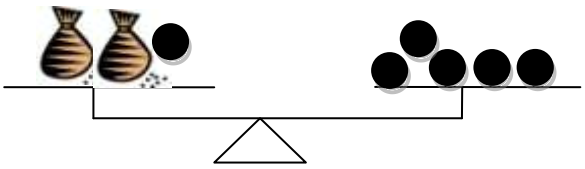
Equations - October/November S1

- June/October/November S2 and continuously thereafter.

Equations

Equations are solved by the balancing approach

Example 1



$$2x + \underset{-1}{1} = \underset{-1}{5}$$

Subtract 1 from both sides

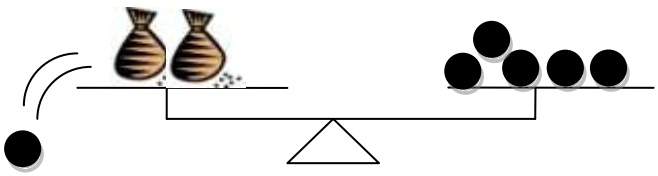
$$2x = 4$$

$$\frac{2x}{2} = \frac{4}{2}$$

Divide both sides by 2

$$x = 2$$

Example 2



$$2x - \underset{+1}{1} = \underset{+1}{5}$$

Add 1 to both sides

$$2x = 6$$

$$\frac{2x}{2} = \frac{6}{2}$$

Divide both sides by 2

$$x = 3$$

Example 3 Equations with fractions

$$\frac{1}{3}x = 7$$

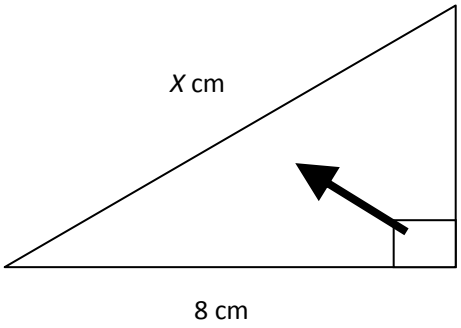
$$3 \times \frac{1}{3}x = 7 \times 3$$

"Remove" fraction by multiplying both sides by denominator

$$x = 21$$

Note that the = signs form a vertical line to clearly delineate the Left Hand Side and Right Hand Side of the equation.

Pythagoras



Always draw diagram

Arrow points to hypotenuse

Write down:

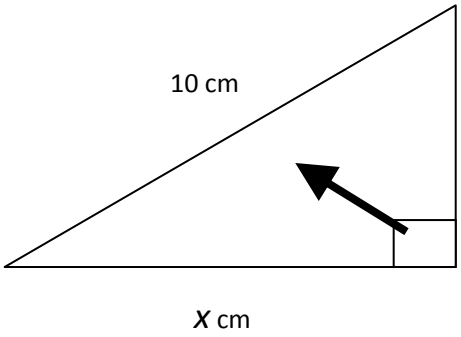
$x^2 = 6^2 + 8^2$

$= 36 + 64$

$= 100$

$x = \sqrt{100}$

$x = 10$



Always draw diagram

Arrow points to hypotenuse

Write down:

$10^2 = x^2 + 6^2$

$100 = x^2 + 36$

$-36 \quad\quad -36$

$64 = x^2$

$\sqrt{64} = x$

$8 = x$ ✓

$x = 8$ ✓

x can be left on LHS or RHS

Formulae

Maths would expect the following when using formulae.

In a simple formula

$if\ l = 5cm\ and\ b = 4cm\ find\ the\ area, A.$

$A = lb$	formula
$A = 5\ \times\ 4$	substitute
$A = 20cm^2$	calculation and units

And a more advanced formula.

$if\ b = 5cm, c = 4cm\ and\ \angle A = 60^o$

$\mathrm{a}^2\ = \mathrm{b}^2 + \mathrm{c}^2 - 2\mathrm{bc}\ \cos \mathrm{A}$	formula
$\mathrm{a}^2\ = 5^2 + 4^2 - 2\ \mathrm{x}\ 5\ \mathrm{x}\ 4 \cos 60^{\mathrm{o}}$	substitute
$a^2\ = 21$	calculation
$a\ = 4.58cm$	units

This is also an example of the minimum amount of working specified by the SQA

Using the balancing approach to change the subject of a formula (e.g. to x).

$$p = ax + b$$
$$-b \qquad -b$$
$$p - b = ax$$
$$\frac{p}{a} - \frac{b}{a} = \frac{ax}{a}$$
$$\frac{p-b}{a} = x$$

$$P = \frac{x}{R}$$
$$R \times P = \frac{x}{R} \times R$$
$$PR = x$$

Maths does not teach cross-multiplication

- Except when using the Sine Rule (November S4)

To deal with a problem such as:

$$\frac{R}{120} = \frac{55}{175}$$

$$\frac{120}{1} \times \frac{R}{120} = \frac{55}{175} \times \frac{120}{1}$$

$$\frac{120R}{120} = \frac{6600}{175}$$

$$R = \frac{264}{7}$$

or $$R = 37 \cdot 7$$

Note on calculator use:

Calculators are only used in maths when it is appropriate. Much of the work done in Maths does not require calculator use and the use of calculators is not encouraged when their use is not necessary.

Maths Timeline: Simple Formulae – From August S1: collect terms, evaluate expressions, evaluate formulae. Change of subject S4.

Statistical Graphs

Most work done by pupils in S1 and S2 involves interpreting graphs not drawing them – with the exception of some time spent on Pie Charts and Scatter Diagrams.

Bar Graph/Chart

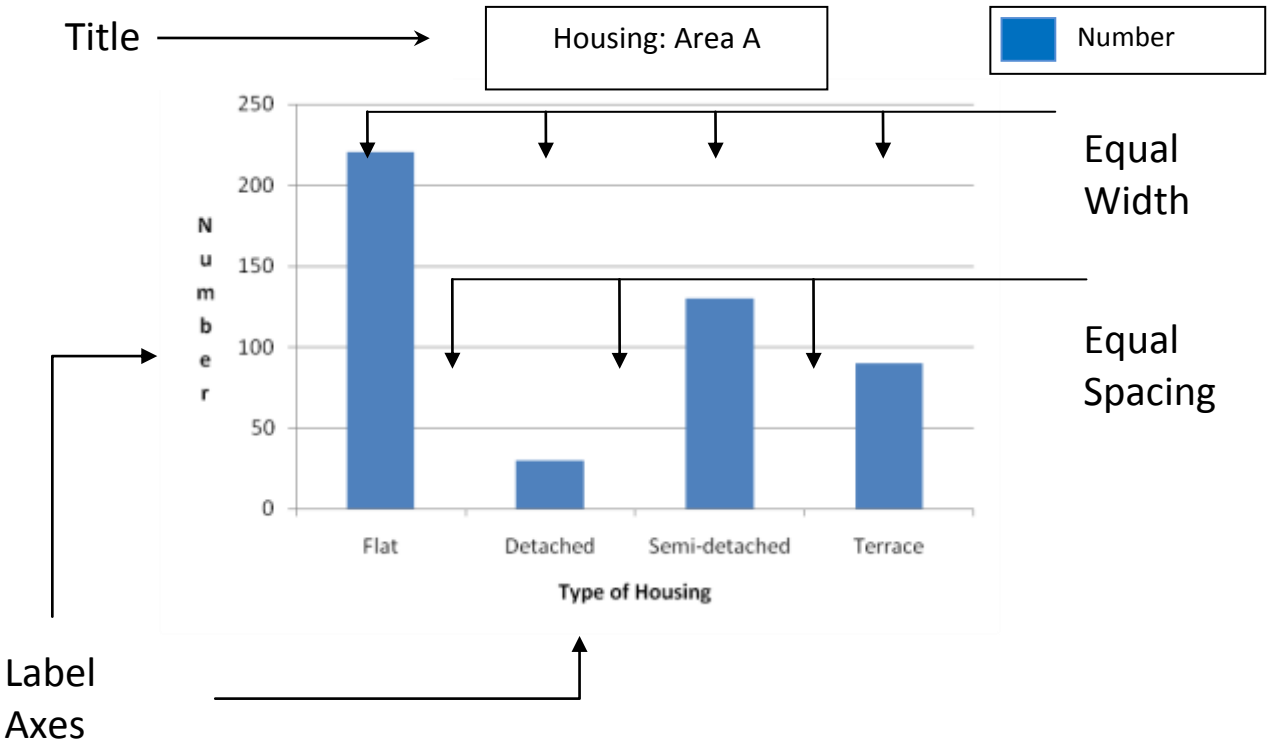
A bar chart is a way of displaying discrete or non-numerical data. That is data which is in separate categories.

For example: Type of housing
- flat
- detached
- semi-detached
- terrace

etc

Food content
- protein
- carbohydrate
- fat
- sugar

etc.



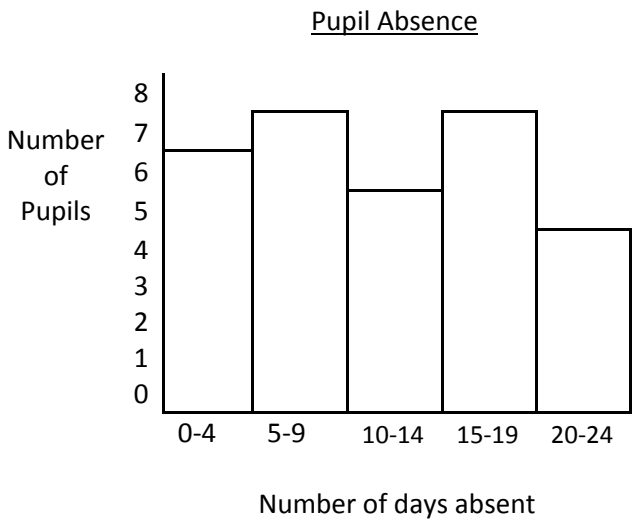
An equal space should be between each bar and each bar should be of an equal width. Leave a space between the y-axis and the first bar.

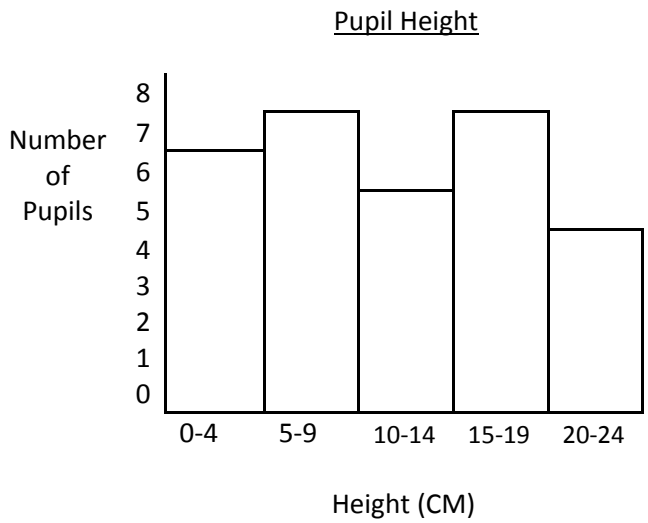
Histogram

A Histogram is often confused with a bar chart. More appropriately used when data is continuous.

Continuous data are data that have no precise fixed value and are usually measured to within a range. Such data includes height (measurable to the nearest unit, a millimetre for example).

Data displayed in a histogram can be grouped.





As with a bar chart a histogram should have a title and appropriate x and y-axis labels.

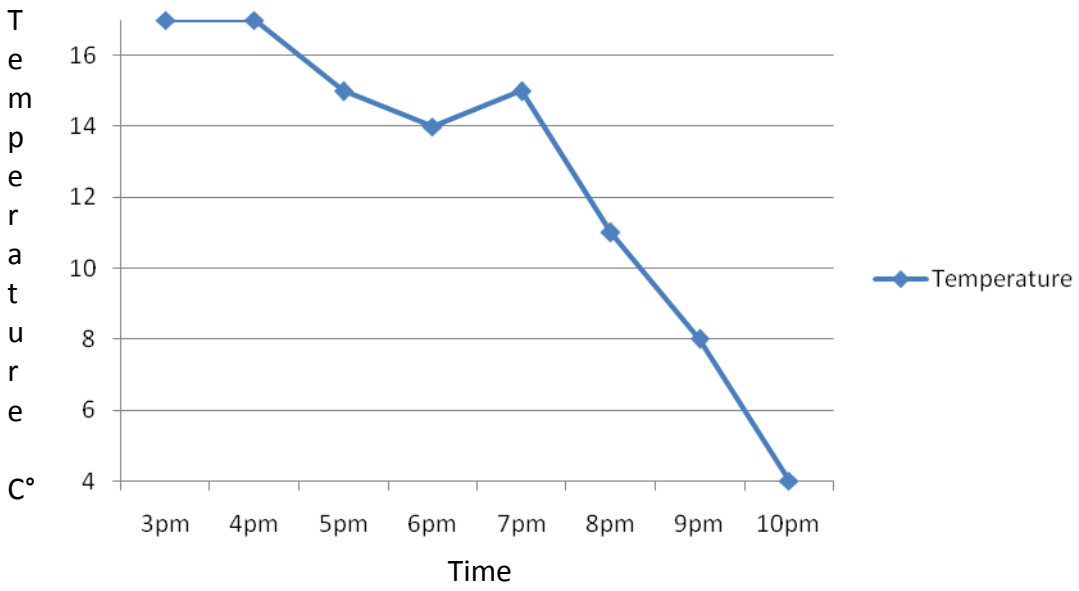
There should be no space between each bar. Each bar should be of an equal width.

Maths Timeline

Bar Graphs – Information Handling – February S1 and December S2

Line graphs compare two quantities (or variables). Each variable is plotted along an axis.

A line graph should have a title and appropriate x and y-axis labels.



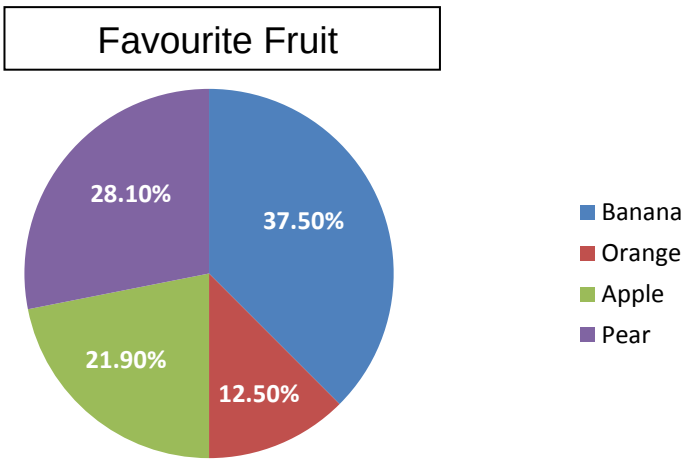
Pie Charts

A pie chart is a way of displaying discrete or non-numerical data.

A pie chart uses fractions or percentages to compare data.

In the construction of pie charts the maths department uses protractors and fractions of 360°. A whole circle is then split into sectors representing those fractions.

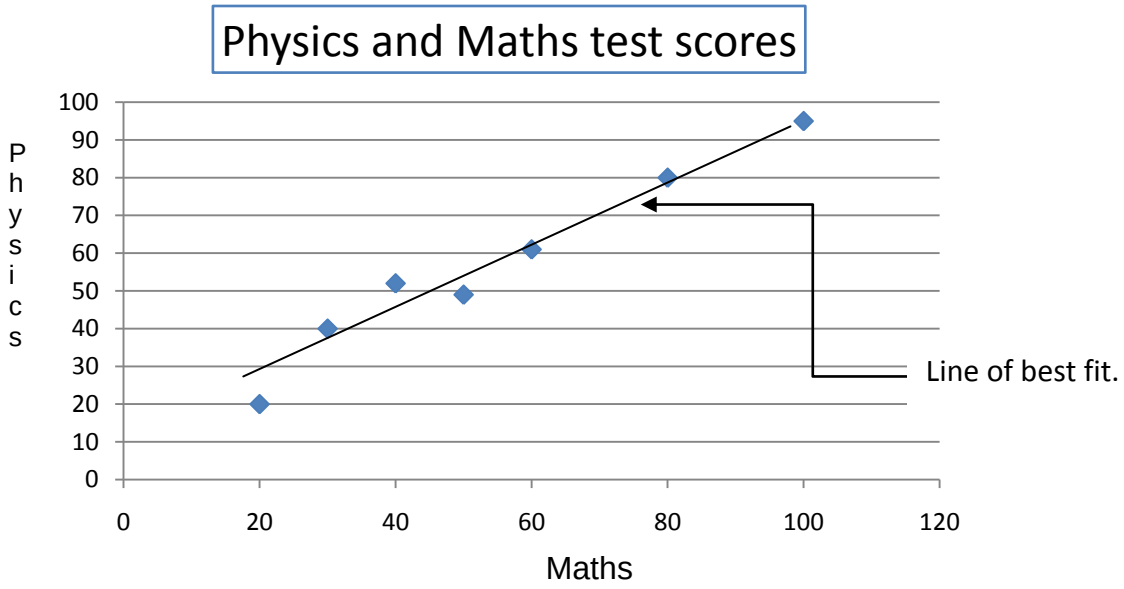
A pie chart needs a title and a key.



Scatter Diagrams

A scattergraph allows you to compare two quantities (or variables). Each variable is plotted along an axis. A scattergraph should have a title and appropriate *x* and *y* - axis labels. For each pair of data items a point is plotted e.g. (maths score, physics score). The points are not joined up.

A scattergraph allows you to see if there is a connection (correlation) between the two quantities. If a correlation exists a line of best fit can be drawn on the diagram.



A line of best fit can be drawn using an "average point": (mean *x*, mean *y*). However, a line of best fit is only ever required to be drawn in maths at General level and at Intermediate 2 where a "reasonable line" is acceptable.

Only pupils at Credit/Int 2 level are expected to find the equation of the line.

Maths Timeline

Line Graphs	- February S1
Pie Charts	- February S1
Scatter Diagrams (incl. line of best fit)	- December S2
Gradient and Equations of Lines	- End of S3/Beginning of S4

S1 Course Summary Level 3 Book R1

Unit 1

Algebra 1	**mth**3-14a/**mnu**3-03b
Dewey Filing System	**mnu**2-02a.3-03b
Symmetry	**mth**2-19a.3-19a.4-19a
Whole numbers and decimals	**mth**4-19a/**mnu**3-01a.3-03a.3-03b
Health and Well Being 1	**hwb**2-36a.3-34a.4-34a/**mnu**3-20a
Sequences, multiples and factors	**mth**3-05a.3-05b.3-06a/**mnu**3-03a.3-03b.3-04a
Egyptian Mathematics	**mth**1-12a
	Unit 1 Test before October Mid Term

Unit 2

Fractions	**mth**3-07b.3-07c.4-07b/**mnu**3-07a
Negative Numbers	**mnu**2-04a.3-04a
Long Multiplication	**mnu**3-03b
Algebra 2	**mth**3-15a.4-15a
Angles	**mth**3-17a
Babylonian Mathematics	**mth**1-12a
	Unit 2 Test – Mid December

Unit 3

Coordinates	**mth**2-18a.3-18a.4-18a.4-18b
Measurement	**mnu**2-11b
Division and Long Division	**mnu**3-03b
Percentages	**mnu**2-07b.3-07a
Information Handling	**mth**3-20a.3.20b.2-2a.3-21a/**mnu**4-20a.4-20b
Greek Mathematics	**mth**1-12a
	Unit 3 Test – Early March

Unit 4

2D shape	**mth**2-16a.3-17a/**mnu**3-11a
Time, distance and speed	**mnu**3-10a
Ratio	**mnu**3-08a
3D shape	**mth**2-16a.3-11b/**mnu**3-11a
Formulae	**mth**3-13a.3-15b
Scale Drawing	**mth**3-16a.3-17b.3-17c
	Unit 4 Test – End May

Literacy Outcomes permeating the course: **lit**3-04a.3-05a.3-09a.3-21a.3-24a

Ex19.3© indicates that a calculator is required

The **Problem Solving** chapter could be used as homework questions.

Review exercises should be used, primarily, for test revision.

Lesson Starter: Make time for short revision questions at the start of each period.

Weekly Non Calculator sheets.

S2 Course Summary Level 3/4 Book R2

Unit1

Algebra 1	**mth**3-14a
Sets of numbers	**mnu**2-04a.3-04a/**mth**3-05b.4-06a.4-06b
Area	**mnu**3-11a/**mth**2-16a.3-11a.3-17a.
Health and Well Being 2	**hwb**
Decimals and significant figures	**mnu**3-01a.3-03a/**mth**3-03b.4-03b.
Formulae and sequences	**mnu**3-03a.3-03b/**mth**3-06a.3-14a.
Chinese Mathematics	

Unit 1 test middle/end of September

Unit 2

Fractions and Percentages	**mnu**2-07b.3-07a
Algebra 2	**mth**3-15a.4-15a
Enlarging and Reducing	**mth**3-17c.4-17c
Proportion	**mnu**3-08a.4-08a

Unit 2 test middle of November

Unit 3

Information Handling	**mnu**3-20a.4-20a/**mth**3-20b.4-20b
Algebra 3	**mth**3-15a.4-14a.4-14b.4-15a
Circle	**mth**4-16b
Probability	**mnu**3-22a.4-22a

Unit 3 test end of January

Unit 4

Time, Distance and Speed	**mnu**3-10a.4-10b
Pythagoras' Theorem	**mth**3-15a.4-16a
Straight Line Graphs	**mth**4-13b.4-13d
Angles and Scale Drawing	**mth**3-16a.3-17b.3-17c

Unit 4 test end of March

Literacy Outcomes permeating the course: **lit**3-04a.3-05a.3-09a.3-21a.3-24a

Ex 19.3© indicators that a calculator is required.

The **Problem Solving** chapter could be used as homework questions.

Review exercises should be used, primarily, for test revision.

Make time for revision, short questions at the start of each period, and test revision.

Weekly Non Calculator sheets.