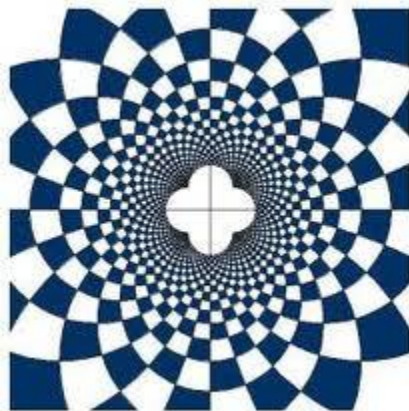


ELY COLLEGE

"GOOD MATHS GUIDE"



A guide to mathematical terms and procedures

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Table of Contents

1	NUMBER	2
1.1	GENERAL NOTES.....	2
1.2	ADDITION.....	3
1.3	SUBTRACTION.....	3
1.4	MULTIPLICATION	4
1.4.1	Written Multiplication Methods.....	4
1.5	DIVISION.....	6
1.5.1	Written division methods	6
2	ALGEBRA	8
2.1	THE BASICS	8
2.2	SOLVING EQUATIONS.....	9
3	HANDLING DATA	10
3.1	TYPES OF DATA.....	10
3.2	TYPES OF CHARTS.....	10
3.2.1	Bar charts.....	10
3.2.2	Pie Charts	11
3.2.3	Scatter Diagrams.....	11
3.3	TYPES OF AVERAGE.....	12
4	MEASURE	13

1 Number

1.1 General Notes

When calculating the answer to any arithmetic problem the student should always first estimate what it should be. An estimate is an approximation of a quantity arrived at by judgement rather than by guessing. Rounding is a necessary skill for estimating. The rule we use is to look at the next digit to the one that we are correcting, if it is 5 or above increase the digit before it by 1. Hence:

To the nearest 10	64 becomes 60 and 67 becomes 70
To the nearest 100	349 becomes 300 and 350 becomes 400
To the nearest whole number	4.46 becomes 4 and 4.63 becomes 5

Estimating encourages the student to think about the appropriateness of their answers and is particularly important when the question involves decimals or using a calculator (where it is easy to mistype a number or an operation).

For example $\frac{56.65 - 23.42}{4.56}$ is approx. $\frac{60 - 20}{5} = \frac{40}{5} = 8$

The answer is therefore approximately 8 rather than 80 or 0.8. Please note that the use of a calculator should not be looked upon as "cheating", instead it should be seen as a tool for facilitating problem solving involving more complex numbers.

1.2 Addition

Students should be able to recall or quickly calculate mentally:

- Addition of single digit numbers
- Bonds to 100
- Doubles of all numbers to 100
- Addition of two, two digit numbers

They will then need to use these strategies in problems. They will rarely need to use a formal (vertical) written method as very large numbers generally occur in problems best suited to a calculator. The student should be encouraged to use a variety of informal written or mental methods appropriate to the sum. These methods could involve adding on, rounding, doubling or equivalence.

1.3 Subtraction

Here are some examples of informal written or mental methods for subtractions. They involve adding-on to the next 10 or 100, or using equivalence:

$$64 - 48$$

$$48 + 2 = 50$$

$$50 + 10 = 60$$

$$60 + 4 = 64$$

$$\text{total added on is } 2 + 10 + 4 = 16$$

$$63 - 47 \quad \text{is equivalent to } (63 + 3) - (47 + 3) = 66 - 50 = 16$$

If a formal (vertical) written method is required students should think in terms of "decomposition" rather than "borrowing and paying back".

For example:

$$273 \\ - \underline{25} \text{ take 1 group of 10 from the 70 to make 13} - 5$$

$$\begin{array}{r} 2 \overset{6}{7} 13 \\ - \underline{25} \\ 248 \end{array}$$

1.4 Multiplication

Students need to be able to derive the multiplication facts up to 10×10 . If they are not able to recall them by heart they could use the following methods:

To multiply by	2	double the number
	3	double and add on to the number
	4	double and double again
	5	\times by 10 and half it
	6	\times by 10, half it and add on to the number
	7	\times by 10, half it and add number doubled
	8	double, double and double
	9	\times by 10 and subtract the number

When mentally calculating the product (result of multiplying two numbers) of 2, two digit numbers students should be encouraged to look for equivalent products. One example of this is to double one number and half the other as in this example:

$$\begin{array}{l}
 16 \times 15 \quad \text{is equivalent to} \\
 8 \times 30 \quad \text{is equivalent to} \\
 4 \times 60 \quad \text{is equivalent to} \\
 2 \times 120 \quad \text{is equivalent to} \\
 1 \times 240 = 240
 \end{array}$$

1.4.1 Written Multiplication Methods

Students may use a variety of written methods when dealing with larger numbers. Here are two of the most commonly used:

1.4.1.1 Partitioning

This method is favoured at Keystage 2 as it encourages understanding of place value.

For example:

$$76 \times 42 \quad (\text{first calculate an estimated answer: } 80 \times 40 = 3200 \text{ to use as a check for the final answer})$$

$$76 = 70 + 6$$

$$\text{And } 42 = 40 + 2 \quad (\text{each number is partitioned into tens and units})$$

Draw out a grid and write in each box the product of the 2 numbers:

	70	6
40	2800 (70 \times 40)	240
2	140	12

Then add together all the products

$$\begin{array}{r}
 2800 \\
 240 \\
 140 \\
 + \quad 12 \\
 \hline
 3192
 \end{array}$$

1.4.1.2 Gelosia

(may be known as Elizabethan or Chinese method)

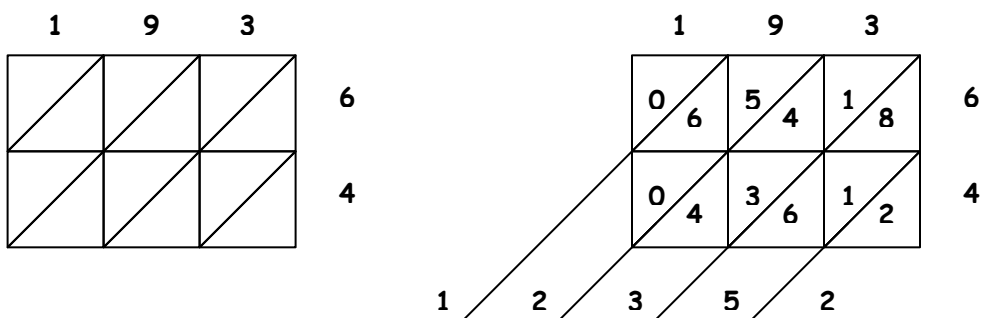
For some students this method gives an almost 'foolproof' route to the answer when practised regularly. It is best to use centimetre squared paper to ease the setting up of the grid.

For example:

$$193 \times 64 \quad (\text{estimate --- } 200 \times 60 = 12000)$$

Write each digit of one number along the top of the grid and each digit of the other number down the right hand side of the grid.

Fill in the product of each pair of numbers. Then add down the diagonals starting from the right hand side and carrying tens digits over to the next diagonal.



1.5 Division

It is important to stress that division is the inverse (opposite) to multiplication and that therefore a good knowledge of the multiplication tables is essential.

It can be useful to know the following checks for divisibility:

If a number is divisible by:	It will:
2	Be even
3	Have digits that add up to 3, 6 or 9
4	Be even and even when halved
5	End with 5 or 0
6	Fit checks for 2 and 3
7	Have no check
8	Be even when halved twice
9	Have digits that add up to 9
10	End with 0

1.5.1 Written division methods

From the Keystage 2 Numeracy Strategy students may be most used to the following 'chunking' method for division of larger numbers:

1.5.1.1 Chunking

For example: $254 \div 15$ take away 'chunks' (multiples of 15)

$$10 \times 15 = 150$$

$$6 \times 15 = 90$$

$$\begin{array}{r} 254 \\ - 150 \\ \hline 104 \\ - 90 \\ \hline 14 \end{array}$$

So $16 \times 15 = 240$ with 14 left over. So the answer is **16 remainder 14**

1.5.1.2 Division Algorithm

Examples:

$$\bullet \quad 64 \div 4 \quad 4 \overline{) 64} \begin{array}{r} 16 \\ \underline{4} \\ 24 \\ \underline{24} \\ 0 \end{array}$$

$$\bullet \quad 21.3 \div 5 \quad 5 \overline{) 21.30} \begin{array}{r} 4.26 \\ \underline{20} \\ 13 \\ \underline{10} \\ 30 \\ \underline{30} \\ 0 \end{array}$$

add a zero and continue until there are no remainders to carry forward.

- **$12 \div 0.4$**

It is not necessary to divide by a decimal. If each number is multiplied by **10** then an equivalent division of **$120 \div 4$** is obtained and the answer is **30**.

2 Algebra

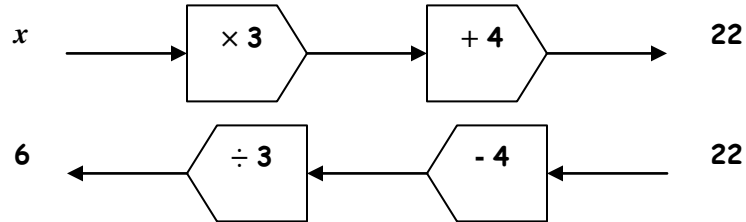
2.1 The Basics

- A curly x should be used so that it is not confused with the multiplication sign \times .
- Students should stick to the same case of letter as appears in the question; generally lower case 'a' is not the same in algebra as upper case 'A'
- Letter or numbers appearing next to each other are multiplied;
 $4ab$ means $4 \times a \times b$
- $c + c + c$ can be simplified to $3c$
- 4^2 means 4×4 and not 4×2
- Fractions should be written with a horizontal line; $\frac{2}{5}$ so that they are written in the same way as algebra fractions; $\frac{x+1}{5}$ means add 1 to x then divide your answer by 5.
- Operations should be carried out in the **BIDMAS** order of priority **B**rackets, **I**ndices, **D**ivision, **M**ultiplication, **A**ddition & **S**ubtraction
Hence $4 + 3 \times 2 = 10$ as the multiplication comes first
($3 \times 2 = 6$ then $6 + 4 = 10$)
- Students should set working out a line at a time
 $34 - 16 = 34 - 10 - 6$
 $= 24 - 6$ is better than $34 - 16 = 34 - 10 = 24 - 6 = 18$
 $= 18$ which contains incorrect statements.

2.2 Solving Equations

Students are likely to solve equations initially by drawing function machines and using inverse operations.

For example: Solve $3x + 4 = 22$



They will then progress to a balancing method where to keep the equation true the same operation has to be performed on both sides of the $=$ sign:

$$\begin{array}{ll} 3x + 4 = 22 & \text{(subtracting 4 from each side)} \\ 3x = 18 & \text{(dividing each side by 3)} \\ 1x = 6 & \text{so } x = 6 \end{array}$$

3 Handling Data

3.1 Types of Data

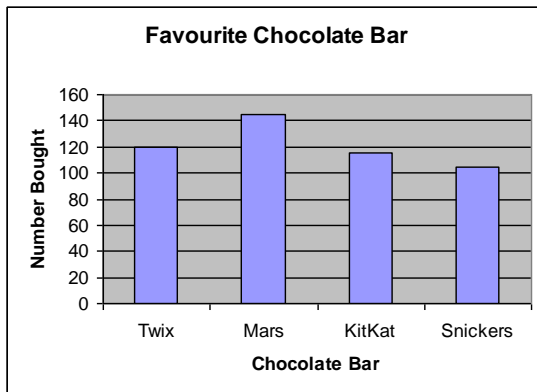
Students will be required to work with three main types of data:

- **Categorical** : a list of categories e.g. favourite colour: pink, yellow, etc.
- **Discrete** : a list of numbers e.g. the price of stamps: 18p, 26p, etc.
- **Continuous** : numbers which could have any value on a continuous scale, i.e. anything that has to be measured such as length, time and weight.

3.2 Types of Charts

3.2.1 Bar charts

(also called bar graphs, column graphs or block graphs)

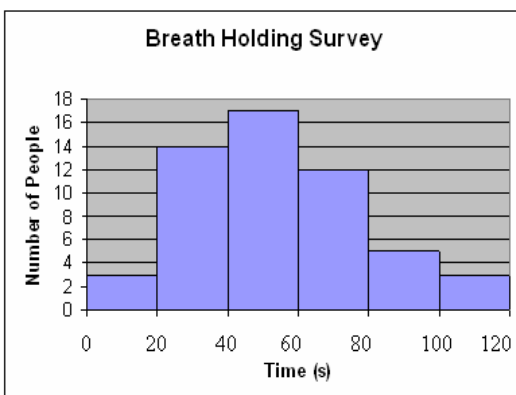
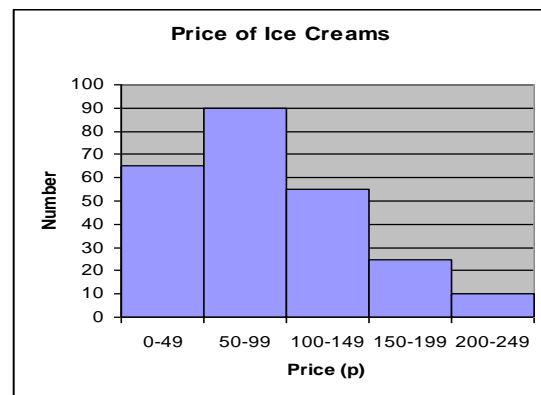


Categorical Data:

- Gaps between bars.
- The axis labels go in the middle of the bars.

Discrete data in groups:

- No gaps between bars.
- The axis labels go in the middle of the bars.



Continuous Data:

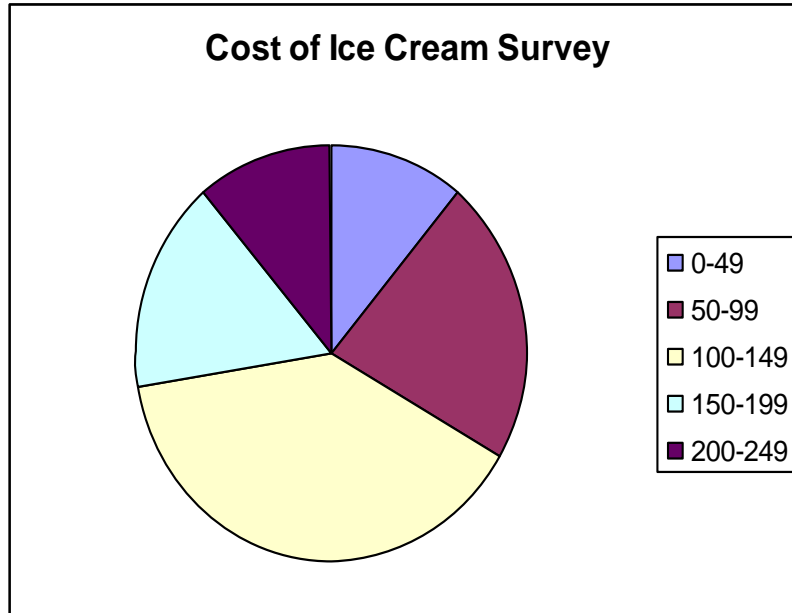
- No gaps between bars.
- The axis labels begin and end with the bars - like a graph.

All Charts Must Have:

- A title.
- Labels on both axes.

3.2.2 Pie Charts

These are most appropriately used to display categorical data. Students may be required to calculate the angle for each sector in terms of degrees or by percentages.

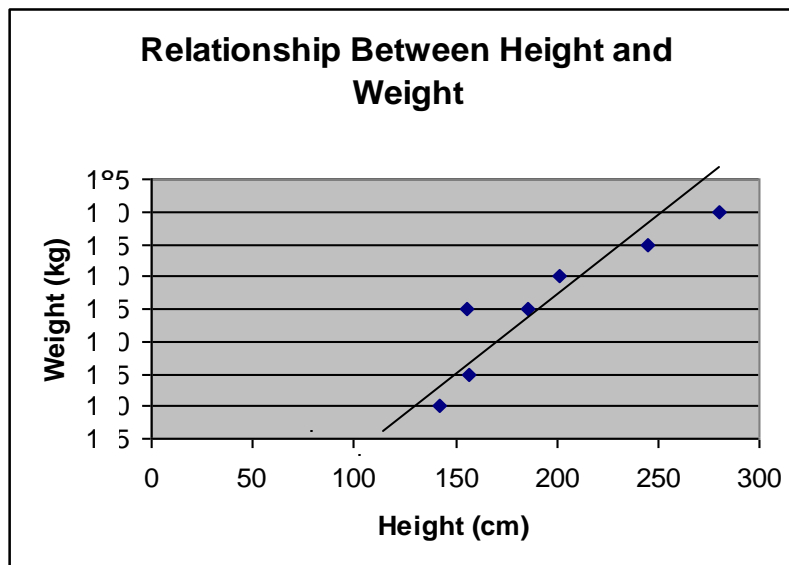


The methods are:

- For degrees: number in the required set divided by the total number in the group, then multiply by **360**.
- For percentages: as above but multiply by **100** instead of **360**.

3.2.3 Scatter Diagrams

These are used to look for a correlation (connection) in 2 sets of data. A line of best fit is a straight line drawn through the points and is used to estimate (read off) answers.



3.3 Types of Average

Students will become aware that there are three averages each of which can give a representative value of the data at hand:

- **Mean** : add up all the numbers and divide the total by the amount of numbers
- **Median** : arrange the numbers in order of size and find the middle one
- **Mode** : the most frequently occurring number

For example with the following set of numbers:

6, 8, 8, 7, 6, 9, 4, 18, 6

The **Mean** is $\frac{6 + 8 + 8 + 7 + 6 + 9 + 4 + 18 + 6}{9} = \frac{72}{9} = 8$

The **Median** is 4, 6, 6, 6, 7, 8, 8, 9, 18

↓
7

The **Mode** is **6** as there are more 6's than any other number

4 Measure

Students need to have a working knowledge of the following metric measures

Weight

1 tonne	= 1000 kilograms (kg)
1 kilogram	= 1000 grams (g)

Length

1 kilometre (km)	= 1000 metres (m)
1 metre (m)	= 100 centimetres (cm)
1 centimetre (cm)	= 10 millimetres (mm)

Capacity

1 litre (l)	= 1000 millilitres (ml)
1 litre (l)	= 1000 cm³

It is likely however, that students will be using a mixture of metric and imperial measures in everyday life. For example they will be more familiar with miles than kilometres and they may know their weight in stones and pounds. It is therefore recommended that they know the following approximate conversions by heart:

1 inch	is approximately	2.5 centimetres
5 miles	is approximately	8 kilometres
2.2 pounds	is approximately	1 kilogram
1.8 pints	is approximately	1 litre