

BELMONT HOUSE SCHOOL

NUMERACY & MATHEMATICS GUIDE

*A guide to how numeracy &
mathematics topics are
taught across the curriculum*

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BASICS

It is important for ALL pupils, from Junior 1 in the Junior School to Senior 6 in the Senior School, to revise and practise their basic number skills.

Every pupil should know ALL their times tables, particularly as they progress through the School.

Place value is often forgotten and should be reinforced regularly.

HUNDREDS	TENS	UNITS	DECIMAL POINT	TENTHS	HUNDREDS
3	6	1	.	4	9

This is the number three hundred and sixty-one point four nine.

Reading and writing very large numbers is a common difficulty and revision is essential. When reading a newspaper, it is a good idea to go over numbers with pupils, getting them to read the number out loud to you.

eg 12 315 987 is read as twelve million, three hundred and fifteen thousand, nine hundred and eighty seven.

Pupils should be made aware of metric (and imperial) weights and measures.

eg their own height and weight.

Estimating sensibly and getting the feel of large and small weights, heights and distances, as well as using money in a practical way can be practised at home (or while shopping).

The better the pupils know the basics, the easier it will be to progress numerically.

ESTIMATING

At Level C

Pupils should be able to:

- estimate height and length in cm, m, $\frac{1}{2}$ m, $\frac{1}{10}$ m

Example: length of pencil = 10 cm
 width of desk = $\frac{1}{2}$ m

At Level D

Pupils should be able to:

- estimate small weights, small areas, small volumes

Example: bag of sugar = 1 kg

At Level E

Pupils should be able to:

- estimate areas in square metres, lengths in mm and m

Example: area of a whiteboard = 3 m²
 diameter of 1p coin = 15 mm

ROUNDING

Note: We always round up for 5 or more

At Level B

Pupils should be able to:

- round a 2 digit whole numbers to the nearest 10

Example: round 74 to the nearest 10 \rightarrow 70

At Level C

Pupils should be able to:

- round 3 digit whole numbers to the nearest 10

Example: round 386 to the nearest 10 \rightarrow 390

At Level D

Pupils should be able to:

- round any number to the nearest whole number, 10 or 100

Example: round 347.5 to nearest whole number \rightarrow 348
round 347.5 to nearest ten \rightarrow 350
round 347.5 to nearest hundred \rightarrow 300

At Level E

Pupils should be able to:

- round any number to 1 decimal place

Example: round 7.51 to one decimal place \rightarrow 7.5
round 8.96 to one decimal place \rightarrow 9.0

At Level F

Pupils should be able to:

- round to any number of decimal places or significant figures

Example: round 3.14159 to three decimal places \rightarrow 3.142
round 3.14159 to two decimal places \rightarrow 3.14
round 3.14159 to three significant figures \rightarrow 3.14

SUBTRACTION

WE DO NOT: "borrow and pay back"

From Level C

Pupils should be able to:

- subtract using decomposition (as a written method)

Example: $271 - 38$

$$\begin{array}{r} 6 \\ 2\cancel{7}1 \\ \underline{38} \\ 233 \end{array}$$

Example: $400 - 74$

$$\begin{array}{r} 39 \\ 4\cancel{0}0 \\ \underline{74} \\ 326 \end{array}$$

- check by addition

Example: To solve $41 - 27$, count on from 27 until you reach 41
27 add what gives 41?
+ 4 will give 31, so answer is 14!

- promote alternative mental methods where appropriate

Example: Breaking up the number being subtracted:
e.g. To solve $41 - 27$, subtract 20 then subtract 7.
 $41 - 20 = 21$, $21 - 7 = 14$

COORDINATES

NOTE: "go **ALONG** the corridor, then **UP/DOWN** the stairs"

At Level D

Pupils should be able to:

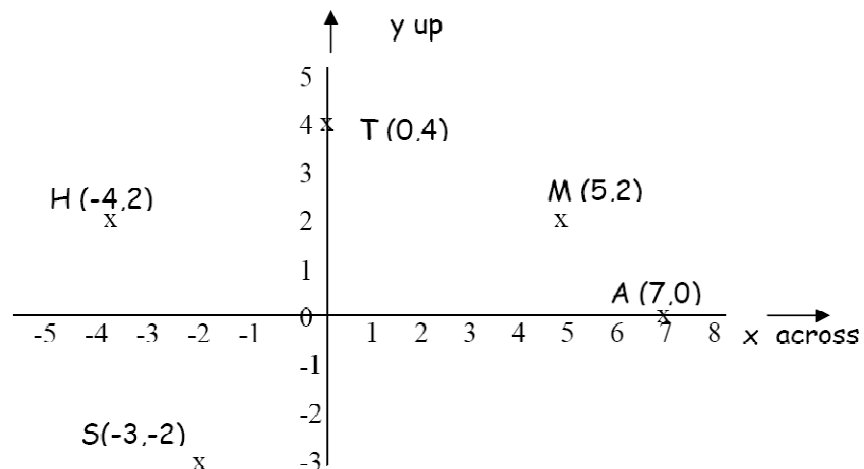
- use a co-ordinate system to locate a point on a grid
- number the grid lines rather than the spaces
- use the terms across/back and up/down for the different directions
- use a comma to separate as follows : 3 across 4 up = (3, 4)

At Level E

Pupils should be able to:

- use co-ordinates in all four quadrants to plot positions

Example: Plot the following points: M (5, 2), A (7, 0), T (0, 4), H (-4, 2), S (-3, -2)



BAR GRAPHS

Pupils should:

- use a sharpened pencil and a ruler
- give the graph a title
- label the axes
- label the bars in the centre of the bar (each bar has an equal width)
- label the frequency (up the side) on the lines not on the spaces
- make sure there are spaces between the bars

At Level B

Pupils should be able to:

- construct bar graphs with frequency graduated in single units

At Level C

Pupils should be able to:

- construct bar graphs with frequency graduated in multiple units

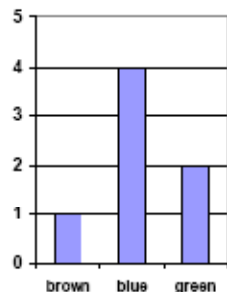
At Level D

Pupils should be able to:

- construct bar graphs involving simple fractions or decimals

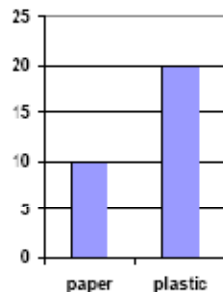
LEVEL C

colour of eyes



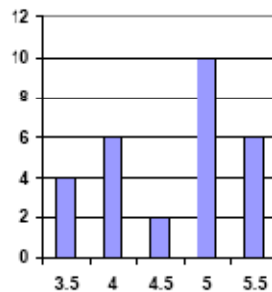
LEVEL D

quantities of litter



LEVEL E

shoe size



LINE GRAPHS

At Level D

Pupils should be able to:

- use a sharpened pencil and a ruler
- choose an appropriate scale for the axes to fit the paper
- label the axes
- give the graph a title
- number the lines not the spaces
- plot the points neatly (using a cross or dot)
- fit a suitable line

At Level F

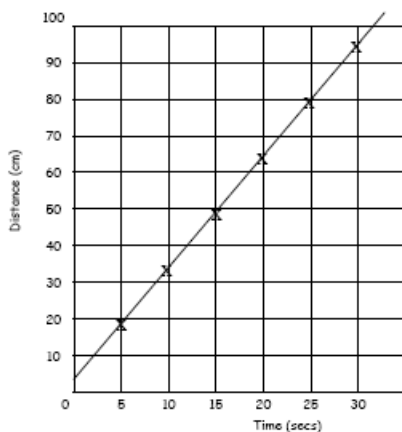
Pupils should be able to:

- if necessary, make use of a jagged line to show that the lower part of a graph has been missed out.

Example: The distance a gas travels over time has been recorded in the table below:

Time (s)	0	5	10	15	20	25	30
Distance (cm)	0	15	30	45	60	75	90

Distance travelled by a gas over time



PIE CHARTS

Pupils should:

- use a sharpened pencil
- label all the slices or insert a key as required
- give the pie chart a title

At Level D

Pupils should be able to:

- construct pie charts involving simple fractions or decimals

At Level E

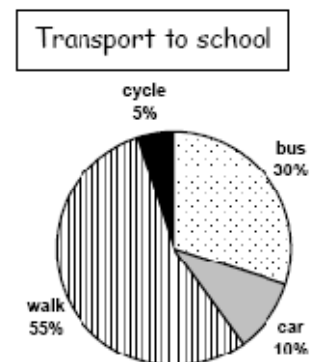
Pupils should be able to:

- construct pie charts of data expressed in percentages

Example:

30% of pupils travel to school by bus, 10% by car, 55% walk and 5% cycle.
Draw a pie chart of the data.

Bus (30%)	=	30% of 360	=	108°
Car (10%)	=	10% of 360	=	36°
Walk (55%)	=	10% of 360	=	198°
Cycle (5%)	=	36% of 360	=	18°



At Level F

Pupils should be able to:

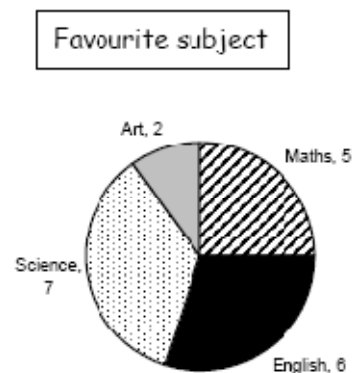
- construct pie charts of raw data

Example:

20 pupils were asked "What is your favourite subject?"
Replies were Maths 5, English 6, Science 7, Art 2
Draw a pie chart of the data.

(TOTAL PUPILS = 20)

Maths	5 ÷ 20 × 360	=	90°
English	6 ÷ 20 × 360	=	108°
Science	7 ÷ 20 × 360	=	126°
Art	2 ÷ 20 × 360	=	36°



DATA ANALYSIS

Correlation in scatter graphs is described in qualitative terms.

Example:

"The warmer the weather, the less you spend on heating" is negative correlation.

"The more people in your family, the more you spend on food" is positive correlation.

Probability is always expressed as a fraction.

$$P(\text{event}) = \frac{\text{number of favourable outcomes}}{\text{total number of possible outcomes}}$$

At Level E

Pupils should be able to:

- analyse ungrouped data using a tally table and frequency column or an ordered list
- calculate range of a data set - in mathematics, this is taught as the difference between the highest and lowest values of the data set (range is expressed differently in biology)
- calculate the mean (average) of a set of data

At Level F

Pupils should be able to:

- use a stem and leaf diagram
- calculate the mean (average)
- median (central value of an ordered list)
- mode (most common value) of a data set
- obtain these values from an ungrouped frequency table

Example: The results of a survey of the number of pets pupils owned were:

3, 3, 4, 4, 4, 5, 6, 6, 7, 8

Mean = $(3 + 3 + 4 + 4 + 4 + 5 + 6 + 6 + 7 + 8) \div 10 = 5$

Median = the middle when data in order = $(4 + 5) \div 2 = 4.5$

Mode = most common piece of data = 4

Range = highest - lowest = $8 - 3 = 5$

FRACTIONS

At Level C

Pupils should be able to:

- do simple fractions of 1 or 2 digit numbers

Example: $\frac{1}{3}$ of 90 = $90 \div 3 = 30$

$\frac{1}{5}$ of 70 = $70 \div 5 = 14$

At Level D

Pupils should be able to:

- do simple fractions of up to 4 digit numbers

Example: $\frac{3}{4}$ of 176 = $176 \div 4 \times 3 = 132$

$\frac{2}{5}$ of 1225 = $1225 \div 5 \times 2 = 500$

At Level E

Pupils should be able to:

- use equivalence of widely used fractions and decimals

Example: $\frac{3}{10} = 0.3$

- find widely used fractions mentally
- find fractions of a quantity with a calculator

At Level E

Pupils should be able to:

- use equivalence of all fractions, decimals and percentages
- add, subtract, multiply and divide fractions with and without a calculator

Add and Subtract	Multiply	Divide
Make denominators the same	Multiply top and multiply bottom	Invert the second fraction, then multiply
$\frac{1}{2} + \frac{1}{3}$	$\frac{2}{3} \times \frac{5}{7}$	$\frac{3}{4} \div \frac{2}{5}$
$\frac{3}{6} + \frac{2}{6} = \frac{5}{6}$	$\frac{2 \times 5}{3 \times 7} = \frac{10}{21}$	$\frac{3}{4} \times \frac{5}{2} = \frac{15}{8} = 1\frac{7}{8}$

PERCENTAGES

We do not use the % button on the calculator because of inconsistencies between models

At Level E

Pupils should be able to:

- recognise that "of" means multiply
- find 50%, 25%, 10% and 1% without a calculator and use addition/subtraction to find other amounts

Example: Find 36% of £250

$$\begin{aligned} 10\% &= \text{£}25.00 && (\text{£}250 \div 10) \\ 5\% &= \text{£}12.50 && (10\% \div 2) \\ 1\% &= \text{£}2.50 && (10\% \div 10) \\ 30\% &= \text{£}75.00 && (3 \times 10\%) \\ 36\% &= \text{£}90.00 && (30\% + 5\% + 1\%) \end{aligned}$$

- find percentages with a calculator

Example: $23\% \text{ of } \text{£}300 = 23 \div 100 \times 300 = \text{£}69$ **OR** $0.23 \times \text{£}300 = \text{£}69$

At Level F

Pupils should be able to:

- Express a fraction as a percentage via the decimal equivalent

Example: Express two fifths as a percentage

$$\frac{2}{5} = 2 \div 5 = 0.4 = 40\% \quad \text{OR} \quad \frac{2}{5} = \frac{4}{10} = \frac{40}{100} = 40\%$$

- Calculate percentage profit or loss

Example: I buy a car for £5000 and sell it for £3500.

What is the percentage loss?

$$\text{Loss} = \text{£}5000 - \text{£}3500 = \text{£}1500$$

$$\text{Percentage Loss} = \frac{\text{loss}}{\text{original amount}} \times 100 = \frac{1500}{5000} \times 100 = 30\%$$

Example: Increase £350 by 15%

$$115\% \text{ of } 350 = 1.15 \times \text{£}350 = \text{£}402.50$$

OR

$$\begin{aligned} 15\% \text{ of } \text{£}350 &= \text{£}52.50 \\ \text{£}350 + \text{£}52.50 &= \text{£}402.50 \end{aligned}$$

RATIO

At Level F

Pupils should be able to:

- Find ratios between quantities;
- Use simple unitary ratio:

Example 1: In a school, the ratio of pupils coming by car to those coming on foot is 1:5. In one class, 4 came by car. How many were likely to come on foot?

$$\begin{array}{ccc} & \text{Car} & \text{Foot} \\ \times 4 \leftarrow & 1 & : & 5 & \rightarrow \times 4 \\ & 4 & : & & \end{array}$$

Example 2: Divide 84 in the ratio 3:4,

3:4 means total number of parts:	$3 + 4 = 7$
Each part is worth:	$84 \div 7 = 12$
3 parts are worth:	$3 \times 12 = 36$
4 parts are worth:	$4 \times 12 = 48$

Example 3: In a class of 30 there are 18 girls and 12 boys:

- (a) Express the ratio of boys to girls in simplest form
- (b) If this was the same ratio throughout the 795 pupil school, how many girls are there in the Whole School?

$$\text{(a)} \quad \div 6 \leftarrow \begin{array}{ccc} 18 & : & 12 \\ 3 & : & 2 \end{array} \rightarrow \div 6$$

(b)	3:2 means total number of parts:	$3 + 2 = 5$
	Each part is worth:	$795 \div 5 = 159$
	3 parts are worth:	$3 \times 159 = 477$
	4 parts are worth:	$4 \times 159 = 636$

PROPORTION

At Level F

Pupils should be able to:

- identify direct and inverse proportion
- record appropriate "headings" with the unknown on the right
- use the unitary method (i.e. find the value of 'one' first then multiply by the required value)
- if rounding is required we do not round until the last stage

Example 1: Direct Unitary Method

If 5 bananas cost 80 pence, then what do 3 bananas cost?

Bananas		cost (pence)	
5	→	80	
1	→	$80 \div 5$	= 16
3	→	16×3	= 48

Example 2: Inverse Unitary Method

The journey time at 60 km/h = 30 minutes, so what is the journey time at 50km/h?

Speed (km/h)		Time (mins)	
60	→	30	
1	→	30×60	= 1800 minutes
50	→	$1800 \div 50$	= 36 minutes

EQUATIONS

We do not "change the side, change the sign"

At Level E

Pupils should be able to solve simple equations by:

- "Balancing"
- performing the same operation to each side of the equation
- doing "Undo" operations:
 - undo + with -
 - undo - with +
 - undo \times with \div
 - undo \div with \times
- encouraging statements like:
 - "add something to both sides"
 - "multiply both sides by something"
- We prefer
 - the letter x to be written differently from a multiplication sign
 - one equals sign per line
 - equals signs beneath each other
 - we discourage bad form such as $3 \times 4 = 12 \div 2 = 6 \times 3 = 18$

Example: $2x + 3 = 9$ take away 3 from both sides
 $2x = 6$ divide both sides by 2
 $x = 3$

At Level F

Pupils should be able to:

- understand equivalence of expressions and use standard algebraic conventions to rearrange them;
 - o Simplify
 - o Multiply out and Factorise using a common factor
- evaluate expressions using the conventions for order of operations in calculations;

Example: $3x + 6 = 2(x - 9)$ multiply out the bracket
 $3x + 6 = 2x - 18$ subtract $2x$ from both sides
 $x + 6 = -18$ subtract 6 from both sides
 $x = -24$

TIME CALCULATIONS

We do not teach time as a subtraction

At Level D

Pupils should be able to:

- convert between the 12 and 24 hour clock (2327 = 11.27pm)
- calculate duration in hours and minutes by counting up to the next hour then on to the required time

Example 1: How long is it from 0755 to 0948?

0755 → 0800 → 0900 → 0948
5 mins 1 hour 48 mins

Total time = 5 min + 1 hr + 48min
= 1hr 53 mins

At Level E

Pupils should be able to:

- convert between hours and minutes (multiply by 60 for hours into minutes)

Example 1: Change 27 minutes into hours equivalent

27 min = $27 \div 60 = 0.45$ hours

USING FORMULAE

We do not rearrange the formula before substitution (too difficult)
We do not state the answer only - ALL working must be shown

At Level F

Pupils should be able to construct and use simple formulae by:

- writing down the formula first
- rewriting the formula replacing the letters by the appropriate numbers (substitution)
- solving the equation
- interpreting the answer and putting the appropriate units back into context

Example 1: The length of a string S mm for the weight of W g is given by the formula: $S = 16 + 3W$

(a) Find S when $W = 3$ g (b) Find W when $S = 20.5$ mm

- (a) $S = 16 + 3W$ (write formula)
 $S = 16 + 3 \times 3$ (replace letters by numbers)
 $S = 16 + 9$ (solve the equation - by doing and undoing)
 $S = 25$
Length of string is 25 mm (interpret result in context)
- (b) $S = 16 + 3W$ (write formula)
 $20.5 = 16 + 3W$ (replace letters by numbers)
 $4.5 = 3W$ (solve the equation - by doing and undoing)
 $W = 1.5$
Weight is 1.5 g (interpret result in context)

SCIENTIFIC NOTATION

Scientific notation (or Standard Form) is introduced at level F.

It is also part of the *General and Credit Standard Grade* courses and is taught in Senior 2 and Senior 3.

We teach that scientific notation consists of a number between one and ten that is multiplied by 10 to some power.

Example: Put the following numbers into scientific notation

(a)	24 500 000	(b)	0.000 098 8
	24 500 000		0.000 098 8
	= 2.45×10^7		= 9.88×10^{-5}

Other subjects may approach this topic differently.

At Level E

The following terms are introduced:

- kilo meaning one thousand
- milli meaning one thousandth

At Level F

Pupils should be able to use:

- powers
- square roots

ORDER OF OPERATIONS

We use the mnemonic BODMAS to remind the pupils of the correct sequence for carrying out mathematical operations.

Scientific calculators use a rule to know which answer to calculate when given a string of numbers to add, subtract, multiply, divide etc.

Example: $2 + 3 \times 5$

This can be tackled in two ways - the correct way and the incorrect way.

$$(2 + 3) \times 5 = 5 \times 5 = 25 \text{ OR } 2 + (3 \times 5) = 2 + 15 = 17$$

BODMAS can be used to give the correct answer:

Brackets

Order/Of

Division

Multiplication

Addition

Subtraction

According to BODMAS, multiplication should always be done before addition, therefore 17 is the correct answer according to BODMAS and should also be the answer which your scientific calculator will give if you

Order means a number raised to a power such as 2^2 or $(-3)^3$.

(The power is also called the exponent leading to an alternative mnemonic BEDMAS but both mean the same thing)

CHANGE THE SUBJECT OF THE FORMULA

This topic deals with the movement of letters in a formula and makes a different letter the subject. This topic is taught at Standard Grade, Credit Level and Intermediate 2.

Make x the subject of the formula for the following:

(a) $xy + a = b$

(b) $x^2 - y = p$

(c) $\frac{x}{y} = \frac{a}{b}$

(d) $\sqrt{x + a} = p$

(a) $xy + a = b$ subtract a from each side

$xy = b - a$ divide each side by y

$x = \frac{b-a}{y}$

(b) $x^2 - y = p$ add y to each side

$x^2 = p + y$ square root both sides

$x = \sqrt{p + y}$

(c) $\frac{x}{y} = \frac{a}{b}$ multiply both sides by y

$x = \frac{ay}{b}$

(d) $\sqrt{x + a} = p$ square both sides

$x + a = p^2$ subtract a from both sides

$x = p^2 - a$