

Numeracy Across the Curriculum

A Guide for Parents of all
Subjects as to how the various
Numeracy Topics are approached
within the School

Stewarton Academy 2008

Version 1.0

Introduction

Recently Stewarton Academy set up a working group to see how topics involving numbers are taught in the various departments within the school. The group consulted all departments and a teachers booklet was produced so all departments could have a consistent approach. Initially the focus is on S1/S2 year groups.

This information booklet has been produced to tell parents and teachers how each topic is taught within the Maths Department at the school. Other departments will use this booklet to make them aware of how topics are taught in maths. Teaching of topics will then be more uniform throughout the school which should make it easier for pupils to learn.

It is hoped that use of the information in the booklet will help you understand the way number topics are being taught to your children in the school, making it easier for you to help them with their homework, and as a result improve their progress.

Basics

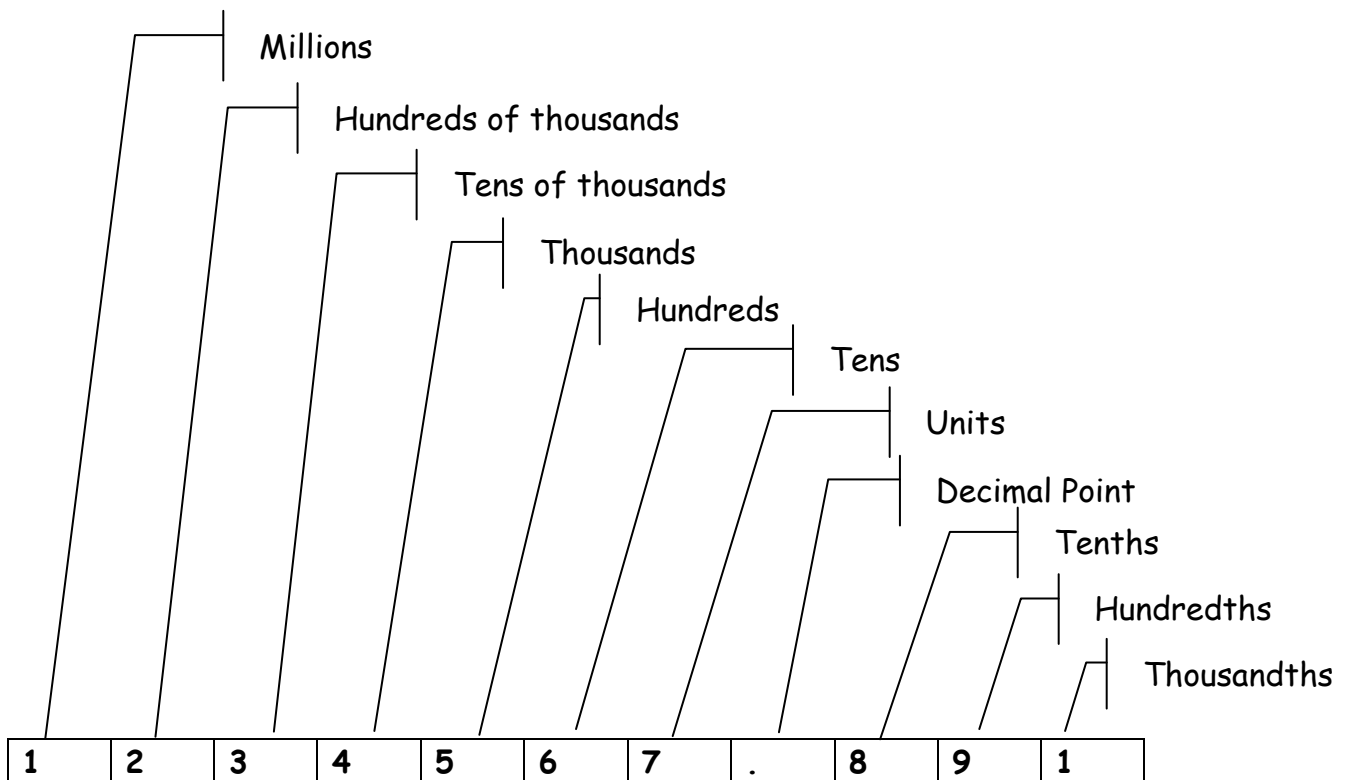
When pupils come to secondary school they start a lot of different subjects and have a lot of new interests but it is still important that they practise their basic number work which may not be reinforced as often as it was in primary school.

Every pupil should know their tables, particularly as they go up the school. Their six, seven, eight, and nine times tables are very important and can be practised at home.

Primary School learning about place value is often forgotten and can be reinforced at home.

Remember

The number **One Million, two hundred and thirty four thousand, five hundred and sixty seven point eight nine one** would be set out as follows:



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Measure and Estimate

We expect pupils to

- **At Level C**

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

Volume in litres, $\frac{1}{2}$ litres, $\frac{1}{4}$ litres

Read scales on measuring devices where an intermediate graduation may be deduced.

- **At Level D** estimate small weights, small areas, small volumes

Measure height and length in mm

Understand that 1 litre = 1000 ml.

Be aware of common imperial units.

- **At Level E** estimate areas in square metres, cm and mm

Read scales, estimating between graduations.

Rounding

We expect pupils to

- at **Level B** round 2 digit whole numbers to the nearest 10
- at **Level C** round 3 digit whole numbers to the nearest 10
- at **Level D** round any number to the nearest whole number, 10 or 100
- at **Level E** round any number to 1 decimal place
- at **Level F** round to any number of decimal places or significant figures

Note: We always round up for 5 or above

WORKED EXAMPLES:

Level B/C

74 to the nearest 10 → 70 (Level B); 386 → 390 (Level C)

Level D

347.5 → 348 (to nearest whole number); or → 350 (to nearest ten);
or → 300 (to nearest hundred)

Level E

7.51 (to 1 decimal place) → 7.5; 8.96 (to 1 decimal place) → 9.0

Level F

3.14159 (to 3 decimal places) → 3.142; or 3.14 (to 2 decimal places);
or 3.14 (to 3 significant figures)

3054 (to 1 significant figure) → 3000; or 3100 (2 sig figs); or 3050 (3 sig figs);

Subtraction

From **Level C** onwards we do....

- subtraction using decomposition (as a written method)
- check by addition
- promote alternative mental methods where appropriate

WORKED EXAMPLES

- Decomposition:

$$\begin{array}{r} 6 \\ 27^1 1 \\ \underline{38} \\ 233 \end{array}$$

$$\begin{array}{r} 39 \\ 40^1 0 \\ \underline{74} \\ 326 \end{array}$$

- Counting on:

To solve $41 - 27$, count on from 27 until you reach 41

- Breaking up the number being subtracted:

e.g. To solve $41 - 27$, subtract 20 then subtract 7

DO NOT
"borrow and pay back"

Order of Operations (BODMAS)

Bodmas is a mnemonic which we teach in maths to enable pupils to know exactly the right sequence for carrying out mathematical operations.

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

For example

What is the answer to $2 + 3 \times 5$?

Is it $(2 + 3) \times 5 = 5 \times 5 = 25$? or $2 + (3 \times 5) = 2 + 15 = 17$?

We use BODMAS to give the correct answer:

Do the following operations in order

(B)rackets (O)f (D)ivision (M)ultiplication (A)ddition (S)ubtraction

According to BODMAS, multiplication should always be done before addition, therefore 17 is the correct answer and should also be the answer which your calculator will give if you type in $2 + 3 \times 5$ <enter>.

Of refers to "Powers OF" i.e. a number raised to a power, e.g. 2^3 is 2 to the power OF 3. The power is also called the exponent or index leading to an alternative mnemonic BEDMAS or BIDMAS but both mean the same thing.

WORKED EXAMPLE:

Calculate $4 + 70 \div 10 \times (1+2)^2 - 1$

Brackets first > $4 + 70 \div 10 \times (3)^2 - 1$

Of next > $4 + 70 \div 10 \times 9 - 1$

Division > $4 + 7 \times 9 - 1$

Multiplication > $4 + 63 - 1$

Addition > $67 - 1$

Subtraction > 66

Answer is 66

Fractions

○ At **Level C** we expect pupils to do simple fractions of 1 or 2 digit numbers e.g

$$\frac{1}{3} \text{ of } 9 = 3 \text{ (} 9 \div 3 \text{)}$$

○ At **Level D** we expect pupils to do simple fractions of up to 4 digit numbers e.g

$$\frac{3}{4} \text{ of } 176 = 132 \text{ (} 176 \div 4 \times 3 \text{)}$$

○ At **Level E** we...

use equivalence of widely used fractions and decimals e.g. $\frac{3}{10} = 0.3$

find widely used fractions mentally e.g. $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{10}$

find fractions of a quantity with a calculator

○ At **Level F** we ...

use equivalence of all fractions, decimals and percentages

add, subtract, multiply and divide fractions with and without a calculator

WORKED EXAMPLES

Add and Subtract	Multiply	Divide
Make the denominators equal	Multiply top and multiply bottom	Invert the second fraction and multiply
$\frac{1}{2} + \frac{1}{3}$ $= \frac{3}{6} + \frac{2}{6}$ $= \frac{5}{6}$	$\frac{3}{4} \times \frac{2}{3}$ $= \frac{6}{12}$ $= \frac{1}{2}$	$\frac{3}{4} \div \frac{2}{5}$ $= \frac{3}{4} \times \frac{5}{2}$ $= \frac{15}{8}$ $= 1\frac{7}{8}$

Co-ordinates and Position

At **Level D** we expect pupils to

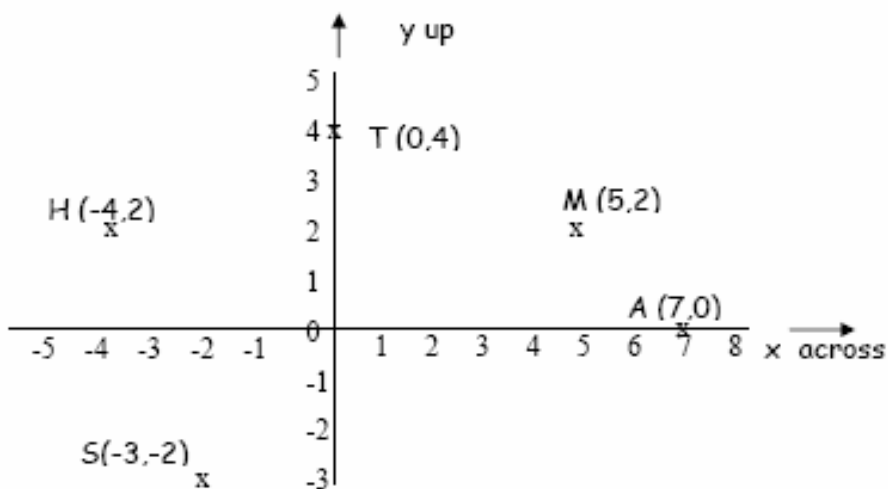
- use a co-ordinate system to locate a point on a grid in the positive quadrant only e.g. (4,6)
- number the **grid lines** rather than the spaces
- use the terms across/back and up/down for the X and Y directions (mnemonic "X is a cross, wise up")
- use a comma to separate as follows : 3 across 4 up = (3,4)
- use an 8 point compass rose to describe position or direction

At **Level E** we expect pupils to

- use co-ordinates in all four quadrants to plot positions
- use 3 figure bearings for position, direction from North e.g east is 090°

WORKED EXAMPLE:

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



Percentages

At **Level E** we expect pupils to

○ find 50%, 25%, 10% and 1% without a calculator and use addition to find other amounts such as 15% (add 10% and 5%)

○ find percentages with a calculator

(e.g 23% of £300 = $300 \div 100 \times 23 = \text{£}69$)

recognise that "of" means multiply

○ At **Level F** we expect pupils to

Express a fraction as a percentage via the decimal equivalent

WORKED EXAMPLES

NON-CALCULATOR

○ Find 36% of £250

10% is £25

30% is £75 (10% \times 3)

5% is £12.50 (10% \div 2)

1% is £ 2.50 (10% \div 10)

So 36% is **£90** (30% + 5% + 1%)

CALCULATOR

○ Find 36% of £250

$36 \div 100 \times 250$

○ Express $\frac{2}{5}$ as a percentage

$$\frac{2}{5} = \frac{4}{10} = \frac{40}{100} = 40\%$$

○ Express $\frac{9}{13}$ as a percentage

$$9 \div 13 \times 100 = 69.2\%$$

○ Buy a car for £5000 and sell it for £3500 what is the percentage loss?

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

NON-CALCULATOR

$$\frac{1500}{5000} = \frac{15}{50} = \frac{30}{100} = 30\%$$

CALCULATOR

$$1500 \div 5000 \times 100 = 30\%$$

○ Increase £120 by 15%

$$15\% \text{ of } 120 = 15 \div 100 \times 120 = \text{£}18$$

$$\text{£}120 + \text{£}18 = \text{£}138$$

(..... to find the increase)

(then add on for the new total)

DO NOT use the % button on the calculator because of inconsistencies between models

Proportion

At **Level F** we expect pupils 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

WORKED EXAMPLES:

A. Direct Unitary Method

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

bananas cost (pence)

$$5 \rightarrow 80$$

$$1 \rightarrow 80 \div 5 = 16$$

$$3 \rightarrow 16 \times 3 = 48$$

B. 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)

$$60 \rightarrow 30$$

$$1 \rightarrow 30 \times 60 = 1800 \text{ minutes}$$

$$50 \rightarrow 1800 \div 50 = 36 \text{ minutes}$$

Equations

At **Level E** we expect pupils to solve simple equations by

- doing "Undo" operations e.g
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 $3 \times 4 = 12 \div 2 = 6 \times 3 = 18$

WORKED EXAMPLES:

Level E $2x + 3 = 9$ undo the +3 by subtracting 3 from the right side
 $2x = 6$ undo the times 2 by dividing by 2 on the right side
 $x = 3$

Level F $3x + 6 = 2(x - 9)$
 $3x + 6 = 2x - 18$ (subtract 6 from both sides)
 $3x = 2x - 24$ (subtract $2x$ from both sides)
 $x = -24$

DO NOT say
"change the side,
change the sign "

Line Graphs

From **Level D** we expect pupils to

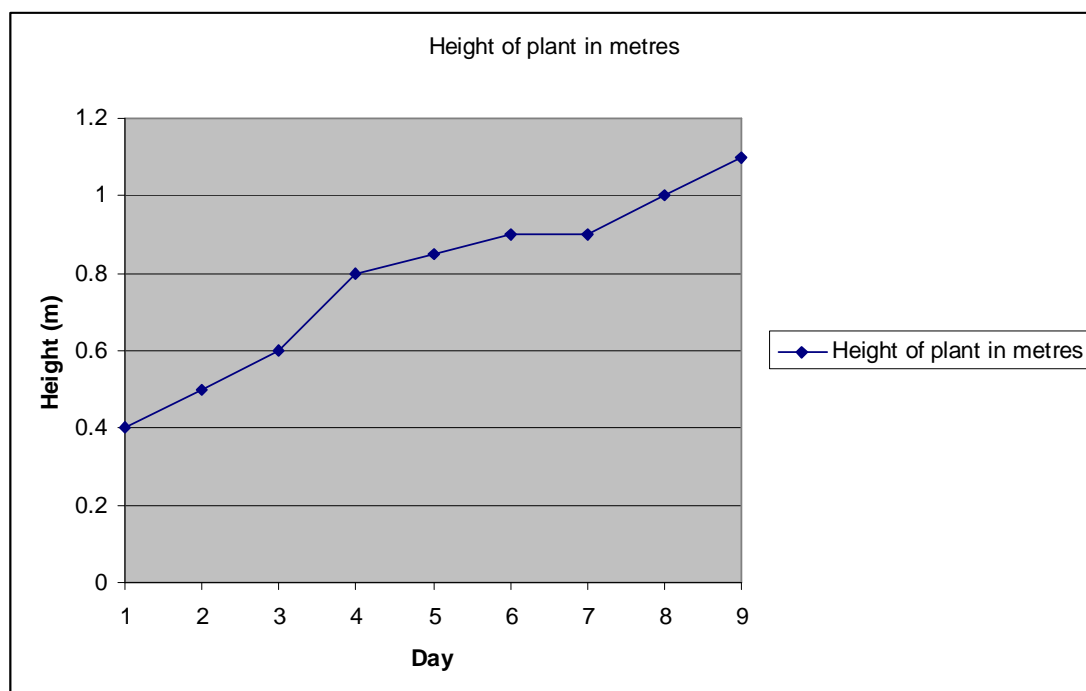
- use a sharpened pencil and a ruler
- choose an appropriate scale for the axes to fit the paper
- label the axes
- give the graph a title
- number the lines **not** the spaces
- plot the points neatly (using a cross or dot)
- fit a suitable line by joining point to point with a straight line.
(Lines of best fit not covered until standard grade)

At Level F

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

Worked example: The height of a plant measured over 9 days...

Height (m)	0.4	0.5	0.6	0.8	0.85	0.9	0.9	1.0	1.1
Day	1	2	3	4	5	6	7	8	9



Bar Graphs

We expect pupils to

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

At **Level B** construct bar graphs with frequency graduated in single units

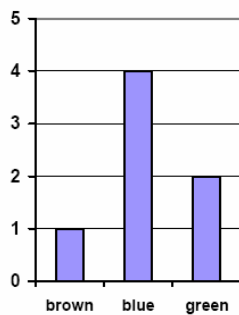
At **Level C** construct bar graphs with frequency graduated in multiple units

At **Level D** construct bar graphs involving simple fractions or decimals

WORKED EXAMPLES:

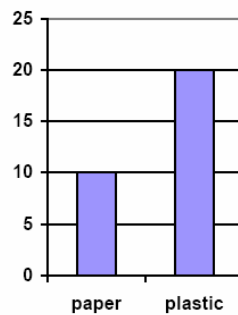
Level B

colour of eyes



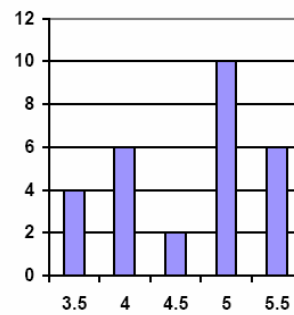
Level C

quantities of litter



Level D

shoe size



Pie Charts

We expect pupils to

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

Level D

construct pie charts involving simple fractions or decimals

at Level E

construct pie charts of data expressed in percentages

at Level F

construct pie charts of raw data

WORKED EXAMPLES:

Level E

30% of pupils travel to school by bus, 10% by car, 55% walk and 5% cycle.

Draw a pie chart of the data.

$$10\% \text{ of } 360^\circ = 36^\circ$$

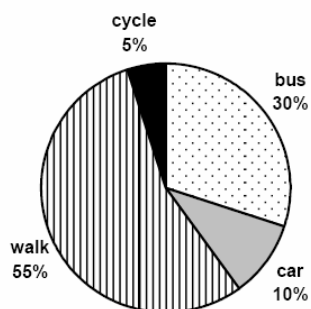
$$\text{Bus } 30\% = 3 \times 10\% = 108^\circ$$

$$\text{Car } 10\% = 1 \times 10\% = 36^\circ$$

$$\text{Walk } 55\% = 5.5 \times 10\% = 198^\circ$$

$$\text{Cycle } 5\% = 0.5 \times 36^\circ = 18^\circ$$

Transport to school



Level F

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.

$$360 \div 20 \text{ (the total)} = 18^\circ$$

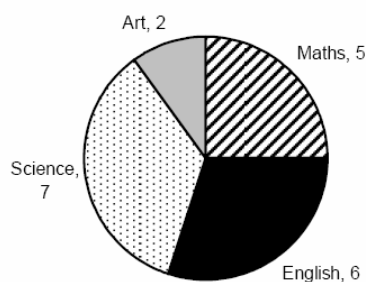
$$\text{Maths } 5 \quad 5 \times 18 = 90^\circ$$

$$\text{English } 6 \quad 6 \times 18 = 108^\circ$$

$$\text{Science } 7 \quad 7 \times 18 = 126^\circ$$

$$\text{Art } 2 \quad 2 \times 18 = 36^\circ$$

Favourite subject



Time Calculations

We expect pupils to

at **Level D**

- convert between 12 and 24 hour clock (2327 = 11.27pm, 0000 = midnight)
- calculate duration in hours and minutes by counting up to the next hour and then on to the required time

at **level E**

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

Worked Examples:

Level D

How long is it from 0755 to 0948

$$\begin{array}{ccccccc} 0755 & \rightarrow & 0800 & \rightarrow & 0900 & \rightarrow & 0948 \\ & & (5 \text{ mins}) & + & (1 \text{ hour}) & + & (48 \text{ mins}) \end{array}$$

Total time 1 hr 53 minutes

Level F

Change 27 minutes in to hours equivalent

$$27 \text{ min} = 27 \div 60 = 0.45 \text{ hours}$$

We **DO NOT** teach
time as subtraction

Using Formulae

We expect pupils to construct and use formulae at **Level F** by

- writing down the formula first
- substituting the given numerical values in to the formula
- solving the equation
- interpreting the answer including the correct units

Worked Examples:

The length of a spring S mm for the weight of W grams is given by the formula: $S = 16 + 3W$

a) Find S when $W = 3$ g

$$S = 16 + 3W \quad (\text{write the formula})$$

$$S = 16 + 3 \times 3 \quad (\text{replace letters by numbers})$$

$$S = 16 + 9 \quad (\text{solve the equation})$$

$$S = 25$$

Length of string is 25 mm (interpret result in context)

b) Find W when $S = 20.5$ mm

$$S = 16 + 3W \quad (\text{write the formula})$$

$$20.5 = 16 + 3W \quad (\text{replace letters by numbers})$$

$$4.5 = 3W \quad (\text{solve the equation - by doing and undoing})$$

$$1.5 = W$$

The weight is 1.5 g (interpret result in context)

Do Not

Rearrange the formula before substitution
State the answer only. Working must be shown

Data Analysis

We expect pupils to

at level E

- analyse ungrouped data using a tally table and frequency column or an ordered list
- calculate range of a data set. In maths this is taught as the difference between the highest and lowest values of the data set.
- calculate the mean (average) of a set of data

at Level F

- 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

Correlation in scatter graphs is described in qualitative terms.

e.g. "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

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

Worked Examples

The results of a survey of a number of pets that pupils owned were

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

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

$$\text{Median} = \text{the middle (order list first)} = (4 + 5) \div 2 = 4.5$$

$$\text{Mode} = \text{most common} = 4$$

$$\text{Range} = \text{highest} - \text{lowest} = 8 - 3 = 5$$

Scientific Notation (Standard Form)

We expect pupils at Level F to

Convert large and small numbers to scientific notation and vice versa by moving the decimal point to between the first and second non zero number, then counting the number of places moved.

In maths, scientific notation always consists of a number between 1 and 10 multiplied by 10 raised to a power

At Level E we introduce the terms

- Kilo meaning one thousand
- Milli meaning one thousandth

At level F we expect pupils to use powers and square roots

Worked Example

$$24,500,000 = 2.45 \times 10^7 \text{ (Move the point 7 places and multiply by } 10^7\text{)}$$

$$0.000988 = 9.88 \times 10^{-4} \text{ (Negative index for numbers less than 1)}$$

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