Numeracy Across The Curriculum

How topics involving numbers are taught within Sir James Smiths

Contents

Introduction

This information booklet has been produced to inform parents and teachers how and when each topic is taught, within the Maths Department at the school.

Other departments will use this booklet to make them aware of how and when 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 the use of the information in this 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 many different subjects and have a lot of new interests, but it is still important that they practise their basic number work, especially times tables to 12 x 12.

Every pupil should know their tables and these can be practised at home.

Place value is important.
Remember:

hundreds	tens	units	Decimal Point	tenths	hundredths
3	5	6	.	7	5

This number is said as: "three hundred and fifty six point seven five."

3 678 023

This number is said as "three million, six hundred and seventy eight thousand and twenty three."

Pupils experience both metric and imperial weights and measures. For example they should be aware of their own height and weight in both.

Opportunities to use money and time in a practical situation will be of value.

The better your child knows the basics, the easier it will be for him or her to make progress.

Pupils will meet the topics listed below at various times, depending on their pathway. In general, each topic is ranked from easiest to the most difficult.

Estimating

We expect pupils to:

Estimate height and length in centimetres (cm) and metres (m).

e.g. length of pencil = 10cm

width of desk = $\frac{1}{2}$ m or 0.5m

Know appropriate units of measure for estimating distance, weight and volume.

e.g. bag of sugar = 1kg

Know useful conversion facts:

1kg ≈ 2.2 lbs

1 litre ≈ 1.75 pints

8 km ≈ 5 miles

2.5 cm ≈ 1 inch

Rounding

We expect pupils:

- to round any whole number less than 1000 to the nearest 10 or 100

  e.g 74 to the nearest 10 is 70;

  386 the nearest 100 is 400

- to round decimals to the nearest whole number

  e.g 23.54 to the nearest whole number is 24

- to round any number to 1 or 2 decimal places

  e.g 2.456 to 1 dp is 2.5

  2.456 to 2 dp is 2.46

- to round to 1, 2 or 3 significant figures

  eg 3.14159 to 1 sf is 3

  3.14159 to 2 sf is 3.1

  3.14159 to 3 sf is 3.14

Subtraction

- subtraction using decomposition or number line methods;
- check by addition;
- promote alternative mental methods where appropriate.

Decomposition

$$\begin{array}{r} 2\,{}^{6}\!\not{7}\,{}^{1}1 \\ -\quad 3\,8 \\ \hline 2\,3\,3 \end{array}$$

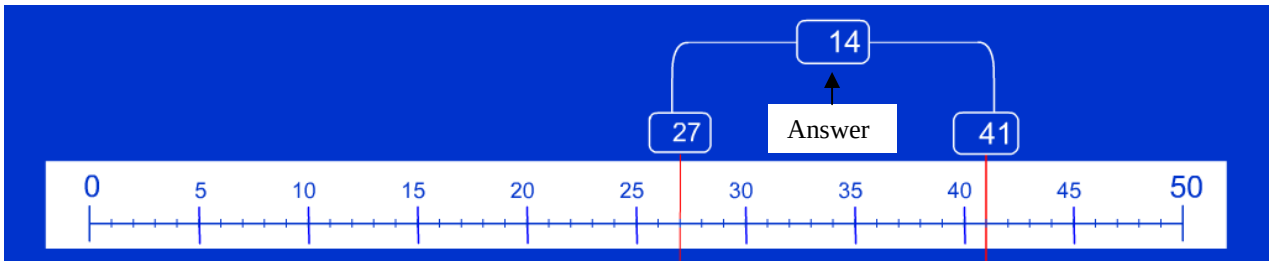
$$\begin{array}{r} {}^{3}\!\not{4}\,{}^{9}\!\not{0}\,{}^{1}0 \\ -\quad 7\,4 \\ \hline 3\,2\,6 \end{array}$$

We do not "borrow and pay back"

Number line Methods

Counting on:

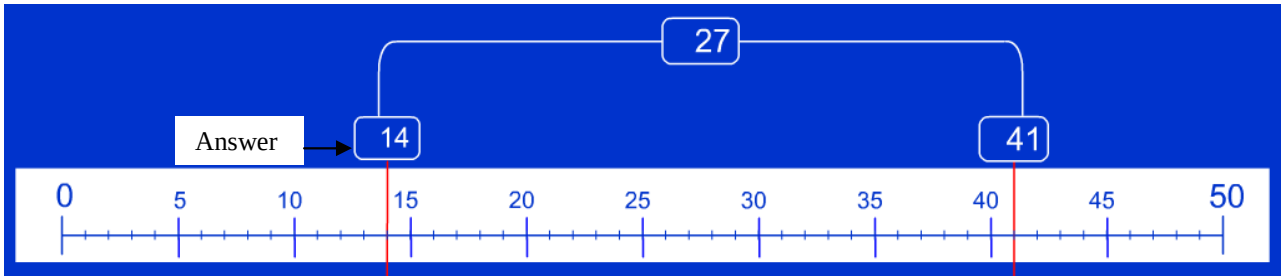
To solve 41 – 27, count on from 27 until you reach 41.



Finding the difference

Breaking up the number being subtracted:

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



Multiplication

We encourage pupils to have a variety of strategies to multiply, building on the methods they have used in their Primary school.

A: **Grid Method**

346 x 9 is approximately 350 x 10 = 3500

346 x 9 x 300 40 6

9 | 2700 | 360 | 54 | = 3114

72 x 38 is approximately 70 x 40 = 2800

72 x 38 x 70 2

	70	2
30	2100	60
8	560	16

2160
+576
2736

B. **Partitioning**

Short multiplication: HTU x U
316 x 9 is approximately 350 x 10 = 3500

		346				346
	X	9			x	9
300 x 9		2700	leading to			3114
40 x 9		360				
6 x 9		54				
		3114				

Long multiplication: TU x TU
72 x 38 is approximately 70 x 40 = 2800

		72
	X	38
72 x 30		2160
72 x 8		576
		2736

Extend to simple decimals with one decimal place.
Multiply by a single digit, approximately first. Know that decimal points should line up under each other.

4.9 x 3 is approximately 5 x 3 = 15

4.9 x 3	4.0 x 3 =	12.0
	0.9 x 3 =	2.7
		14.7

Division

We encourage students to realise that division is the inverse operation of multiplication and so familiarity with multiplication tables is essential.

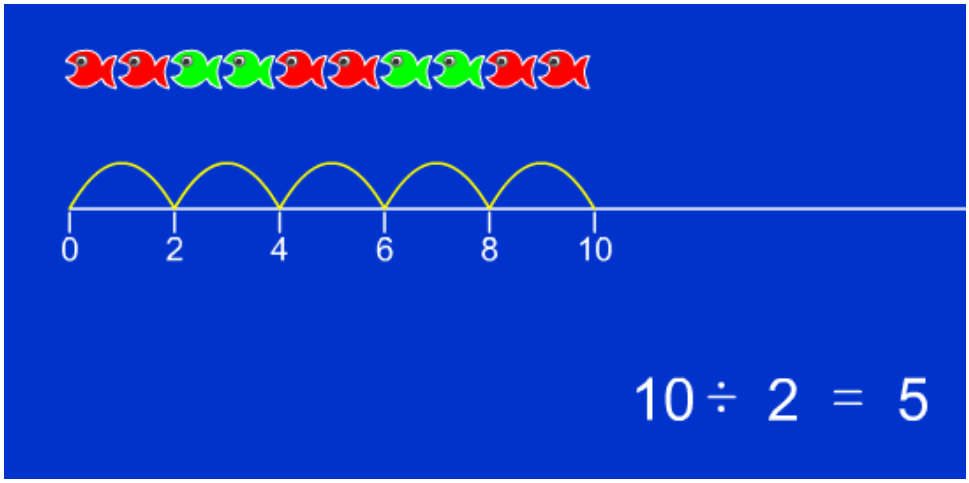
2 x 5 = 10

5 x 2 = 10

10 ÷ 5 = 2 **Is a set of related facts**

10 ÷ 2 = 5

When we divide we say: "How many lots of 2 are there in 10?"



Division Methods

144 ÷ 6

Chunking

144
-60 10 x 6
84
-60 10 x 6
24
-24 4 x 6
0

24 x 6 = 144

so 144 ÷ 6 = 24

Chunking works by repeated subtraction of multiples of 6

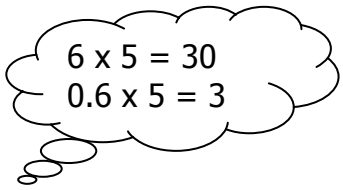
Bus Stop

$$6\overline{)144} = 024$$

The bus stop is the standard (and preferred) method taught for division.

148÷5

148
-100 20 x 5
48
- 45 9 x 5
3 0.6 x 5
0



29.6 x 5 = 148
148 ÷ 5 = 29.6

$$5\overline{)148.0} = 029.6$$

Or with a remainder of 3/5

3/5 means 3 ÷ 5

Fractions

Know the equivalence of commonly used fractions and decimals

e.g. $\frac{3}{10} = 0.3$

We expect pupils to calculate simple fractions of amounts

$\frac{1}{3}$ of 9 = 3 (9÷3); $\frac{1}{5}$ of 70 = 14 (70 ÷ 5)

We expect pupils to find more complex fractions of amounts

$\frac{3}{4}$ of 176 = 132 (176 ÷ 4 x 3)

We expect pupils to:

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

WORKED EXAMPLES

Add	Multiply	Divide
Make the denominators the same	Multiply the top and multiply the bottom.	Invert the second fraction and multiply the top and bottom.
$\frac{1}{3} + \frac{1}{2} = \frac{2}{6} + \frac{3}{6}$ $= \frac{5}{6}$	$\frac{1}{4} X \frac{2}{5} = \frac{2}{20}$ $= \frac{1}{10}$	$\frac{3}{4} \div \frac{2}{5}$ $\frac{3}{4} X \frac{5}{2} = \frac{15}{8}$ $= 1\frac{7}{8}$

Co-ordinates

We expect pupils to:

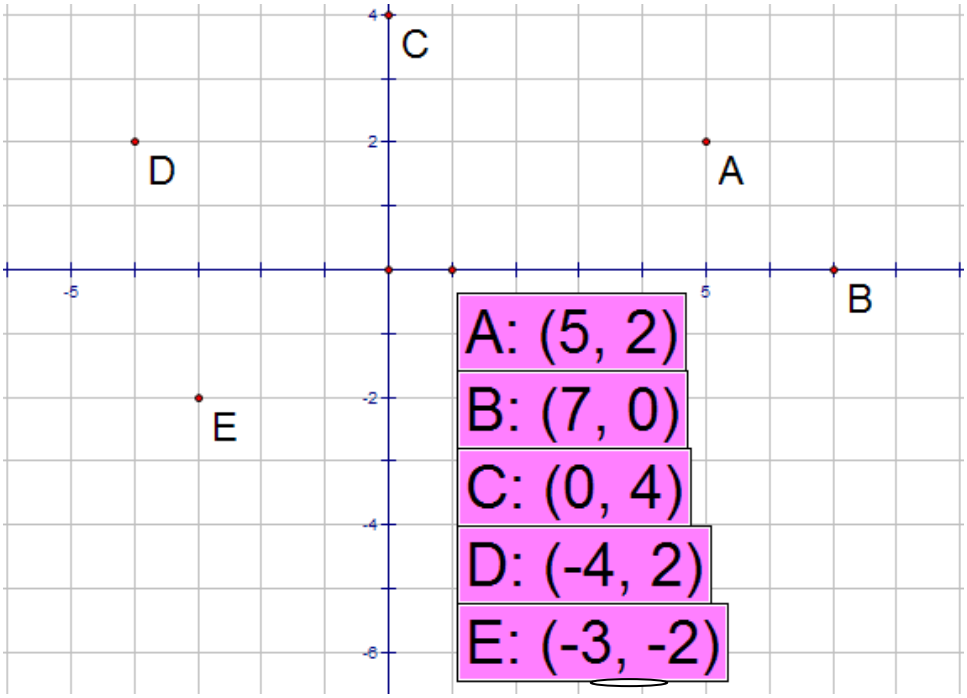
- o use a co-ordinate system to locate a point on a grid;
- o number the grid lines rather than the spaces;
- o use the terms across/back and up/down for the different directions;
- o use a comma to separate as follows: 3 across 4 up = (3,4).

We expect pupils to

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

WORKED EXAMPLE:

Plot the following points:
A (5,2), B (7,0), C (0,4), D (-4,2), E (-3,-2)



Remember (x) Along the corridor (y) up the stairs

Percentages

We expect pupils to:

find 50%, 25%, 10% and 1% without a calculator and use addition to find other amounts.

e.g. Find 36% of £250

10% is £25
30% is £75 (10% x 3)
5% is £12.50 (10% ÷ 2)
1% is £ 2.50 (10% ÷ 10)
36% is **£90** (30% + 5% + 1%)

Express a fraction as a percentage and as a decimal equivalent

e.g. $\frac{2}{5} = \frac{20}{50} = \frac{40}{100} = 40\% = 0.4$

We expect pupils to:

- find percentages with a calculator
  (e.g 23% of £300 = 0.23 x 300 = £69)
  recognise that "of" means multiply.
- Solve problems involving percentage increase and decrease.
  e.g. If you buy a car for £5000 and sell it for £3500 what is the percentage loss?
  Loss = £5000 – £3500 = £1500

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

e.g. Increase £350 by 15%

15% increase of 350 = 1.15 X 350 = £402.50

WE DO NOT…

use the % button on the calculator because of inconsistencies between models

Proportion

We expect pupils to:

- identify direct and inverse proportion;
- use the unitary method (i.e. find the value of 'one' first then multiply by the required value).

Direct Unitary Method

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

bananas	cost (pence)	
5	80	
1	80 ÷ 5	= 16p
3	16 x 3	= 48p

Inverse Unitary Method

If the journey time at 60 km/h is 30 minutes, what is the journey time at 50km/h?

Speed (km/h)	Time (mins)
60	30
1	30 x 60 = 1800 minutes
50	1800 ÷ 50 = 36 minutes

Equations

We expect pupils to solve simple equations by:

- "Balancing" or performing the same operation to each side of the equation.
- Inverse operations
  e.g undo +with -,
  undo – with + ,
  undo x with ÷,
  undo ÷ with x

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 x 4 = 12 ÷ 2 = 6 x 3 = 18

This should read 3 x 4 = 12

12 ÷ 2 = 6

6 x 3 = 18

WORKED EXAMPLES:

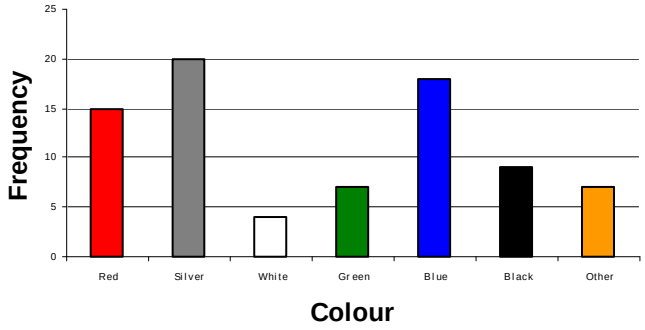
$2x + 3$	$= 9$	take away 3 from both sides
$2x$	$= 6$	divide by 2 both sides
x	$= 3$	

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

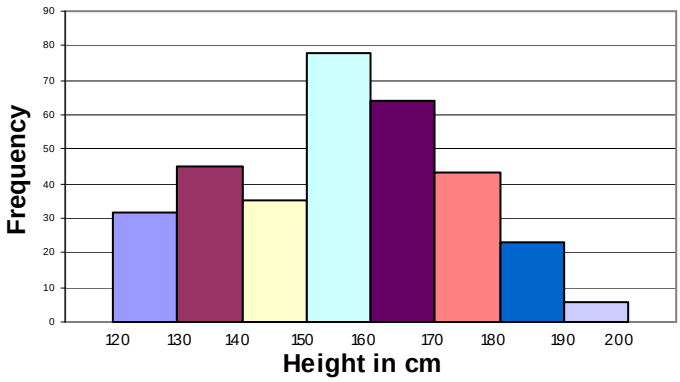
WE DO NOT…
"change the side, change the sign."

Bar and Frequency Graphs

A Bar Chart to Show the Colour of 80 cars in a Car Park



A Frequency Diagram to show the Distribution of Pupils' Heights in Year 11



Discrete Data

Discrete data can only take certain values in a given range.

Examples:

- Shoe size : 2, 2.5, 3, 3.5, 4 etc;
- Hair Colour;
- Number of Children in a Family;
- Number of Cars in a Car Park.

When Plotting Discrete Data in a Bar Chart make sure there is:

- A gap between the bars.
- The Y axis is labelled Frequency (The number of times the data appeared).
- The X axis is labelled with the categories.
- The title says what type of graph you are plotting and what it is showing.

Continuous Data

Continuous data can take any value in a given range. Height is continuous data because it can never be measured precisely as it is always possible to divide the unit being used by ten.

Examples of continuous data are:

- Length;
- Weight;
- Mass;
- Area;
- Volume.

When plotting continuous data we use a frequency diagram make sure there is:

- No gaps between the bars.
- The data has been grouped correctly.
- Groups intervals are the same size.
- The Y axis is labelled Frequency (The number of times the data appeared).
- The X axis is labelled with the categories
- The title says what type of graph you plotting and what it is showing.

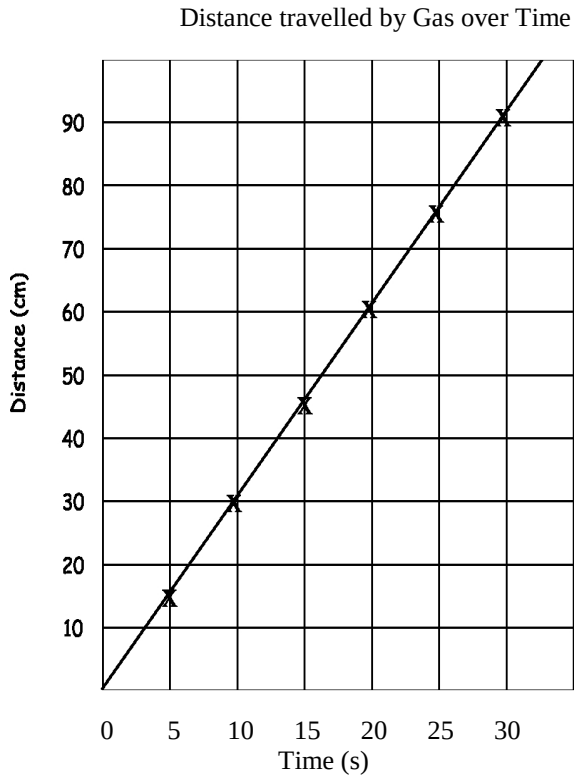
Line Graphs

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);
- fit a suitable line;
- if necessary, make use of a jagged line to show that the lower part of a graph has been missed out. This is called a Broken Axis.

WORKED EXAMPLES: In a science experiment, 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



Pie Charts

We expect pupils to:

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

- construct pie charts involving simple fractions or decimals;
- construct pie charts of data expressed in percentages;
- construct pie charts of raw data.

Worked Examples

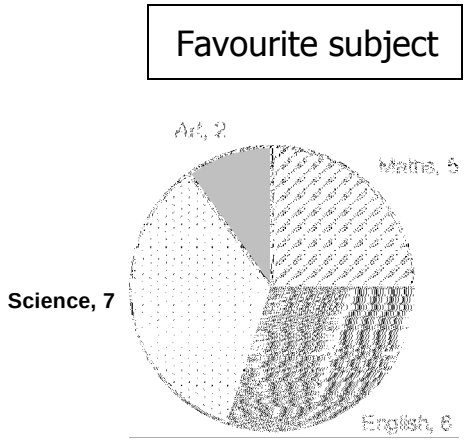
20 pupils were asked ”What is your favourite subject?”

Replies were Maths 5, English 6, Science 7, Art 2

Draw a pie chart of the data.

$\frac{360}{20}$ = 18º represents 1 pupil

Maths	**5 x 18=90º**
English	**6 x 18=108º**
Science	**7 x 18=126º**
Art	**2 x 18=36º**



Time Calculations

We expect pupils to:

- convert between the 12 and 24 hour clock (23:27 = 11.27pm);
- calculate duration in hours and minutes by counting up to the next hour then on to the required time.

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

WORKED EXAMPLES:

How long is it from 07:55 to 09:48?

07:55 08:00 09:00 0948
(5 mins) + *(1 hr)* + (48 mins)

Total time **=** 1 hr 53 minutes

Change 27 minutes into the hours equivalent.

27 min = 27 ÷ 60 = 0.45 hours

Using Formulae

The length of a string S mm for the weight of W g is given by the formula:

$$S = 16 + 3W$$

Find S when W = 3 g

S = 16 + 3W *(write formula)*
S = 16 + 3 x 3 *(replace letters by numbers(this is called **substitution**))*
S = 16 + 9 *(solve the equation – by doing and undoing)*
S = 25

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

Find W when S = 20.5 mm

S = 16 + 3 W *(write formula)*
20.5 = 16 + 3W *(replace letters by numbers)*
4.5 = 3W *(solve the equation – by doing and undoing)*
1.5 = W
The weight is 1.5 g *(interpret result in context)*

Data Analysis

We expect pupils to:

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

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

Correlation in scatter graphs is described in qualitative terms.

Eg.

"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 EXAMPLE

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

5, 2, 5, 5, 3

Mean $= \frac{5+2+5+5+3}{5}$

$= 4$

Median = 2, 3, 5, 5, 5

Median = 5

Mode = 5

Using Indices and Standard Form

Pupils should be able to use powers and square roots.

Pupils solve problems involving calculating with powers, roots and numbers expressed in standard form, checking for correct order of magnitude.

We use standard form when working with very big or very small numbers.

We teach that a number in standard form consists of a number between one and ten multiplied by 10 to some power.

For example

24,500,000 = 2.45×10^{7}

0.000988 = 9.88×10^{-4}

On a calculator display 2.45×10^{7} may appear as $2.45\ ^{07}$. Other calculators may differ and pupils need to be familiar with their own.

Order of Operations or BIDMAS

BIDMAS is the 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 do you think the answer to 2 + 3 x 5 is?
Is it 2 + 3 x 5 = 5 x 5 = 25? or 2 + 3 x 5 = 2 + 15 = 17?

We use BIDMAS to give the correct answer:

(B)rackets (I)ndices (D)ivision (M)ultiplication (A)ddition (S)ubtraction

According to BIDMAS, multiplication should always be done before addition, therefore 17 is the correct answer. A scientific calculator applies BIDMAS automatically and should give the answer 17 when you type in 2 + 3 x 5 <enter>.

Indices means a number raised to a power such as 2^2 or $(-3)^3$. The power is also called the order leading to an alternative mnemonic BODMAS but both mean the same thing.

Worked example:

Calculate $4 + 70 \div 10 \times (1 + 2)^2 - 1$ according to the BIDMAS rules.

Brackets gives	$4 + 70 \div 10 \times (3)^2 - 1$
Indices gives	$4 + 70 \div 10 \times 9 - 1$
Division gives	$4 + 7 \times 9 - 1$
Multiplication gives	$4 + 63 - 1$
Addition gives	$67 - 1$
Subtraction gives	66
Answer	**66**