Saint Edmund Arrowsmith Catholic High School

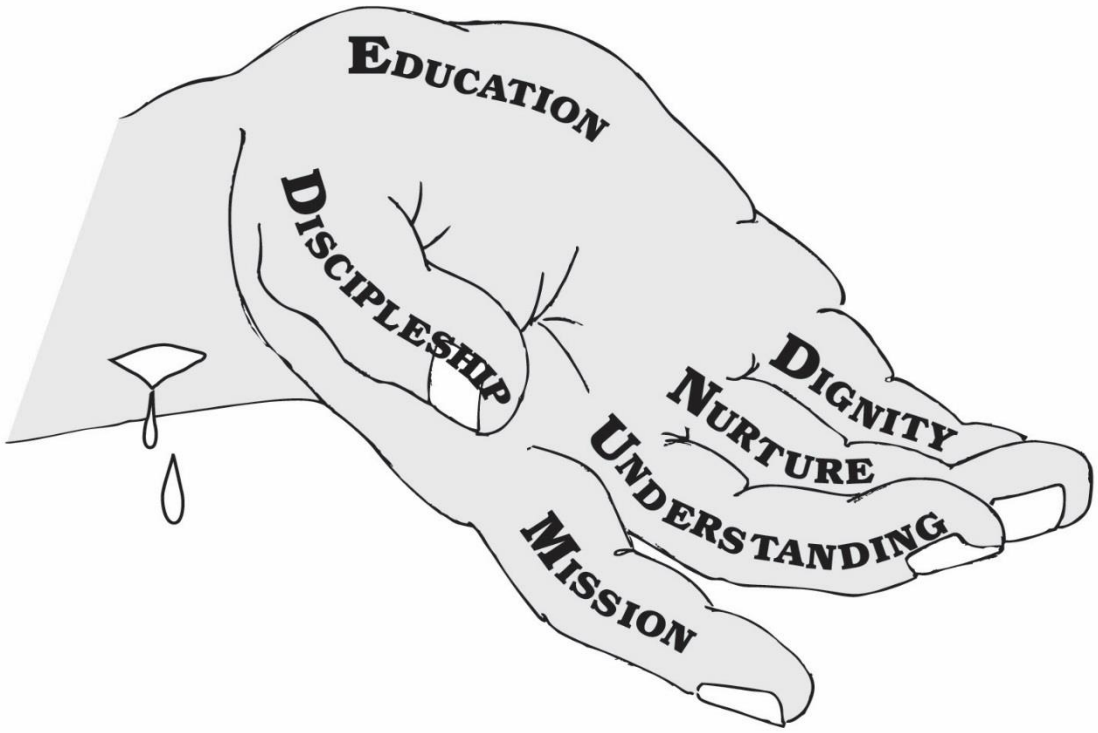
Numeracy Booklet

A guide for parents, pupils and staff.

Contents Page

The Mission Statement

Prepare the way of the Lord



Dignity - To respect the value and work of ourselves and others as children of God (Genesis 1:17 - Created in the image of God).

Mission - To let God be known through words and actions (Mt 7:12 - "Do for others, what you want them to do for you")

Understanding - To respond to the needs of others (Mt 7:7 - "Ask, and you will receive; seek and you will find; knock, and the door will be opened to you.")

Nurture - To allow all to grow to full potential (John 15:5 - "I am the vine and you are the branches. Those who remain in me, and I in them, will bear much fruit.")

Discipleship - To follow Christ in Faith, Hope and Love. (Mk 1:16 "Follow Me.")

Introduction

This booklet is to give advice and guidance to parents and pupils on how certain Numeracy topics are taught in Mathematics and across the school.

Use this booklet to help you solve Mathematical problems in any subject. There is a contents page to help you find the relevant information and step-by-step guide. If parents want to help their children with homework and other numerical topics, please refer to this booklet to see what methods are being taught in school. The booklet also includes skills useful in all subjects as well as Mathematics. For particular help with certain Mathematics concepts, please ask your child's teacher, look at their exercise book or logon onto either www.mymaths.co.uk or www.vle.mathswatch.co.uk/vle/ websites using your child's login details.

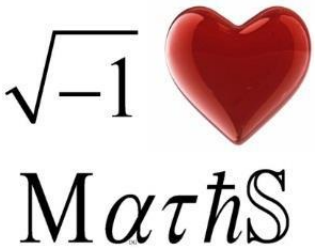
Please note - some topics include more than one method?
In some topics (e.g. percentages), the technique and methods used will be dependent on the level of difficulty of the question, and whether or not a calculator is permitted. For all mental calculations, pupils should try to develop a variety of strategies so that they can use the most appropriate method in any given situation.

What is 'numeracy' and why is it so important?

"Numeracy is a life skill. Being numerate goes beyond simply 'doing sums'; it means having the confidence and competence to use numbers and think mathematically in everyday life…"

http://www.nationalnumeracy.org.uk/what-is-numeracy/index.html

Having a good level of numeracy is essential if children are to make the best of all the opportunities available to them, both whilst at school and in their future lives. There are unfortunately too many shocking statistics that describe the serious consequences of having low levels of numeracy for young people and adults.



We believe there are 3 essential factors needed in order for a child to become fully numerate:

1. The belief that they can be, and are good at Maths.
2. The belief that Maths is relevant for their everyday life.
3. To study with enthusiasm and develop the ability to work through problems.

These points cannot be achieved without consistent support and encouragement from both home and school. This booklet provides some practical advice and support on how to achieve this consistency. We hope it is helpful.

Cross-department guidance:

This document should provide information and guidelines to help produce consistency across the curriculum - it is not intended to be a prescription for teaching although some advice is given.

Approaches

- It is recognised that not all students in a teaching group will have the same numerical skills and where unsure of an appropriate 'numerical level' teachers will consult with the Mathematics Department.

- All teachers will discourage students from writing down answers only and encourage students to show their numerical working out within the main body of their work.

- All teachers will encourage the use of estimation particularly for checking work.

- All teachers will encourage students to write mathematically correct statements.

- It is recognised that there is never only one correct method and students will be encouraged to develop their own correct methods where appropriate rather than be taught 'set' ways.

- Wherever possible students will be allowed and encouraged to 'vocalise' their maths - a necessary step towards full understanding for many students.

- All students should be helped to understand the methods they are using or being taught - students gain more and are likely to remember much more easily if they understand rather than are merely repeating by rote.

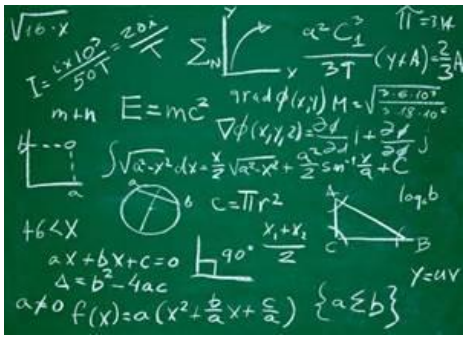
Calculators:

In order to improve numeracy skills, it is essential that students should be encouraged to use non-calculator methods whenever possible. However, departments should ensure students have access to calculators when they are necessary.

It is recognised that where calculators are to be used their correct use may have to be taught.

The Maths department sell Sharp calculators using the D.A.L. system of display, e.g. you type in Sin 38 not 38 sin. Where appropriate it would be helpful if other departments used similar calculators.

Methods and Presentation:



Where a student is gaining success with a particular method it is important that s/he is not confused by being given another method. This does not disallow the possibility of introducing alternatives in order to improve understanding or as part of a lesson deliberately designed to investigate alternative methods, provided students can manage this without confusion.

Language:

When referring to decimals say "three point one four" rather than "three point fourteen".
Read numbers out in full, so say three thousand four hundred rather than three, four, zero, zero.
It is important to use the correct mathematical term for the type of average being used, i.e. mean, median or mode.

Mean — Total of values of sample ÷ sample size.
[The term average is commonly used when referring to the mean]

Median — Middle value of sample when sample values are arranged in order size.

Mode Sample values which occur most frequently.

Checking:

Encourage students to check divisions by multiplication and subtractions by adding.

Working out:

In all arithmetic, the importance of place value and neat column keeping should be stressed.

In a line of workings an "equals" sign should only appear once.

This is poor practice: £3.50 x 0.85 = 2.975 + 3.50 = 6.475 = £6.48

This is good practice: £3.50 x 0.85 = 2.975

2.98 + 3.50 = £6.48

Rough Conversions between Metric and Imperial:

In the Maths Department we teach the following conversions:

1 inch ≈ 2.5 cm	1 yard ≈ 1 m	1 kg ≈ 2.2 lbs
2 pints ≈ 1 litre	1 mile ≈ 1.6 km	1 oz. ≈ 25 g

Pupils should be expected to record the units they are using when answering a question.

Standard Form:

Students need to be aware of how their calculators express standard form and what it means. E.g. on some calculators $5 \div 200 = 2.5^{-2}$

It should be noted that this should be recorded as 2.5 x 10^{-2} and that it is equivalent to 0.025

Expressing units of Time:

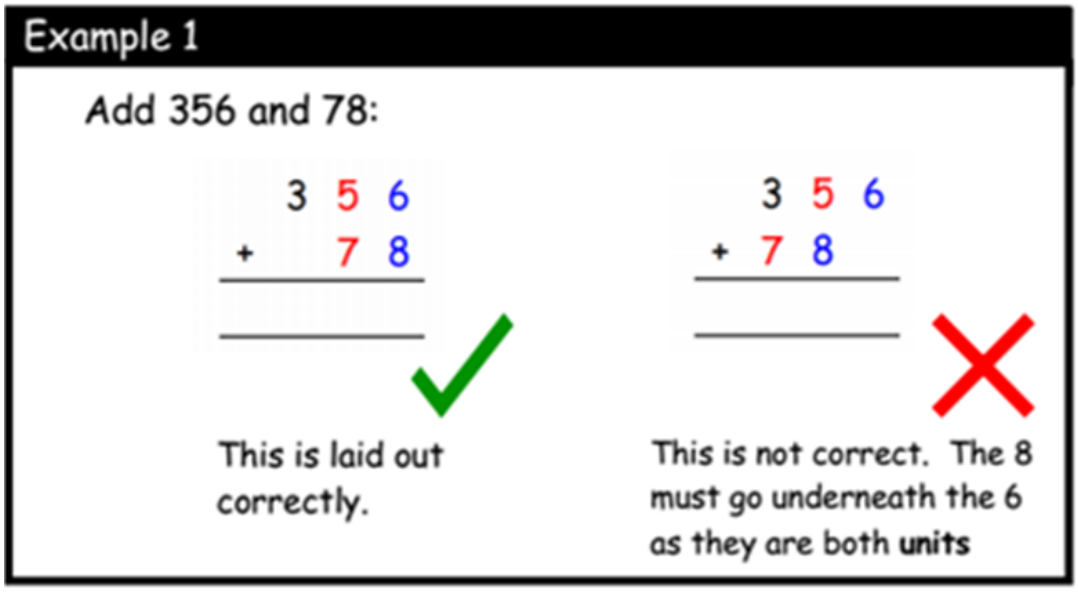
Pupils should never record 3hrs and 30 mins as 3.30hrs but as 3.5hrs.When working with time it is possible to use the degrees/mins/secs key on many calculators.

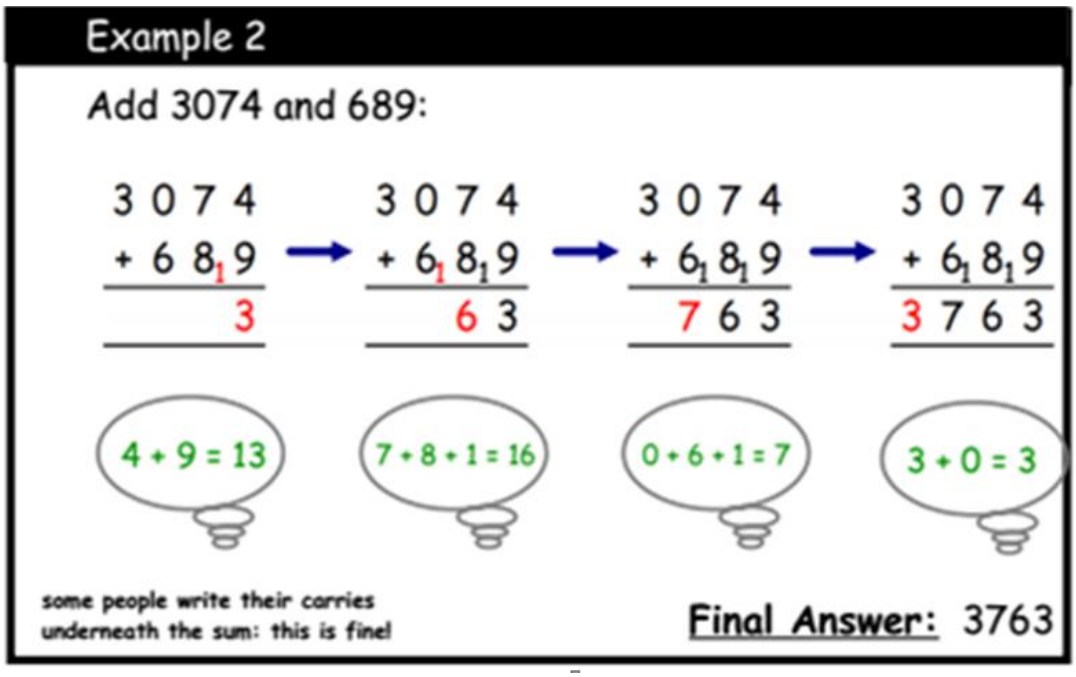
Addition

Pupils will know how to add numbers using a written method.

Remember to line up the units (ones), tens and hundreds columns etc.

Start adding from the right, write down the units and 'carry' the tens



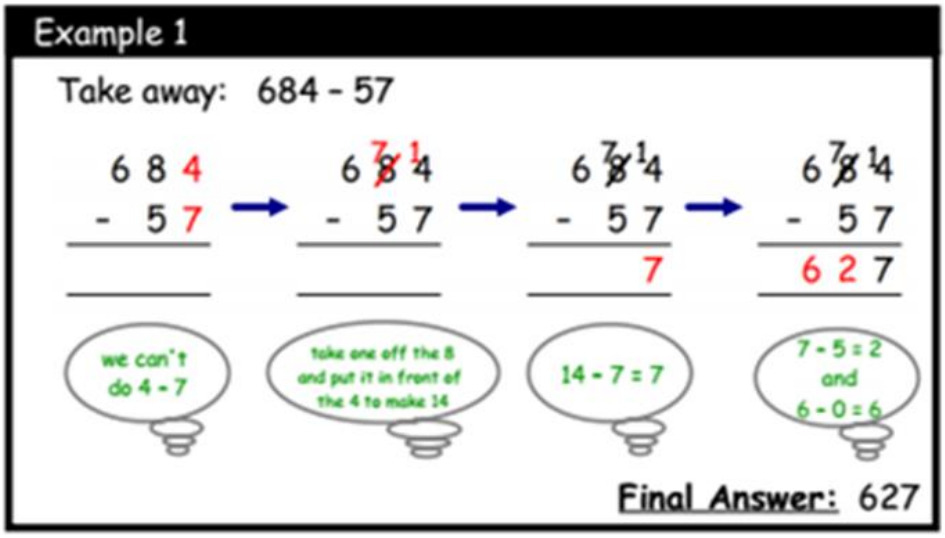


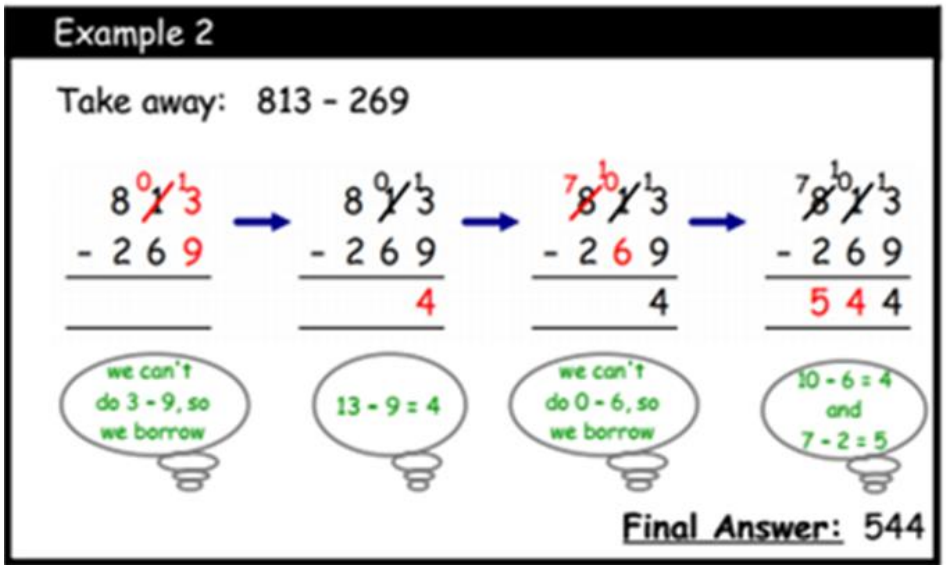
Subtraction

Pupils will learn how to subtract using a written method. Please note, we do not teach the method of 'borrow and pay back' that parents' may have learned at school.

Similar to adding line up the columns by place value and begin taking away from the right column.

When the number 'on the top' is smaller than the number below, we 'borrow' 1 from the number to the left.





Times Tables

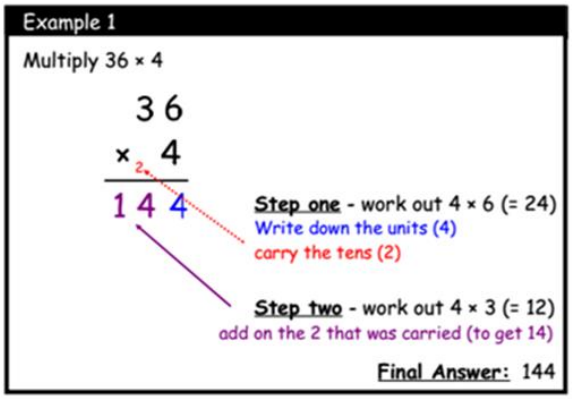
Pupils will need to know all the times tables up to 12 x 12

X	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	40	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144

A simple homework that parents can try that will help their children is to practice the times tables.

Multiplication

Pupils will need to know how to how multiply by a single digit



Multiples of ten:

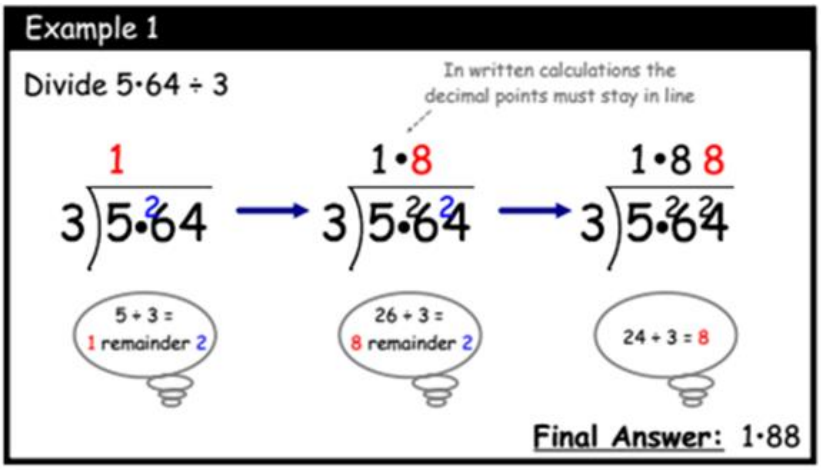
When multiplying by ten we do not teach the 'rule' add a nought or move the decimal point along one but rather explain that the numbers move one place to the left relative to the decimal place.

So 3 . 6 4 x 10

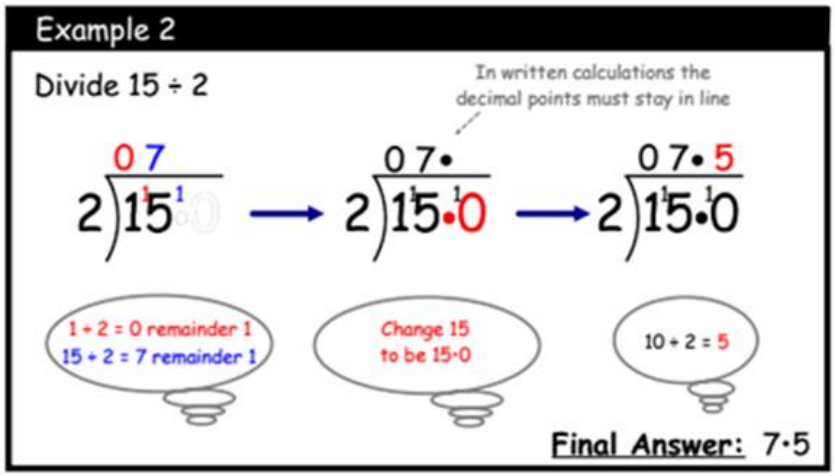
= 3 6 . 4

Division

Pupils will need to know how to divide using a written technique. Remember to start from the left



If there is a remainder at the end, write a zero at the end of the calculation and continue dividing



Dividing by 10, 100 or 1000

When dividing by 10, move every digit one place to the right.
When dividing by 100, move every digit two places to the right.
When dividing by 1000, move every digit three places to the right

364 ÷ 10 = 36.4
364 ÷ 100 = 3.64
364 ÷ 1000 = 0.364

Order of Operations (commonly known as 'B.I.D.M.A.S' or 'B.O.D.M.A.S'

If there is more than one operation in a question, we follow the rule of

Brackets
Indices or Order
Divide
Multiply
Add
Subtract and work out the calculation in this order.

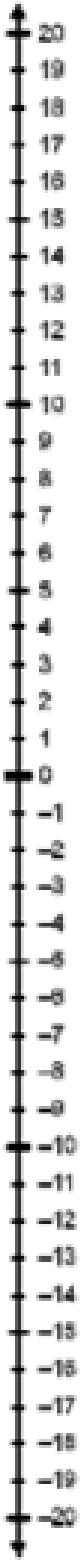
Examples

1) 4 + 3 x 7 (work out 3 x 7 first as 'M' is before 'A')
= 4 + 21
= 25

2) 14 – 10 ÷ 5 (work out 10 ÷ 5 first as 'D' id before 'S')
= 14 – 2
= 12

3) (2 +3) x (6 – 2) (work out the Brackets first)
= 5 x 4
= 20

Negative Numbers



Negative numbers are numbers lower than zero.

Pupils need to know the position of negative numbers on a number line as shown here.

Pupils should know that '4' and '-4' are completely different numbers.

We pronounce '-4' as 'minus 4' or ' negative 4' and pupils will be familiar with both.

Pupils will need to use a number line to help them answer real-life questions such as

Examples

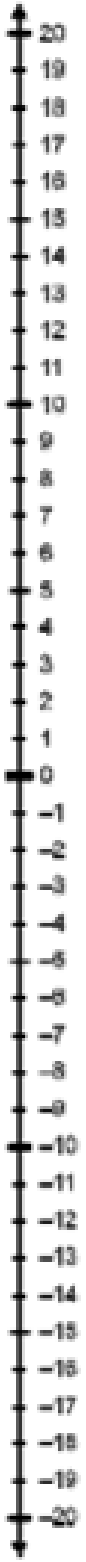
1) The temperature in Moscow was – 15 °c. The next day it rose by 4°c. What is the temperature?

We start at -15 on the number line and count up 4 places to -11°c.

2) The temperature in Oslo was 5°c. It fell by 9^0c. What is the new temperature?

We start at 5°c on the number line and count down 9 places to -4°c.

Addition and subtraction with negative numbers



We count up or down using the number line.

A) To add a positive number, count upwards

1) - 2 + 5 = 3 start at - 2, count up 5 places
2) - 6 + 3 = - 3 start at - 6, count up 6 places

B) To subtract a positive number, count downwards

1) 3 – 7 = - 4 start at 3, count down 7 places
2) -5 – 4 = - 9 start at – 5, count down 4 places

C) To add a negative number, count downwards

1) 3 + - 5 = - 2 start at 3, count down 5 places
2) - 5 + - 2 = - 7 start at - 5, count down 2 places.

D) To subtract a negative number, count upwards.

1) 3 - - 4 = 3 + 4 = 7 start at 3, count up 4
2) - 5 - - 6 = - 5 + 6 = 1 start at -5, count up 6

Multiplication and Division with negative numbers

If one number is negative in a multiplication or division question, the answer will also be negative.

-3 X 6 = -18
7 X -2 = -14

-12 ÷ 4 = -3
15 ÷ -3 = -5

If both numbers are negative in a multiplication or division question, then the answer will be positive.

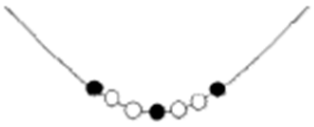
- 4 x – 5 = 20
- 8 x – 3 = 24

- 30 ÷ - 6 = 5
- 50 ÷ - 2 = 25

Fractions

The number on the bottom (denominator) is the total. The number on the top (numerator) is the amount that you have.

For example, a necklace is made out of white and black beads.



What fraction are black beads?

There are 3 black beads out of a total of 7 beads, so $\frac{3}{7}$ of the beads are black.

Equivalent Fractions

Fractions can have different numerators and denominators but still be the same size. These are called equivalent fractions.

Example 1

$\frac{3}{4}$ of a pizza is the same as $\frac{6}{8}$ of the same pizza

$\frac{3}{4} = \frac{6}{8}$

You can find equivalent fractions by multiplying the top and bottom by the same number.

$\frac{3}{4} = \frac{6}{8}$ (×2 above, ×2 below)

Example 2

Find fractions that are equivalent to $\frac{2}{5}$:

We can choose any number we like to multiply by. If we randomly choose 2, 7 and 10, we get the following fractions

$\frac{2}{5} = \frac{4}{10}$ (×2 above, ×2 below)

$\frac{2}{5} = \frac{14}{35}$ (×7 above, ×7 below)

$\frac{2}{5} = \frac{20}{50}$ (×10 above, ×10 below)

Final Answers: $\frac{4}{10}, \frac{14}{35}, \frac{20}{50}$

Simplifying Fractions

To simplify a fraction, we divide the numerator and the denominator by the same number. There must be no remainders, so we divide by a factor (numbers that divide fully into another number).

There are 2 ways of doing this.

1) Divide by the highest common factor

Example 2

Simplify the fraction $\frac{48}{60}$

$\frac{48}{60} \xrightarrow{\div 12} \frac{4}{5}$

Final Answer: $\frac{4}{5}$

2) In stages

Example 1

Simplify the fraction $\frac{48}{60}$

$\frac{48}{60} \xrightarrow{\div 2} \frac{24}{30} \xrightarrow{\div 2} \frac{12}{15} \xrightarrow{\div 3} \frac{4}{5}$

Final Answer: $\frac{4}{5}$

Fraction equivalents of decimal numbers

Fractions can be written as decimals and vice versa.

Decimals with one digit after the point are equivalent to fractions with 10 on the denominator.
Decimals with two digits after the point are equivalent to fractions with 100 on the denominator.
Decimals with three digits after the point are equivalent to fractions with 100 on the denominator.

1) $0.7 = \frac{7}{10}$ 2) $0.3 = \frac{3}{10}$ 3) $0.03 = \frac{3}{100}$ 4) $0.27 = \frac{27}{100}$

5) $0.007 = \frac{7}{1000}$ 6) $0.051 = \frac{0.51}{1000}$

Finding Fractions of amounts or quantities

To find a fraction of an amount, 'divide by the denominator (bottom), then multiply by the numerator (top).

Examples 1 and 2

$\frac{1}{5}$ of £150
$= 150 \div 5 \times 1$
$= £30$

$\frac{1}{5}$ of a number means "split the number into 5 equal groups and then say how much is in 1 group"

$\frac{1}{7}$ of 28kg
$= 28 \div 7 \times 1$
$= 4kg$

$\frac{1}{7}$ of a number means "split the number into 5 equal groups and then say how much is in 1 group"

Example 3

Find $\frac{3}{7}$ of £98

$\frac{3}{7}$ of a number means "split the number into 7 equal groups and then say how much is in 3 group"

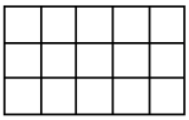
$\frac{3}{7}$ of £98
$= 98 \div 7 \times 3$
$= 14 \times 3$
$= 42$

Final answer: £42

Shading Fractions of shapes

Example 1

Shade in $\frac{2}{5}$ of this shape:



There are 15 squares, so we work out $\frac{2}{5}$ of 15:

$\frac{2}{5}$ of 15

$= 15 \div 5 \times 2$

$= 3 \times 2$

$= 6$

Final Answer:

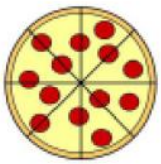
Shade in any **six** boxes

Fractions – adding or subtracting

Only add or subtract fractions when they have the same denominator (bottom). Then we simply add or subtract the numerators (top)

Example 1

This pizza is divided into eight slices. If you take one slice, what fraction of pizza do you have left?



$\frac{8}{8} - \frac{1}{8} = \frac{7}{8}$

8 - 1 = 7

the number on the bottom stays the same

Final Answer: $\frac{7}{8}$

Examples 2 and 3

Add: $\frac{3}{7} + \frac{2}{7}$

$\frac{3}{7} + \frac{2}{7} = \frac{5}{7}$

3 + 2 = 5

the number on the bottom stays the same

Take away: $1 - \frac{5}{8}$

$1 - \frac{5}{8}$

because $1 = \frac{8}{8}$

$= \frac{8}{8} - \frac{5}{8}$

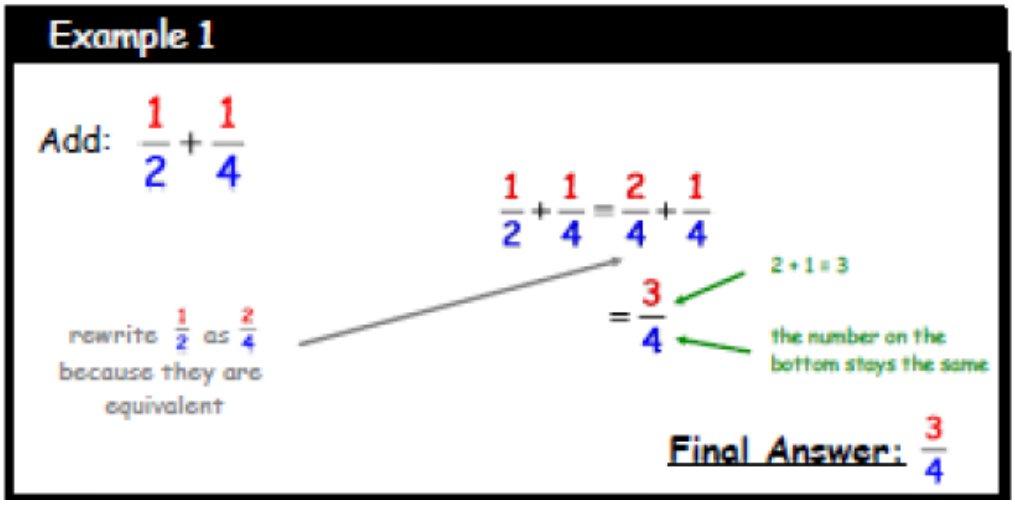
8 - 5 = 3

$= \frac{3}{8}$

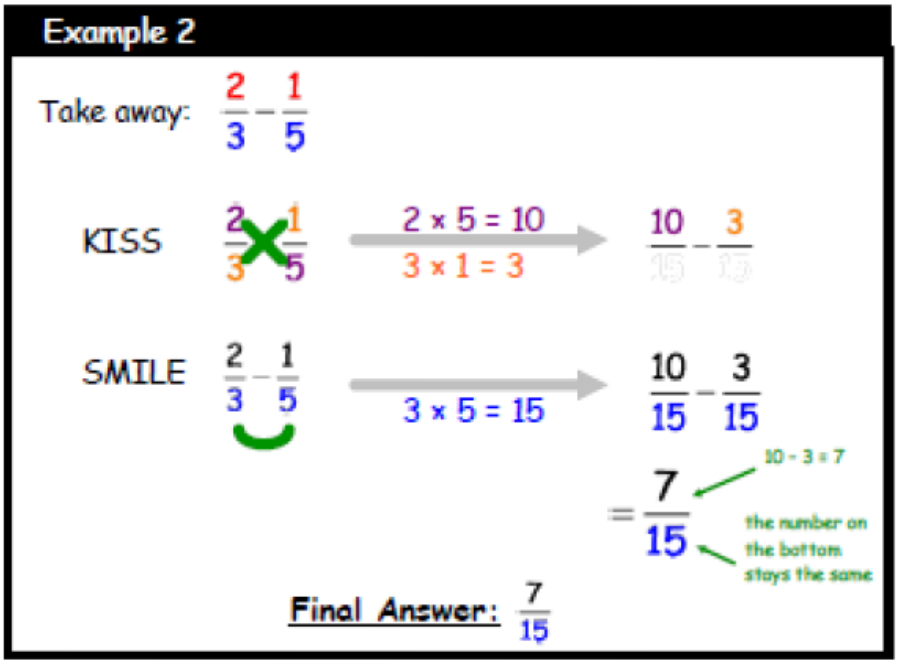
the number on the bottom stays the same

Different denominator (bottom) fractions adding or subtracting

If the denominators are not the same, we have to find equivalent fractions before we add or subtract.



We can find equivalent fractions by using the 'kiss and smile' method.
This method is so called because we draw lines joining pairs of numbers that are multiplied.



Decimals

Continuing a pattern of decimal numbers can be completed like so

Example 1

a) Write the next three numbers:

6·2, 6·4, 6·6, … 6·8, 7·0, (or 7) 7·2

---

b) Write the next three numbers

3·595, 3·596, 3·597, 3·598, … 3·599, 3·600, (or 3.6) 3·601

---

c) Write the next three numbers

2·003, 2·002, 2·001, … 2·000, (or 2) 1·999, 1·998

Ordering decimal numbers

Pupils need to know how to order decimal numbers

Example 2

a) Order 4·4, 4, 0·4, 4·1 smallest to biggest

To help answer this question, it is easiest to think of 4 as 4.0 so that all of the numbers have one decimal place

Answer: 0·4, 4·0, 4·1, 4·4

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b) Order 3·003, 3·01, 3·101, 3·033 smallest to biggest

To help answer this question, it is easiest to think of 3.01 as 3.010 so that all of the numbers have three decimal places

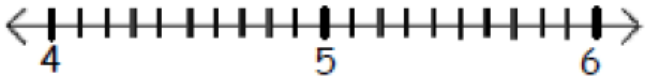
Answer: 3·003, 3·010, 3·033, 3·101

Decimals – marking on numbers line

Pupils will need to know how to indicate given numbers on a number line.

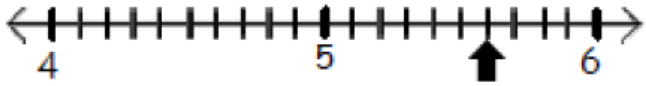
Example 1

Draw an arrow to show where the number 5·6 is on this number line



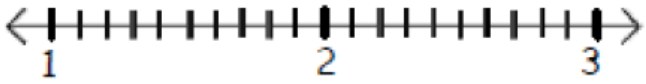
Answer:

The number 5·6 is six tenths along from 5.



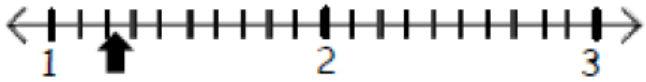
Example 2

Draw an arrow to show where the number 1·23 is on this number line



Answer:

The number 1·23 is slightly higher than 1·2



Example 3

Draw an arrow to show where the number 4·265 is on this number line

Answer:

The number 4·265 is exactly mid-way between 4·26 and 4·27

Percentages

Pupils need to know that percentage means 'out of 100' and 100% represents 'the whole amount'.

Some general conversions between fractions, decimals and percentages

Fraction	Decimal	Percentage
$\frac{1}{2}$	0.5	50%
$\frac{1}{4}$	0.25	25%
$\frac{3}{4}$	0.75	75%
$\frac{1}{3}$	0.33333...	33%
$\frac{2}{3}$	0.66666...	67%
$\frac{1}{10}$	0.1	10%
$\frac{2}{10}$	0.2	20%
$\frac{1}{5}$	0.2	20%
$\frac{2}{5}$	0.4	40%
$\frac{X}{10}$	0.X	X0%

Pupils can use these equivalences to find percentages of amounts

Examples

50% of 80
$= \frac{1}{2}$ of 80
$= 80 \div 2 \times 1$
$= 40$

25% of 80
$= \frac{1}{4}$ of 80
$= 80 \div 4 \times 1$
$= 20$

75% of 80
$= \frac{3}{4}$ of 80
$= 80 \div 4 \times 3$
$= 60$

10% of 80
$= \frac{1}{10}$ of 80
$= 80 \div 10 \times 1$
$= 8$

Percentages without a calculator

1% means '1 out of 100' which is '1' as a fraction. So to find 1%, we divide by 100
100

Example 1

Find 1% of 300

1% of 300

$= \frac{1}{100}$ of 300

$= 300 \div 100 \times 1$

$= 3$

Final Answer: 3

We can use 1% to help us find other percentages.

Example 2

Find 4% of £2000

first find 1% then multiply by 4

× 4 (1% of 2000 = 20 → 4% of 2000 = 80) × 4

Final Answer: £80

We can also use 10% to help us find other percentages.

Example 3

Find 30% of £700

first find 10% then multiply by 3

× 3 (10% of 700 = 70 → 30% of 700 = 210) × 3

Final Answer: £210

Example 4

Find 5% of £6000

first find 10% then half it

÷ 2 (10% of 6000 = 600 → 5% of 6000 = 300) ÷ 2

Final Answer: £300

Percentages with a calculator

Pupils need to be able to find percentages without a calculator.

15% means '15 out of a 100'. This is $\frac{15}{100}$ as a fraction

So to calculate a percentage, divide by 100 then times by the 'percentage amount' (numerator).

Example 1

Find 12% of £233

12% of £233
$= \frac{12}{100}$ of 233
$= 233 \div 100 \times 12$
= £27.96

Find 97% of 495cm

97% of 495cm
$= \frac{97}{100}$ of 495
$= 495 \div 100 \times 97$
= 480.15cm

An alternative method with a calculator is to change the percentage into a decimal (by dividing by 100) and to multiply.

Example 2

Find 3% of £65

3% as a decimal is 0·03 (3 ÷ 100)

3% of £65
$= 0 \cdot 03 \times 65$
= £1.95

Find 12·5% of 420kg

12·5% as a decimal is 0·125 (12·5 ÷ 100)

12·5% of 420kg
$= 0 \cdot 125 \times 420$
= 52·5kg

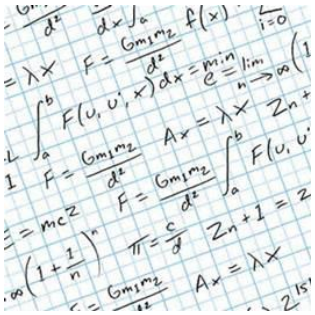
Measurement – key facts

Pupils will need to know the conversions between metric measurements and imperial measurements.

METRIC AND IMPERIAL CONVERSIONS

METRIC CONVERSIONS		
LENGTH	**MASS**	**CAPACITY**
1 cm = 10 mm	1 g = 1000 mg	1 cl = 10 ml
1 m = 100 cm	1 kg = 1000 g	1 l = 1000 ml
1 km = 1000 m	1 tonne = 1000 kg	1 l = 100 cl
IMPERIAL CONVERSIONS		
1 foot = 12 inches	1 pound(lb) = 16 ounces (oz)	1 pint = 20 fluid ounces (fl oz)
1 yard = 3 feet (ft)	1 stone = 14 pounds (lbs)	1 gallon = 8 pints
1 mile = 1760 yards (yd)	1 ton = 2240 pounds (lbs)	
METRIC TO IMPERIAL CONVERSIONS		
1 inch = 2.5 cm	1 kg = 2.2 lbs	1 litre = 1.75 pints
1 mile = 1.6 km		1 gallon = 4.5 litres
1 foot = 30 cm		

Equations:



The terms "cross-multiply" and "swap sides – swap signs" can lead to misunderstandings, as part of any explanation of how to solve equations and so should be avoided.

To teach solution of linear equations we use the 'balancing method' or a flow diagram
To solve: $3x - 7 = 5$

Balance Method: $3x - 7 = 5$ (add 7 to both sides)

$3x - 7 + 7 = 5 + 7$

$3x = 12$ (divide both sides by 3)

$3x \div 3 = 12 \div 3$

$x = 4$

Flow Chart Method:

START: $x \rightarrow \boxed{\times 3} \rightarrow \boxed{-7} \rightarrow 3x - 7$ (you now UNDO)

END: $4 \leftarrow \boxed{\div 3} \leftarrow \boxed{+7} \leftarrow 5$

$X = 4$

Guidelines for Constructing/Using Graphs and Charts

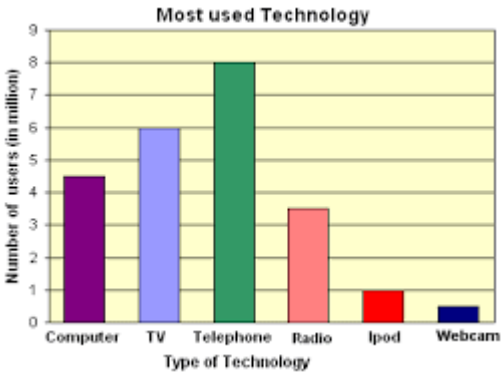
Students should be encouraged to:

- Use a sharp pencil.
- label both axes and give a title
- Use independent variable on *x*-axis, and dependant variable on the *y*-axis. I.e. If graphing temperature of a cooling liquid, time should go on the *x*-axis and temperature on the *y*-axis. [The temperature of the liquid is dependent on the time of the reading.]
- label lines not spaces, unless a bar-chart with discrete data
- use equally spaced intervals
- use convenient scales
- mark points by a small cross not a dot
- draw graphs on squared or graph paper
- to draw graphs of a sensible size (they tend to make them too small)

Pupils should be exposed to Bar Charts, Pie Charts, Pictograms, Line graphs and Cumulative frequency curves. Histograms are only tackled by higher level students.

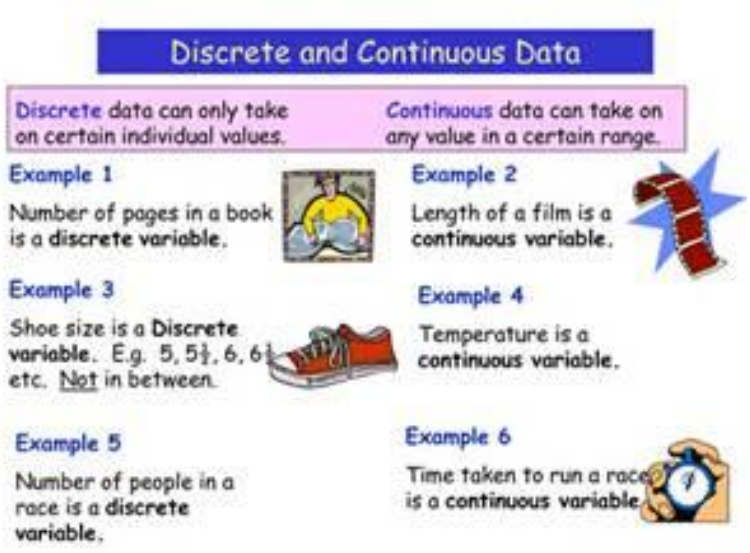
Students need to be taught when each type of graph is appropriate. (This is very important as students will generally produce the type of graph they last met without much thought to appropriateness.)

Bar-charts



The bars should be of equal width and equally spaced out. The bars do not have to touch for *discrete* data but should touch for *continuous* data. '*Frequency*' should be on the y (vertical) axis.

Types of Data



Discrete data

Data is described as discrete if specific values only can be used, e.g. shoe size is discrete as sizes such as 4.8 and 5.77 cannot exist. Think of counting numbers.

Continuous data

Data is described as continuous if all values can exist, e.g. height and weight are continuous data as potentially any value could be measured. Think of measuring numbers.

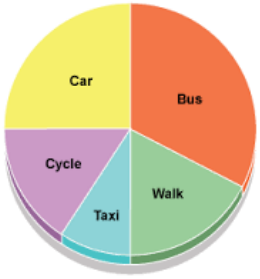
Quantitative data

Data that is information about quantities/amounts and that can be written down with numbers.

Qualitative data

Data that is descriptive and not in numerical form. It is used to describe properties or qualities of an item e.g. car colour, music genres etc.

Pie Charts

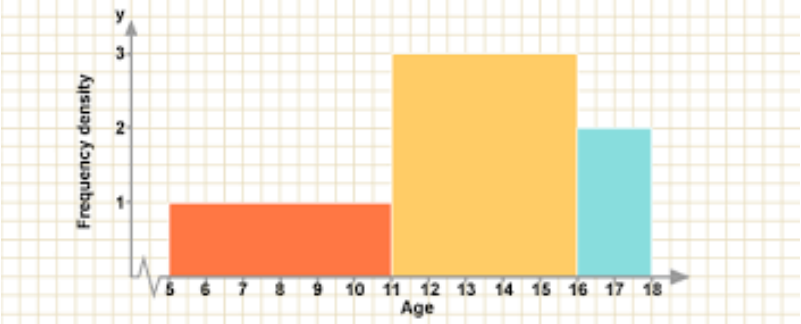


Sectors should be labelled (e.g. Car, Blue….) or there should be a key.

Do not be surprised if the total of all the angles is 360° plus or minus one or two degrees. This will almost certainly be due to the rounding that may be necessary. In these cases either add or take the one or two degrees from the largest angle.

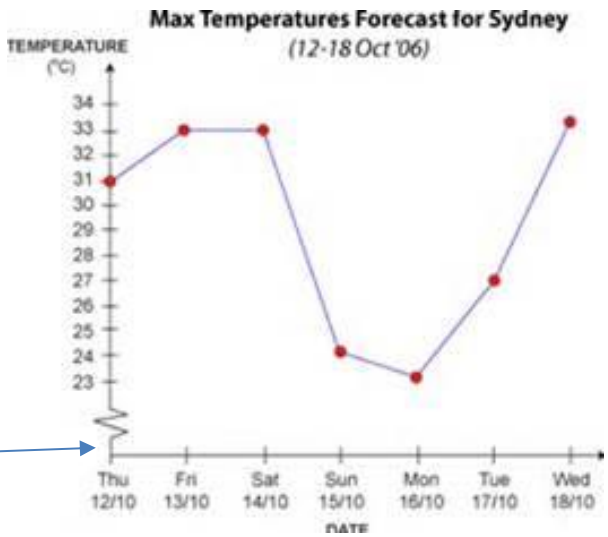
Histograms

Do not use the term Histogram unless the bar widths are unequal and frequency density is plotted along the y axis. Students need to appreciate the connection between the area and the frequency.



Scaling

If axes do not start from zero, a break represented by a zig-zag line should be shown on the axis. This is known as a broken axis.



Broken axis →