CARR HILL HIGH SCHOOL
& Sixth Form Centre

Numeracy Policy

In Pursuit of Excellence

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1. Purpose

The purpose of this Numeracy policy is to enable all our staff to have consistent expectations of the students' use and understanding of Mathematics across the curriculum and to promote the development of numeracy skills. Each department can make a contribution towards improving numeracy skills so that students become confident at tackling Mathematics in any context. To do this, all subjects will incorporate relevant aspects of the policy into their schemes of work and all subjects will use the agreed notation, format and method when relevant.

2. Application

2.1

- It is the responsibility of ALL staff within the school to maximise opportunities for students to develop and improve their Numeracy and to help them to develop a positive attitude towards Mathematics.
- The Logic Cluster aims to recognise the explicit links between subjects, by using examples from other subject areas to highlight their expectations and unique demands.
- The Logic Cluster aims to provide support for ALL subjects within the school to develop Numeracy across the curriculum, and to maximise opportunities for collaboration between Clusters on issues relating to Numeracy.
- All Clusters within the school aim to encourage the selective use of the calculator and to promote non-calculator methods when appropriate.
- This policy and Appendix should be part of the schemes of work for all subjects.

2.2 Being Numerate implies:

- An 'at-homeness' with numbers.
- An ability to make use of Mathematics skills which enables an individual to cope with the Mathematical demands of everyday life.
- To have an appreciation and understanding of information that is presented in Mathematical terms. For instance in graphs, charts or tables or by reference to percentage increase or decrease.
- To appreciate and understand some of the ways in which Mathematics can be used as a means of communication.
- The use of methods of calculation which are both efficient and effective.
- Confidence and ability in mental methods.
- Selecting the most appropriate method of calculation for a given purpose.
- An awareness of the links between different aspects of the Mathematics curriculum.
- Reasoning, justifying and proving results about number.
- Using number to represent Mathematical models of real-life situations.
- To understand and be able to use the language of Mathematics and talk confidently about Mathematical ideas.

2.3 How do students learn to become numerate?

- Through being challenged and struggling to overcome and solve problems.
- Most students are able to become numerate, but vary in their ability and the rate at which they develop their Numeracy.
- Students can develop their own strategies for calculating and solving problems, but it is their teacher's responsibility to help them to refine their methods.
- Students' misunderstandings need to be recognised, made explicit and worked on.

2.4 As a **school** we aim to:

- Promote a positive attitude to Mathematics from ALL staff and students alike.
- Highlight and develop links between all subjects and Mathematics.

- Ensure consistent approaches to Mathematics are used across the curriculum especially with relation to calculations, percentages, the use of calculators and handling data.
- Build students' confidence in transferring skills that they have learnt in Mathematics.

2.5 In order to achieve these aims we believe that **ALL teachers** need to:

- Promote a positive attitude towards Mathematics.
- Raise the profile of Mathematics in their subject by promoting the application of number at every available opportunity.
- Be aware of the range of competence with number that students bring to the lesson.
- Build students' confidence when they encounter difficulties.
- Demonstrate the skills expected of students as identified below.

2.6 And **Students** need to be encouraged to:

- Estimate, and consider the appropriateness of an answer.
- Use mental methods where possible for calculations.
- Know when it is appropriate to use a calculator.
- Use correct Mathematical language.
- Measure to an appropriate degree of accuracy.

Section 3: Appendices to support the implementation of this policy.

Appendix 1: Calculation skills

Appendix 2: Percentages

Appendix 3: The use of calculators

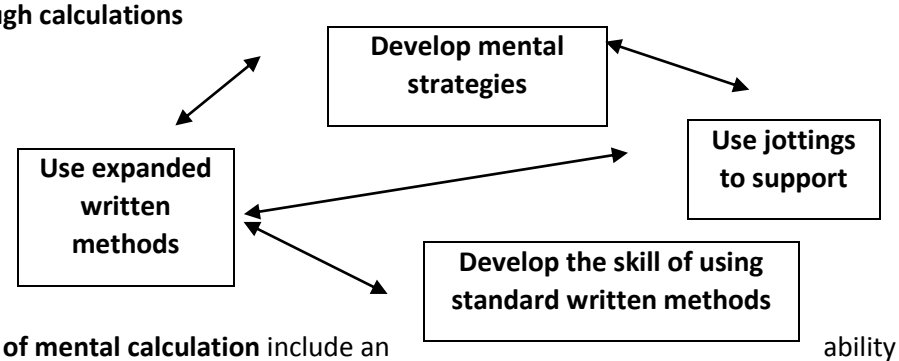
Appendix 4: Guidance on a range of graphs and their purposes

Appendix 5: Mathematics identified in other areas

Appendix 1 - Calculation skills

The strategy stresses the importance of mental calculation methods. To calculate mentally lies at the heart of mathematics. Students are being encouraged to ask 'Can I do this in my head?' before they select any other calculation method.

A route through calculations



The skills of mental calculation include an ability to:

- Remember number facts and recall them without hesitation.
- Use facts that are known to figure out new facts.
- Draw on a repertoire of mental strategies.
- Work out calculations, with some thinking time.
- Understand and use the relationships between operations to work out answers and check results.
- Approximate calculations to judge whether or not an answer is about the right size.
- Solve numerical problems.

Standard written methods are reliable and efficient procedures for calculating which, once grasped, can be used in many different contexts. They are of no use to someone who applies them inaccurately and who cannot judge whether the answer is reasonable. For each operation, the standard written method will be taught to most students, then refined and practised. Students are to be expected to be able explain their chosen method.

Multiplication:

Column method (strongly encouraged)

346 x 9 is approximately 350 x 10 = 3500

```
  346
x   9
3114
```

72 x 38 is approximately 70 x 40 = 2800

```
  72
x 38
576
2160
2736
```

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	
30	2100	60	2160
8	560	16	+ 576
			2736

Division

Short Division

$$\begin{array}{r} 3\ 6 \\ 7\overline{)2542} \end{array}$$

Long Division

$$\begin{array}{r} 36 \\ 7\overline{)252} \\ -\ 21 \\ \hline 42 \\ -\ 42 \\ \hline 0 \end{array}$$

Appendix 2 - Percentages

Calculating a percentage of a quantity:

Some percentage calculations can be done mentally for example:

10% of 45:	45÷10 = 4.5
20% of 45:	Find 10% as above, then double.
15% of 45:	Find 10% as above: 4.5

Halve 10% to give 5%: 4.5 ÷ 2 = 2.25Add the results of 10% and 5% together to give 15%: 4.5 + 2.25 = 6.75

Alternatively, 15% could be found by calculating: 15 ÷ 100 x 45 = 6.75
Some students will be comfortable calculating 15 ÷ 100 mentally and entering 0.15 x 45 into a calculator.

Percentage increase and decrease:
The most able students in Years 9, 10 and 11 should be able to increase or decrease amounts using one operation.
For example:

Increase 76 by 23%:	100% + 23% = 123%	so, 123% of 76 = 1.23 x 76 = 93.48
Decrease 244 by 28%:	100% - 28% = 72%	so, 72% of 244 = 0.72 x 244 = 175.68

Calculating an amount as a percentage:
If the numbers are straightforward write the problem as a fraction and convert this to a percentage.
For example: What is 15 as a percentage of 60? $\frac{15}{60} = \frac{1}{4} = 25\%$ (x4)

What is 12 out of 25 as a percentage? $\frac{12}{25} = \frac{48}{100} = 48\%$ (x4)

If the numbers are more complex, convert the fraction to a decimal and then to a percentage.
For example:
What is 123 as a percentage of 375? $\frac{123}{375} = 123 \div 375 = 0.328 = 32.8\%$

Appendix 3 - The use of calculators

Calculators are part of the equipment needed for Mathematics lessons.

In considering the use of calculators in the classroom teachers should bear in mind the following:

- Students should be encouraged to consider as a first resort which mental methods are appropriate (estimation, calculation, approximation);
- Students should have sufficient understanding of the calculation, and the numbers involved, to decide the most appropriate method: mental, pencil and paper or calculator;
- Students should have the technical skills required to use the basic facilities of a calculator efficiently, (e.g. how to enter numbers as money, measures, fractions, etc.);
- When using calculators students need to be aware of the processes required and are able to say whether their answer is reasonable;
- Students should be able to interpret the calculator display in context (e.g. 5.3 is £5.30 in money calculations) and rounding answers to an appropriate degree of accuracy;
- Students should use the correct order of operations
  – in multi-step calculations, such as (93.2 – 1.65) x (15.6 – 5.77);

  – when considering calculations where no brackets are given

  e.g. 3 + 7 x 5 which equals 50 on a basic (left to right) calculator (incorrect).

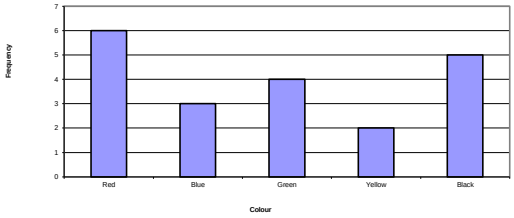
  3 + 7 x 5 which equals 38 on a scientific (multiplication and division first) calculator (correct).

In particular all Clusters should highlight within their schemes of work units of work where:

1. They expect students to be able to use calculators.
2. The expectation is that students will not use calculators.

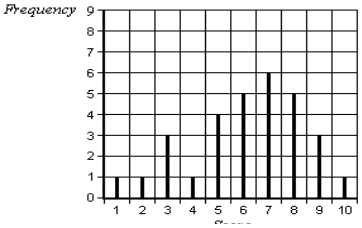
Appendix 4 - Guidance on a range of graphs and their purposes

BAR CHART



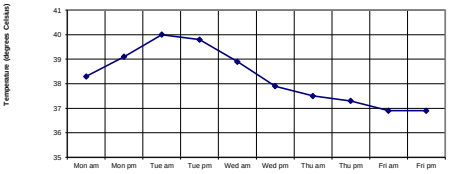
- Useful for comparing data in different categories.
- The lengths of the bars indicate the size of the data categories.
- For qualitative data (eg: colour, names) and discrete quantitative data (eg: number of children in families).
- Gaps are left between the bars.

VERTICAL LINE GRAPH



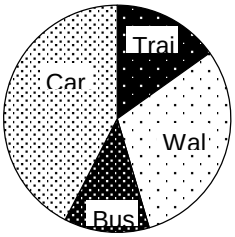
- Useful for comparing data in different categories.
- The lengths of the lines indicate the size of the data category.
- For qualitative data and discrete quantitative data.
- Really a bar chart with narrow columns.

LINE GRAPH



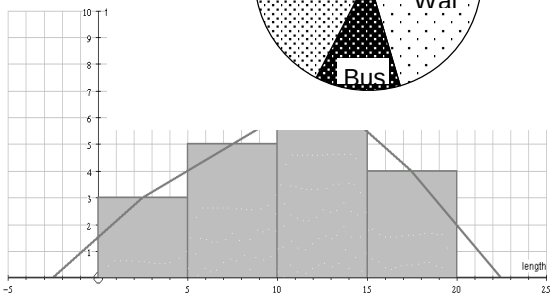
- Useful for showing upward and downward trends in data.
- Intermediate points are unreliable but might be used for estimates.

PIE CHART



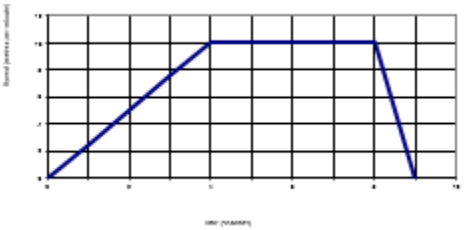
- Used to show how something is divided up.
- Useful when proportions are more important than numbers.

FREQUENCY DIAGRAM



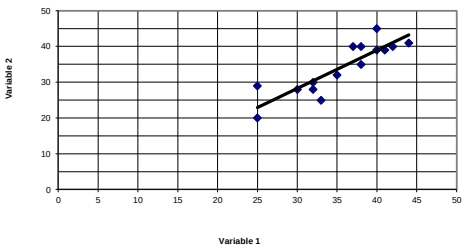
- Useful for comparing data in different categories and showing trends.
- The mid-points of the tops of the bars are joined to form a frequency polygon.
- The mid-points of the first and last columns are joined to the mid-point of the adjacent columns on the horizontal axis.

TRAVEL GRAPH



- Used to show a journey
- It is always distance (↑) against time (→)
- Flat sections are where the object is stationary
- The steeper the graph the faster the object is moving
- The graph going up means the object is travelling away and coming down means the object is returning

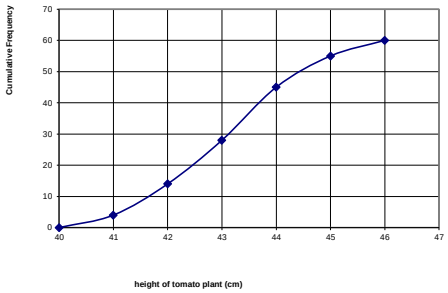
SCATTER DIAGRAM



- Used to examine the relationship between two variables
- If the points generally lie neat to a line of best fit there is a good correlation.
- The line of best fit can be used to estimate one variable given the other variable.
- The line of best fit is a straight line, it doesn't have to go through the origin
- Estimates of variables found by extending the line of best fit beyond the range of the data are unreliable.

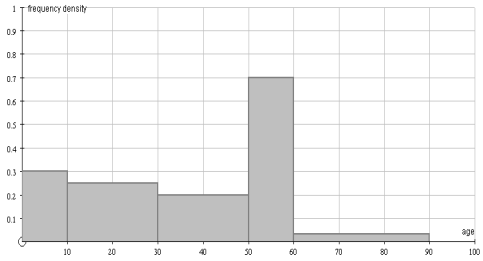
CUMULATIVE FREQUENCY CURVE

- Useful for determining the number of values above or below a specified point and identifying the median, quartiles and percentiles.
- A cumulative frequency table is created from a frequency table by adding each frequency to the sum of its predecessors.
- In a cumulative frequency graph points are plotted at the top of the range for the class.
- This can be in the form of a curve or a series of straight line segments.



HISTOGRAM

- Useful for showing data in grouped frequencies when the class intervals are not all the same.
- The areas of the columns represent the frequencies.
- The axes should have a continuous scale.
- Frequency density is plotted against classwidth



ICT packages:
There are a number of ICT packages, including Excel, which departments may use to support graphical work. In all cases it is important that students are expected to interpret these graphs as well as draw them.

Appendix 5 - Mathematics identified in other curriculum areas

Media • Timing • Scaled diagrams • Timelines • Proportion • Ratio • Statistics	**R.S.** • Addition and subtraction • Time in years and working with a timeline • Recognition of large numbers • Calendar years of different faiths	**P.E.** • Addition and subtraction • Problem solving – routes • Working with time and measure • Recording results in tables • Sensible estimates of distance and time
Geography • Number • Simple ratio and scale • Scale and measurement • Distance and Metric units • Coordinates • Compass directions • Angles • Drawing bar, line graphs and pie charts • Extracting information from charts and diagrams • Percentage analysis	**History** • Recognising large numbers • Roman numerals • Time line – BC/AD • Extracting information from charts and diagrams • Drawing charts/graphs • Chronology • Percentages • Basic economics	**Art** • Proportion and ratio • Increasing and decreasing using scale factors • Tiling patterns • Line and rotational symmetry • Linking 2D to 3D models • Measuring to a given degree of accuracy and conversions • Surveys – interpreting findings • Geometric Shape. • Rule of thirds. • Scale drawings and scale factor
MFL • Read and write numbers • Number problems • Money and Exchange rates • Metric measures • Time – 12 and 24 hour • Calendar • Surveys – working with data • Percentages	**Music** • Counting • Rhythm and Time spans • Fractions • Lengths of string using standard units • Comparison of lengths • Recording results in tables. • Roman numerals • Speed/time	**Sociology** **AS** Sociology • Quantitative research; their strengths and limitations; research design. A2 Sociology • Debates about subjectivity, objectivity and value freedom.
English • Percentages • Word limits • Flow diagrams • Line graphs • Bar charts • Statistics – fact and figures • Costs and Timings • Speaking and Listening Tasks, e.g. the personnel managers' dilemma • Word Limits • Constructing timelines • Tension graphs • Venn diagrams • Mathematical vocabulary	**Drama** • Timing • Group numbering • Scaled diagrams • Designing sets • Timelines • Proportion and ratio • Money • Role play of trade • Costings • Using statistics to persuade and inform • Relative expenses, the changing value of money • Logical sequencing; timelines	**IT** • Using integers and decimals • Four rules of number • Using spreadsheets and algebraic notation • Solving equations in a spreadsheet • Imperial and metric units • Collecting and representing data – graphs, charts etc. • Processing data • Break even • Cash flow • Logic diagrams/algorithms • Ratios • percentage

PSHE

- Money calculations
- Money management
- Budgeting – government/personal
- Mortgages
- Interest rates
- Time
- Extracting information from charts and graphs
- Conducting a survey
- Representing data
- Calculating with numbers

Technology

- Weights and measurements
- Converting between units
- Enlargements
- Scale drawings
- Ratio
- Temperature
- Tessellations and symmetry
- Estimating
- Timing
- Ratio and proportion
- Scaling up
- Data and graphs
- Isometric Drawing
- 3D spatial awareness
- Standard form
- Money
- Circles and circumferences

Photography

- Proportion

Psychology

AS Psychology

- Presentation and interpretation of quantitative data including graphs, scatter grams and tables
- Analysis and interpretation of quantitative data. Measures of central tendency including median, mean, mode. Measures of dispersion including ranges and
- standard deviation
- Analysis and interpretation of correlational data. Positive and negative correlations and the interpretation of correlation coefficients

A2 Psychology

- Appropriate selection of graphical representations
- Probability and significance, including the interpretation of significance and Type 1/Type 2 errors
- Factors affecting choice of statistical test, including levels of measurement
- The use of inferential analysis, including Spearman's Rho, Mann-Whitney, Wilcoxon, Chi-Squared

Engineering

- Measurement
- Dimensions
- Graphs
- Coordinates
- Algebraic expressions using laws of indices/logarithms
- Linear equations
- Quadratic equations/factorisation
- Circular/triangular measurement
- Areas and volume
- Graphs, charts etc.

Health and social Care

- Four rules of number including decimals (multiply and divide as part of calculating BMI)
- Percentages (percentage HR)
- Ratio (height / Weight)
- Word equations (respiration)
- Flow diagrams (peak flow, energy systems)
- Metric units (weight)
- Mass/weight (weight, BMI)
- Drawing and interpreting charts and graphs (norms of peak flow, temperature, blood pressure and heart rate)
- Extracting information from charts and graphs
- Conducting a survey
- Representing data
- Calculating with numbers

Science

7 and 8

- Present observations and data using appropriate methods, including tables and graphs
- Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
- Present reasoned explanations, including explaining data in relation to predictions and hypotheses
- Evaluate data, showing awareness of potential sources of random and systematic errors.
- Measurements
- Understand and use SI units and IUPAC (International Union of Pure and Applied Chemistry) chemical nomenclature
- Use and derive simple equations eg work = force x distance,

- Undertake basic data analysis.
- Calculations eg. comparing ratings of appliances in kilowatts (kW) and amounts of energy from different foods (from labels)
- Auditing change
  - audit calculations using measures of change in the energy associated with elastic deformation, moving and/or vibrating objects, heating materials, and chemical changes involving fuels
  - rates of change measured in kW.
- Describing motion
  - speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time)
  - the representation of a journey on a distance-time graph.

9, 10 and 11

- Understand number, size and scale and the quantitative relationship between units
- Understand when and how to use estimation.
- Carry out calculations involving +, – , ×, ÷, either singly or in combination, decimals, fractions, percentages and positive whole number powers.
- Provide answers to calculations to an appropriate number of significant figures.
- Understand and use the symbols =, <, >, ~.
- Understand and use direct proportion and simple ratios.
- Calculate arithmetic means.
- Understand and use common measures and simple compound measures such as speed.
- Plot and draw graphs (line graphs, bar charts, pie charts, scatter graphs, histograms) selecting
- Appropriate scales for the axes.
- Substitute numerical values into simple formulae and equations using appropriate units.
- Translate information between graphical and numeric form.
- Extract and interpret information from charts, graphs and tables.
- Understand the idea of probability.
- Calculate area, perimeters and volumes of simple shapes.
- Interpret, order and calculate with numbers written in standard form.
- Carry out calculations involving negative powers (only –1 for rate).
- Change the subject of an equation.
- Understand and use inverse proportion.
- Understand and use percentiles

12 and 13 Chemistry

Arithmetic and Computation

- Recognise and use expressions in decimal and standard form
- Use ratios, fractions and percentages
- Make estimates of the results of calculations (without using a calculator)
- Use calculators to find and use power, exponential and logarithmic functions (xn, 1/x, √x, log10x, ex, log ex)
- Handling data
- Use an appropriate number of significant figures
- Find arithmetic means
- Construct and interpret frequency tables and diagrams, bar charts and histograms

Algebra

- Understand and use the symbols: =, <, <<, >>, >, ∝, ~.
- Change the subject of an equation by manipulation of the terms, including positive, negative, integer and fractional indices
- Substitute numerical values into algebraic equations using appropriate units for physical quantities
- Solve simple algebraic equations
- Use logarithms in relation to quantities that range over several orders of magnitude

Graphs

- Translate information between graphical, numerical and algebraic forms
- Plot two variables from experimental or other data
- Understand that y = mx + c represents a linear relationship
- Determine the slope and intercept of a linear graph
- Calculate rate of change from a graph showing a linear relationship
- Draw and use the slope of a tangent to a curve as a measure of rate of change

- Geometry and trigonometry • appreciate angles and shapes in regular 2D and 3D structures
- Visualise and represent 2D and 3D forms including two-dimensional representations of 3D objects
- Understand the symmetry of 2D and 3D shapes

12 and 13 Biology

Arithmetic and computation

- Recognise and use expressions in decimal and standard form
- Use ratios, fractions and percentages
- Make estimates of the results of calculations (without using a calculator)
- Understand the symbols > and <
- Use calculators to find and use mean, standard deviations and xn, 1/x, √x

Handling data

- Use an appropriate number of significant figures
- Find arithmetic means
- Construct and interpret frequency tables, bar charts and histograms
- Understand the principles of sampling as applied to biological data
- Distinguish between chance and probability and understand the importance of chance and probability When interpreting data
- Understand the terms mean, median and mode and standard deviation
- Use a scatter diagram to identify positive and negative correlation between two variables
- Select and use a simple statistical test

Algebra

- Change the subject of an equation
- Substitute numerical values into algebraic equations using appropriate units for physical quantities
- Understand the use of logarithms in relation to quantities that range over several orders of magnitude.

Graphs

- Translate information between graphical and numerical forms
- Plot two variables from experimental or other data using appropriate Institute of Biology conventions
- Calculate rate of change from a graph showing a linear relationship
- Draw and use the slope of a tangent to a curve as a measure of rate of change.

Geometry

- Visualise three dimensional forms from two dimensional representations of three dimensional objects
- Calculate circumferences and areas of circles, surface areas and volumes of regular blocks and cylinders when provided with appropriate formulae.

12 and 13 Physics

Arithmetic and computation

- Recognise and use expressions in decimal and standard form
- Use ratios, fractions and percentages
- Use calculators to find and use x n, 1/x, √ x, log10x, ex, loge x
- Use calculators to handle sin x, cos x, tan x when x is expressed in degrees or radians.

Handling data

- Use an appropriate number of significant figures
- Find arithmetic means.
- Make order of magnitude calculations.

Algebra

- Understand and use the symbols: =, <, <<, >>, >, ∝, ~.
- Change the subject of an equation by manipulation of the terms,
- Including positive, negative, integer and fractional indices
- Substitute numerical values into algebraic equations using appropriate
- Units for physical quantities
- Solve simple algebraic equations

Graphs

- Translate information between graphical, numerical and algebraic forms
- Plot two variables from experimental or other data
- Understand that y = mx + c represents a linear relationship
- Determine the slope and intercept of a linear graph

- Draw and use the slope of a tangent to a curve as a measure of rate of change
- Understand the possible physical significance of the area between a curve and the x -axis and be able to calculate it or measure it by counting squares as appropriate
- Use logarithmic plots to test exponential and power law variations
- Sketch simple functions including y = k/x, y = kx2, y = k/x2, y = sin x, y = cos x, y = e–k x.

Geometry and Trigonometry

- Calculate areas of triangles, circumferences and areas of circles, surface areas and volumes of rectangular blocks, cylinders and spheres
- Use Pythagoras' theorem, and the angle sum of a triangle
- Use sine, cosine and tangent in physical problems
- Understand the relationship between degrees and radians and translate from one to the other.

This policy should be read in conjunction with the school's Safeguarding Policy and Procedures (including Child Protection). All our practice and activities must be consistent and in line with the Safeguarding Policy and Procedures noted above. Any deviations from these policies and procedures should be brought to the attention of the Headteacher so that the matter can be addressed.

Policy Publication and Review Log			
Publication Date	Approval Date	Review Date	Reviewer
January 2015			Mrs. B Taylor