

KS4 – ENGLAND – NUMBER AND ALGEBRA

Using and applying number and algebra

select and use suitable problem-solving strategies and efficient techniques to solve numerical and algebraic problems

break down a complex calculation into simpler steps before attempting to solve it

make mental estimates of the answers to calculations; use checking procedures, including use of inverse operations; work to stated levels of accuracy

Reasoning

show step-by-step deduction in solving a problem

recognise the importance of assumptions when deducing results; recognise the limitations of any assumptions that are made and the effect that varying the assumptions may have on the solution to a problem.

Numbers and the number system

use their previous understanding of integers and place value to deal with arbitrarily large positive numbers and round them to a given power of 10; understand and use positive numbers, both as positions and translations on a number line; order integers; use the concepts and vocabulary of factor (divisor), multiple and common factor

Decimals

use decimal notation and recognise that each terminating decimal is a fraction; order decimals

Percentages

understand that 'percentage' means 'number of parts per 100' and use this to compare proportions; interpret percentage as the operator 'so many hundredths of'; use percentage in real-life situations [for example, commerce and business, including rate of inflation, VAT and interest rates]

Ratio

use ratio notation, including reduction to its simplest form and its various links to fraction notation [for example, in maps and scale drawings, paper sizes and gears].

Calculations

add, subtract, multiply and divide integers and then any number; multiply or divide any number by powers of 10, and any positive number by a number between 0 and 1

understand and use unit fractions as multiplicative inverses [for example, by thinking of multiplication by one-fifth as division by 5, or multiplication by six-sevenths as multiplication by 6 followed by division by 7]; multiply and divide a fraction by an integer, and multiply a fraction by a unit fraction

convert simple fractions of a whole to percentages of the whole and vice versa [for example, analysing diets, budgets or the costs of running, maintaining and owning a car], then understand the multiplicative nature of percentages as operators

divide a quantity in a given ratio

Mental methods

round to the nearest integer and to one significant figure; estimate answers to problems involving decimals

Written methods

use standard column procedures for addition and subtraction of integers and decimals

use standard column procedures for multiplication of integers and decimals, understanding where to position the decimal point by considering what happens if they multiply equivalent fractions; solve a problem involving division by a decimal (up to two places of decimals) by transforming it to a problem involving division by an integer

solve simple percentage problems, including increase and decrease [for example, VAT, annual rate of inflation, income tax, discounts]

solve word problems about ratio and proportion, including using informal strategies and the unitary method of solution

Calculator methods

use calculators effectively and efficiently: know how to enter complex calculations and use function keys for reciprocals, squares and powers

enter a range of calculations, including those involving standard index form and measures [for example, time calculations in which fractions of an hour must be entered as fractions or as decimals]

understand the calculator display, interpreting it correctly [for example, in money calculations, or when the display has been rounded by the calculator], and knowing not to round during the intermediate steps of a calculation.

Solving numerical problems

draw on their knowledge of the operations and the relationships between them, and of simple integer powers and their corresponding roots, to solve problems involving ratio and proportion, a range of measures and compound measures, metric units, and conversion between metric and common imperial units, set in a variety of contexts

select appropriate operations, methods and strategies to solve number problems, including trial and improvement where a more efficient method to find the solution is not obvious

give solutions in the context of the problem to an appropriate degree of accuracy, interpreting the solution shown on a calculator display, and recognising limitations on the accuracy of data and measurements.

Equations, formulae and identities

distinguish the different roles played by letter symbols in algebra, knowing that letter symbols represent definite unknown numbers in equations, defined quantities or variables in formulae, general, unspecified and independent numbers in identities and in functions they define new expressions or quantities by referring to known quantities

Interpret graphical information

interpret information presented in a range of linear and non-linear graphs [for example, graphs describing trends, conversion graphs, distance-time graphs, graphs of height or weight against age, graphs of quantities that vary against time, such as employment].

Breadth of study

extending mental and written calculation strategies and using efficient procedures confidently to calculate with integers, fractions, decimals, percentages, ratio and proportion

solving a range of familiar and unfamiliar problems, including those drawn from real-life contexts and other areas of the curriculum

activities that provide frequent opportunities to discuss their work, to develop reasoning and understanding and to explain their reasoning and strategies

activities focused on developing short chains of deductive reasoning and correct use of the '=' sign

activities in which they do practical work with geometrical objects, visualise them and work with them mentally

practical work in which they draw inferences from data, consider how statistics are used in real life to make informed decisions, and recognise the difference between meaningful and misleading representations of data
activities focused on the major ideas of statistics, including using appropriate

populations and representative samples, using different measurement scales, using probability as a measure of uncertainty, using randomness and variability, reducing bias in sampling and measuring, and using inference to make decisions

substantial use of tasks focused on using appropriate ICT, using calculators correctly and efficiently, and knowing when not to use a calculator.

Attainment Targets: Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7

SHAPE, SPACE AND MEASURES

Using and applying shape, space and measures

select problem-solving strategies and resources, including ICT tools, to use in geometrical work, and monitor their effectiveness

select and combine known facts and problem-solving strategies to solve complex problems

Reasoning

show step-by-step deduction in solving a geometrical problem

Geometrical reasoning

recall and use properties of angles at a point, angles on a straight line (including right angles), perpendicular lines, and opposite angles at a vertex

distinguish between acute, obtuse, reflex and right angles; estimate the size of an angle in degrees

Properties of triangles and other rectilinear shapes

understand, recall and use Pythagoras' theorem

Measures and construction

interpret scales on a range of measuring instruments, including those for time and mass; know that measurements using real numbers depend on the choice of unit; recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction; convert measurements from one unit to another; know rough metric equivalents of pounds, feet, miles, pints and gallons; make sensible estimates of a range of measures in everyday settings

understand angle measure using the associated language [for example, use bearings to specify direction]

understand and use compound measures, including speed

Construction

measure and draw lines to the nearest millimetre, and angles to the nearest degree; draw triangles and other 2-D shapes using a ruler and protractor, given information about their side lengths and angles; understand, from their experience of constructing them, that triangles satisfying SSS, SAS, ASA and RHS are unique, but SSA triangles are not; construct cubes, regular tetrahedra, square-based pyramids and other 3-D shapes from given information

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activities that provide frequent opportunities to discuss their work, to develop reasoning and understanding and to explain their reasoning and strategies

activities focused on developing short chains of deductive reasoning and correct use of the '=' sign

activities in which they do practical work with geometrical objects, visualise them and work with them mentally

practical work in which they draw inferences from data, consider how statistics are used in real life to make informed decisions, and recognise the difference between meaningful and misleading representations of data

activities focused on the major ideas of statistics, including using appropriate populations and representative samples, using different measurement scales, using probability as a measure of uncertainty, using randomness and variability, reducing bias in sampling and measuring, and using inference to make decisions

substantial use of tasks focused on using appropriate ICT [for example, spreadsheets, databases, geometry or graphic packages], using calculators correctly and efficiently, and knowing when not to use a calculator.

Attainment Targets: Level 1, Level 2, Level 3, Level 4, Level 5, Level 6, Level 7

KS4 – ENGLAND – HANDLING DATA

Using and applying handling data

carry out each of the four aspects of the handling data cycle to solve problems:

specify the problem and plan: formulate questions in terms of the data needed, and consider what inferences can be drawn from the data; decide what data to collect (including sample size and data format) and what statistical analysis is needed

collect data from a variety of suitable sources, including experiments and surveys, and primary and secondary sources

process and represent the data: turn the raw data into usable information that gives insight into the problem

interpret and discuss: answer the initial question by drawing conclusions from the data

select and organise the appropriate mathematics and resources to use for a task

review progress while working; check and evaluate solutions

Communicating

communicate mathematically, including using ICT, making use of diagrams and related explanatory text

examine critically, and justify, their choices of mathematical presentation of problems involving data

Reasoning

apply mathematical reasoning, explaining and justifying inferences and deductions

explore connections in mathematics and look for cause and effect when analysing data

recognise the limitations of any assumptions and the effects that varying the assumptions could have on conclusions drawn from the data analysis

Specifying the problem and planning

see that random processes are unpredictable

discuss how data relate to a problem; identify possible sources of bias and plan to minimise it

Collecting data

gather data from secondary sources, including printed tables and lists from ICT-based sources

Processing and representing data

draw and produce, using paper and ICT, pie charts for categorical data, and diagrams for continuous data, including line graphs for time series, scatter graphs, frequency diagrams and stem-and-leaf diagrams

calculate mean, range and median of small data sets with discrete then continuous data; identify the modal class for grouped data

understand and use estimates or measures of probability from theoretical models (including equally likely outcomes), or from relative frequency

find the median for large data sets and calculate an estimate of the mean for large data sets with grouped data

Interpreting and discussing results

interpret a wide range of graphs and diagrams and draw conclusions

consider and check results and modify their approach if necessary

use the vocabulary of probability to interpret results involving uncertainty and prediction

understand that if they repeat an experiment, they may - and usually will - get different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics

discuss implications of findings in the context of the problem

Breadth of study

extending mental and written calculation strategies and using efficient procedures confidently to calculate with integers, fractions, decimals, percentages, ratio and proportion

solving a range of familiar and unfamiliar problems, including those drawn from real-life contexts and other areas of the curriculum

activities that provide frequent opportunities to discuss their work, to develop reasoning and understanding and to explain their reasoning and strategies

activities focused on developing short chains of deductive reasoning and correct use of the '=' sign

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practical work in which they draw inferences from data, consider how statistics are used in real life to make informed decisions, and recognise the difference between meaningful and misleading representations of data

activities focused on the major ideas of statistics, including using appropriate populations and representative samples, using different measurement scales, using probability as a measure of uncertainty, using randomness and variability, reducing bias in sampling and measuring, and using inference to make decisions

substantial use of tasks focused on using appropriate ICT [for example, spreadsheets, databases, geometry or graphic packages], using calculators correctly and efficiently, and knowing when not to use a calculator.

Attainment Targets: Level 1, Level 2, Level 3, Level 4, Level 8