Mathematical requirements

It is expected that these requirements will be covered as part of a mathematics curriculum at this level of study.

Calculators may be used in all parts of the examination.

Numerical answers should be written as decimals (or percentages if appropriate).

Number

- add, subtract, multiply and divide
- use decimals, fractions, percentages, ratios and reciprocals
- convert between decimals, fractions and percentages
- understand and use the symbols: =, <, >
- understand the meaning of sum, difference and product
- use standard form (scientific notation)
- understand that only the final answer in a calculation should be rounded
- use decimal places and significant figures appropriately
- make approximations and estimates to obtain reasonable answers

Algebra

- use positive, whole number indices in algebraic expressions
- substitute values of quantities into equations, using consistent units
- solve simple algebraic equations for any one term when the other terms are known
- recognise and use direct and inverse proportion
- set up simple algebraic equations as mathematical models of physical situations and to represent information given in words
- use Δ (delta) in algebraic expressions and equations to represent changes in a variable

Geometry and trigonometry

- understand the meaning of angle, curve, circle, radius, diameter, circumference, square, parallelogram, rectangle and diagonal
- recall and use the equation for the circumference of a circle
- recall and use the equations for the area of a rectangle, area of a triangle and area of a circle
- recall and use the equations for the volume of a rectangular block and volume of a cylinder
- use scale diagrams
- apply Pythagoras' theorem to the calculation of a side of a right-angled triangle
- understand that a right angle is 90° and that the sum of the angles on a straight line is 180°
- use trigonometric functions (sine, cosine, tangent and their inverses)*
- use mathematical instruments (ruler, compasses, protractor, set square)
- recognise and use the points of the compass (N, S, E, W) and clockwise and anticlockwise directions
- convert between metric units, e.g. cm^3 and m^3; mg, g and kg

* *Extended candidates only*

Graphs, charts and statistics

- draw graphs and charts from data
- interpret graphs and charts, including interpolation and extrapolation of data
- determine the gradient (slope) of a line on a graph, including* by drawing a tangent to a curved line
- determine the intercept of the line on a graph, extending the line graphically (extrapolating) where appropriate
- select suitable scales and axes for graphs
- understand that $y = mx + c$ represents a linear relationship
- recognise direct proportionality from a graph
- calculate and use the average (mean) for a set of data

* *Extended candidates only*

Presentation of data

Taking readings

- Data values should be read from an instrument to an accuracy of one half of one of the smallest divisions on the scale.
- Interpolation between scale divisions should be to an accuracy of one half of a division. That is, where a reading lies between two scale marks, it should be interpolated to the nearest half division.

Recording readings

- Data should be recorded so as to reflect the precision of the measuring instrument, i.e. the smallest difference that can reliably be detected on the measuring instrument scale should be reflected by the number of decimal places and unit given in the measurement.
- A measurement or calculated quantity must be accompanied by a correct unit, where appropriate.
- Each column of a table should be headed with the name or symbol of the measured or calculated quantity and the appropriate unit, e.g. time / s. The solidus (/) is to be used for separating the quantity and the unit in tables, graphs and charts.
- Units should not be included with data in the body of a table.
- Each reading should be repeated, where appropriate, and recorded.
- The number of significant figures given for measured quantities should be appropriate to the measuring instrument used.
- The number of significant figures given for calculated quantities should be the same as the least number of significant figures in the raw data used in that specific calculation.
- A ratio should be expressed as $x : y$.

Drawing and analysing graphs

- The column headings of a table can be directly transferred to the axes of a constructed graph.
- A graph should be drawn with a sharp pencil.
- The axes should be labelled with the name or symbol of the measured or calculated quantity and the appropriate unit, e.g. time / s.

- Unless instructed otherwise, the scales for the axes should allow more than half of the graph grid to be used in both directions, and be based on sensible ratios, e.g. 2 cm on the graph grid representing 1, 2 or 5 units of the variable (or 10, 20 or 50, etc.)
- Points on the graph should be clearly marked as plus signs (+), crosses (×) or encircled dots (⊙) of appropriate size.
- Each data point should be plotted to an accuracy of one half of one of the smallest squares on the grid.
- A best-fit line (trend line) should be a single, thin, smooth straight-line or curve, drawn by inspection. The line does not need to coincide exactly with any of the points; where there is scatter evident in the data, examiners would expect a roughly even distribution of points either side of the line over its entire length. Points that are clearly anomalous and identified by the candidate should be ignored when drawing the best-fit line.
- Candidates should be able to take readings from the graph by extrapolation or interpolation.
- Data values should be read from a line on a graph to an accuracy of one half of one of the smallest squares on the grid. The same accuracy should be used in reading off an intercept.
- The gradient of a straight line should be taken using a triangle whose hypotenuse extends over at least half the length of the candidate's best-fit line, and this triangle should be marked on the graph.
- Calculation of the gradient should be to two or three significant figures.
- When the gradient or intercept of a graph is used in subsequent calculations, it will be assumed to have units consistent with the graph axes.

Conventions (e.g. signs, symbols, terminology and nomenclature)

Candidates are expected to be familiar with the nomenclature used in the syllabus. The syllabus and question papers conform with accepted international practice. In particular, the following document, produced by the Association for Science Education (ASE), should be used as a guideline.

Signs, Symbols and Systematics: The ASE Companion to 16–19 Science (2000).

Decimal markers

In accordance with current ASE convention, decimal markers in examination papers will be a single dot on the line. Candidates are expected to follow this convention in their answers.

Numbers

Numbers from 1000 to 9999 will be printed without commas or spaces. Numbers greater than or equal to 10 000 will be printed without commas. A space will be left between each group of three digits, e.g. 4 256 789.

Units

To avoid any confusion concerning the symbol for litre, the equivalent quantity, the cubic decimetre (dm^3) will be used in place of *l* or litre.

In practical work, candidates will be expected to use SI units or, where appropriate, units approved by the BIPM for use with the SI (e.g. minute). A list of SI units and units approved for use with the SI may be found in the SI brochure at **www.bipm.org**. The use of imperial/customary units such as the inch and degree Fahrenheit are not acceptable and should be discouraged.

In all examinations, where data is supplied for use in questions, candidates will be expected to use units that are consistent with the units supplied and should not attempt conversion to other systems of units unless this is a requirement of the question.