2 Algebra and graphs

2.1 Introduction to algebra	Notes and examples
1 Know that letters can be used to represent generalised numbers.	
2 Substitute numbers into expressions and formulas.	

2.2 Algebraic manipulation	Notes and examples
1 Simplify expressions by collecting like terms.	Simplify means give the answer in its simplest form, e.g. $2a^2 + 3ab - 1 + 5a^2 - 9ab + 4 = 7a^2 - 6ab + 3$.
2 Expand products of algebraic expressions.	e.g. expand $3x(2x - 4y)$, $(3x + y)(x - 4y)$. Includes products of more than two brackets, e.g. expand $(x - 2)(x + 3)(2x + 1)$.
3 Factorise by extracting common factors.	Factorise means factorise fully, e.g. $9x^2 + 15xy = 3x(3x + 5y)$.
4 Factorise expressions of the form: • $ax + bx + kay + kby$ • $a^2x^2 - b^2y^2$ • $a^2 + 2ab + b^2$ • $ax^2 + bx + c$ • $ax^3 + bx^2 + cx$.	
5 Complete the square for expressions in the form $ax^2 + bx + c$.	

2.3 Algebraic fractions	Notes and examples
1 Manipulate algebraic fractions.	Examples include: • $\frac{x}{3} + \frac{x-4}{2}$ • $\frac{2x}{3} - \frac{3(x-5)}{2}$ • $\frac{3a}{4} \times \frac{9a}{10}$ • $\frac{3a}{4} \div \frac{9a}{10}$ • $\frac{1}{x-2} + \frac{x+1}{x-3}$.
2 Factorise and simplify rational expressions.	e.g. $\frac{x^2 - 2x}{x^2 - 5x + 6}$.

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2.4 Indices II	Notes and examples
1 Understand and use indices (positive, zero, negative and fractional).	e.g. solve: • $32^x = 2$ • $5^{x+1} = 25^x$.
2 Understand and use the rules of indices.	e.g. simplify: • $3x^{-4} \times \frac{2}{3}x^{\frac{1}{2}}$ • $\frac{2}{5}x^{\frac{1}{2}} \div 2x^{-2}$ • $\left(\frac{2x^5}{3}\right)^3$. Knowledge of logarithms is **not** required.

2.5 Equations	Notes and examples
1 Construct expressions, equations and formulas.	e.g. write an expression for the product of two consecutive even numbers. Includes constructing simultaneous equations.
2 Solve linear equations in one unknown.	Examples include: • $3x + 4 = 10$ • $5 - 2x = 3(x + 7)$.
3 Solve fractional equations with numerical and linear algebraic denominators.	Examples include: • $\frac{x}{2x+1} = 4$ • $\frac{2}{x+2} + \frac{3}{2x-1} = 1$ • $\frac{x}{x+2} = \frac{3}{x-6}$.
4 Solve simultaneous linear equations in two unknowns.	
5 Solve quadratic equations by factorisation, completing the square and by use of the quadratic formula.	Includes writing a quadratic expression in completed square form. Candidates may be expected to give solutions in surd form. The quadratic formula is given in the List of formulas.
6 Change the subject of formulas.	e.g. change the subject of a formula where: • the subject appears twice • there is a power or root of the subject.

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2.6 Inequalities

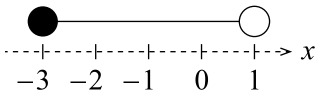
Notes and examples

1 Represent and interpret inequalities, including on a number line.

When representing and interpreting inequalities on a number line:

- open circles should be used to represent strict inequalities (<, >)
- closed circles should be used to represent inclusive inequalities (⩽, ⩾)

e.g. $-3 \leqslant x < 1$



2 Construct, solve and interpret linear inequalities.

Examples include:

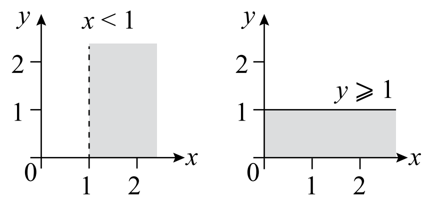
- $3x < 2x + 4$
- $-3 \leqslant 3x - 2 < 7$.

3 Represent and interpret linear inequalities in two variables graphically.

The following conventions should be used:

- broken lines should be used to represent strict inequalities (<, >)
- solid lines should be used to represent inclusive inequalities (⩽, ⩾)
- shading should be used to represent unwanted regions (unless otherwise directed in the question).

e.g.



4 List inequalities that define a given region.

Linear programming problems are not included.

2.7 Sequences

Notes and examples

1 Continue a given number sequence or pattern.

Subscript notation may be used, e.g. T_n is the nth term of sequence T.

2 Recognise patterns in sequences, including the term-to-term rule, and relationships between different sequences.

Includes linear, quadratic, cubic and exponential sequences and simple combinations of these.

3 Find and use the nth term of sequences.

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2.8 Proportion	Notes and examples
Express direct and inverse proportion in algebraic terms and use this form of expression to find unknown quantities.	Includes linear, square, square root, cube and cube root proportion. Knowledge of proportional symbol ($\propto$) is required.

2.9 Graphs in practical situations	Notes and examples
1 Use and interpret graphs in practical situations including travel graphs and conversion graphs.	Includes estimation and interpretation of the gradient of a tangent at a point.
2 Draw graphs from given data.	
3 Apply the idea of rate of change to simple kinematics involving distance–time and speed–time graphs, acceleration and deceleration.	
4 Calculate distance travelled as area under a speed–time graph.	Areas will involve linear sections only.

2.10 Graphs of functions	Notes and examples
1 Construct tables of values, and draw, recognise and interpret graphs for functions of the following forms: • ax^n (includes sums of no more than three of these) • $ab^x + c$ where $n = -2, -1, -\frac{1}{2}, 0, \frac{1}{2}, 1, 2, 3$; a and c are rational numbers; and b is a positive integer.	Examples include: • $y = x^3 + x - 4$ • $y = 2x + \frac{3}{x^2}$ • $y = \frac{1}{4} \times 2^x$.
2 Solve associated equations graphically, including finding and interpreting roots by graphical methods.	e.g. finding the intersection of a line and a curve.
3 Draw and interpret graphs representing exponential growth and decay problems.	
4 Estimate gradients of curves by drawing tangents.	

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2.11 Sketching curves	Notes and examples
Recognise, sketch and interpret graphs of the following functions: (a) linear (b) quadratic (c) cubic (d) reciprocal (e) exponential.	Functions will be equivalent to: • $ax + by = c$ • $y = ax^2 + bx + c$ • $y = ax^3 + b$ • $y = ax^3 + bx^2 + cx$ • $y = \frac{a}{x} + b$ • $y = ar^x + b$ where a, b and c are rational numbers and r is a rational, positive number. Knowledge of turning points, roots and symmetry is required. Knowledge of vertical and horizontal asymptotes is required. Finding turning points of quadratics by completing the square is required.

2.12 Functions	Notes and examples
1 Understand functions, domain and range, and use function notation.	Examples include: • $f(x) = 3x - 5$ • $g(x) = \frac{3(x+4)}{5}$ • $h(x) = 2x^2 + 3$.
2 Understand and find inverse functions $f^{-1}(x)$.	
3 Form composite functions as defined by $gf(x) = g(f(x))$.	e.g. $f(x) = \frac{3}{x+2}$ and $g(x) = (3x + 5)^2$. Find $fg(x)$. Give your answer as a fraction in its simplest form. Candidates are **not** expected to find the domains and ranges of composite functions. This topic may include mapping diagrams.