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| **UNIT 2: Expressions, substituting into simple formulae, expanding and factorising, equations, sequences and inequalities, simple proof** |

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**SPECIFICATION REFERENCES**

N1 … use the symbols =, ≠, <, >, ≤, ≥

N3 recognise and use relationships between operations, including inverse operations (e.g. cancellation to simplify calculations and expressions); use conventional notation for priority of operations, including brackets, powers, roots and reciprocals

N8 calculate exactly with fractions, **surds** …; **simplify surd expressions involving squares** …

N9 calculate with and interpret standard form *A* × 10*n*, where 1 ≤ *A* < 10 and *n* is an integer.

A1 use and interpret algebraic notation, including:

* + *ab* in place of *a* × *b*
  + 3*y* in place of *y* + *y* + *y* and 3 × *y*
  + *a*2 in place of *a* × *a*, *a*3 in place of *a* × *a* × *a*, *a*2*b* in place of *a* × *a* × *b*
  +  in place of *a* ÷ *b*
  + coefficients written as fractions rather than as decimals
  + brackets

A2 substitute numerical values into formulae and expressions, including scientific formulae

A3 understand and use the concepts and vocabulary of expressions, equations, formulae, identities, inequalities, terms and factors

A4 simplify and manipulate algebraic expressions … by:

* collecting like terms
* multiplying a single term over a bracket
* taking out common factors
* expanding products of two … binomials
* factorising quadratic expressions of the form *x*2 + *bx* + *c*, including the difference of two squares; …
* simplifying expressions involving sums, products and powers, including the laws of indices

A5 understand and use standard mathematical formulae; rearrange formulae to change the subject

A6 know the difference between an equation and an identity; argue mathematically to show algebraic expressions are equivalent, and use algebra to support and construct arguments **and proofs**

A7 where appropriate, interpret simple expressions as functions with inputs and outputs; …

A17 solve linear equations in one unknown algebraically …;

A20 **find approximate solutions to equations numerically using iteration**

A21 translate simple situations or procedures into algebraic expressions or formulae; derive an equation …, solve the equation and interpret the solution

A23 generate terms of a sequence from either a term-to-term or a position-to-term rule

A24 recognise and use sequences of triangular, square and cube numbers, simple arithmetic progressions, Fibonacci type sequences and simple geometric progressions (*rn* where *n* is an integer, and *r* is a rational number > 0), recognise and use other sequences **or a surd)**

A25 deduce expressions to calculate the *n*th term of linear sequences.

**PRIOR KNOWLEDGE**

Students should have prior knowledge of some of these topics, as they are encountered at Key Stage 3:

* the ability to use negative numbers with the four operations and recall and use hierarchy of operations and understand inverse operations;
* dealing with decimals and negatives on a calculator;
* using index laws numerically.

**KEYWORDS**

Expression, identity, equation, formula, substitute, term, ‘like’ terms, index, power, negative and fractional indices, collect, substitute, expand, bracket, factor, factorise, quadratic, linear, simplify, approximate, arithmetic, geometric, function, sequence, *n*th term, derive

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| **2b. Sequences**  (N8, N9, A23, A24, A25) | **Teaching time**  3-5 hours |

**OBJECTIVES**

By the end of the sub-unit, students should be able to:

* Recognise simple sequences including at the most basic level odd, even, triangular, square and cube numbers and Fibonacci-type sequences (including those involving numbers in standard form or index form);
* Generate sequences of numbers, squared integers and sequences derived from diagrams;
* Describe in words a term-to-term sequence and identify which terms cannot be in a sequence;
* Generate specific terms in a sequence using the position-to-term rule and term-to-term rule;
* Find and use (to generate terms) the *n*th term of an arithmetic sequence;
* Use the *n*th term of an arithmetic sequence to decide if a given number is a term in the sequence, or find the first term above or below a given number;
* Identify which terms cannot be in a sequence by finding the *n*th term;
* Continue a quadratic sequence and use the *n*th term to generate terms;
* Find the *n*th term of quadratic sequences;
* Distinguish between arithmetic and geometric sequences;
* Use finite/infinite and ascending/descending to describe sequences;
* Recognise and use simple geometric progressions (*rn* where *n* is an integer, and *r* is a rational number > 0 or a surd);
* Continue geometric progression and find term to term rule, including negative, fraction and decimal terms;
* Solve problems involving sequences from real life situations.

**POSSIBLE SUCCESS CRITERIA**

Given a sequence, ‘which is the 1st term greater than 50?’

Be able to solve problems involving sequences from real-life situations, such as:

* 1 grain of rice on first square, 2 grains on second, 4 grains on third, etc (geometric progression), or person saves £10 one week, £20 the next, £30 the next, etc;
* What is the amount of money after *x* months saving the same amount, or the height of tree that grows 6 m per year;
* Compare two pocket money options, e.g. same number of £ per week as your age from 5 until 21, or starting with £5 a week aged 5 and increasing by 15% a year until 21.

**OPPORTUNITIES FOR REASONING/PROBLEM SOLVING**

Evaluate statements about whether or not specific numbers or patterns are in a sequence and justify the reasons.

**COMMON MISCONCEPTIONS**

Students struggle to relate the position of the term to “*n*”.

**NOTES**

Emphasise use of 3*n* meaning 3 x *n*.

Students need to be clear on the description of the pattern in words, the difference between the terms and the algebraic description of the *n*th term.