SPECIFICATION REFERENCES

N1   order positive and negative integers, decimals and fractions; 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

A1   use and interpret algebraic notation, including:
- ab in place of $a \times b$
- $3y$ in place of $y + y + y$ and $3 \times y$
- a^2 in place of $a \times a$, a^3 in place of $a \times a \times a$, a^2b in place of $a \times a \times b$
- $\dfrac{a}{b}$ in place of $a \div b$
- 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 …
- 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

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

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

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

Tier 2
Expression, term, variable, simplify, factor, term, identity
Tier 3
Formula, factorise, equation, substitute, index, expand, bracket, linear

SMSC/RWCM/CEIAG
Any medical career will use substitution to ensure correct dosages of medicines for different patients.

2a. Algebra: the basics	Teaching time

OBJECTIVES

By the end of the sub-unit, students should be able to:
- Use notation and symbols correctly;
- Write an expression;
- Select an expression/equation/formula/identity from a list;
- Manipulate and simplify algebraic expressions by collecting 'like' terms;
- Multiply together two simple algebraic expressions, e.g. $2a \times 3b$;
- Simplify expressions by cancelling, e.g. $\dfrac{4x}{2} = 2x$;
- Use index notation when multiplying or dividing algebraic terms;
- Use index laws in algebra;
- Use index notation in algebra.
- Understand the $\neq$ symbol and introduce the identity $\equiv$ sign;

POSSIBLE SUCCESS CRITERIA/EXAM QUESTIONS

Simplify $4p - 2q + 3p + 5q$.
Simplify $z^4 \times z^3$, $y^3 \div y^2$, $(a^7)^2$.
Simplify $x^{-4} \times x^2$, $w^2 \div w^{-1}$.

(*a*) Simplify $5f - f + 2f$

(1)

(*b*) Simplify $2 \times m \times n \times 8$

(1)

(*c*) Simplify $t^2 + t^2$

(1)

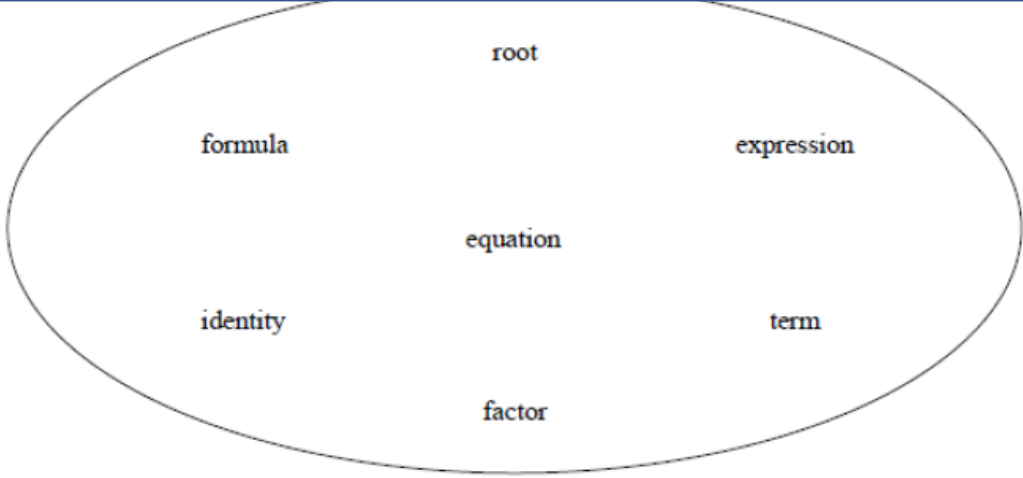**(Total 3 marks)**
Specimen Papers Set 1, Paper 2F qu.4 (A1, A4 − AO1)

(*a*) Simplify $8x - 3x + 2x$

(1)

(*b*) Simplify $4y \times 2y$

(1)

(Total 2 marks)
New SAMs Paper 3F qu.2 (A4 − AO1)

root

formula   expression

equation

identity   term

factor

Choose a word from those above that makes this statement correct.

(a) x^2 is a .... in $x^2 + 4y$

(1)

Choose a word from those above that makes this statement correct.

(b) $(y + 2)$ is a .... of $3y + 6$

(1)

(Total 2 marks)
Original SAMs Paper 2F qu.9 (A3 – AO1)

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING

Forming expressions and equations using area and perimeter of 2D shapes, this will also recap work done on area/perimeter in KS3.

COMMON MISCONCEPTIONS

Any poor number skills involving negatives and times tables will become evident.

NOTES

Some of this will be a reminder from Key Stage 3.
Emphasise correct use of symbolic notation, i.e. $3 \times y = 3y$ and not $y3$ and $a \times b = ab$.
Use lots of concrete examples when writing expressions, e.g. 'B' boys + 'G' girls.
Plenty of practice should be given and reinforce the message that making mistakes with negatives and times tables is a different skill to that being developed.

OBJECTIVES

By the end of the sub-unit, students should be able to:
- Multiply a single number term over a bracket;
- Write and simplify expressions using squares and cubes;
- Simplify expressions involving brackets, i.e. expand the brackets, then add/subtract;
- Argue mathematically to show algebraic expressions are equivalent;
- Recognise factors of algebraic terms involving single brackets;
- Factorise algebraic expressions by taking out common factors.

POSSIBLE SUCCESS CRITERIA/EXAM QUESTIONS

Expand and simplify $3(t - 1)$.
Understand $6x + 4 \neq 3(x + 2)$.
Argue mathematically that $2(x + 5) = 2x + 10$.

(a) Factorise $3f + 9$

(1)

(b) Factorise $x^2 - 2x - 15$

(2)

(Total 3 marks)
New SAMs Paper 2F qu.20 (A4 – AO1)

COMMON MISCONCEPTIONS

$3(x + 4) = 3x + 4$.
The convention of not writing a coefficient with a single value, i.e. x instead of $1x$, may cause confusion.

NOTES

Provide students with lots of practice.
This topic lends itself to regular reinforcement through starters in lessons.

OBJECTIVES

By the end of the sub-unit, students should be able to:
- Write expressions to solve problems representing a situation;
- Substitute numbers in simple algebraic expressions;
- Substitute numbers into expressions involving brackets and powers;
- Substitute positive and negative numbers into expressions;
- Derive a simple formula, including those with squares, cubes and roots;
- Substitute numbers into a word formula;
- Substitute numbers into a formula.

POSSIBLE SUCCESS CRITERIA/EXAM QUESTIONS

Evaluate the expressions for different values of x: $3x^2 + 4$ or $2x^3$.

$f = 5x + 2y$
$x = 3$ and $y = -2$

Find the value of f.

(Total 2 marks)
New SAMs Paper 2F qu.18 (A2 − AO1)

Here is a number machine.

input $\longrightarrow$ $\boxed{\times 3}$ $\longrightarrow$ $\boxed{-4}$ $\longrightarrow$ output

(a) Work out the **output** when the input is 4

(1)

(b) Work out the **input** when the output is 11

(2)

(c) Show that there is a value of the input for which the input and the output have the same value.

(2)

(Total 5 marks)
New SAMs Paper 3F qu.7 (A7, A17, A2 − AO1/AO2)

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING

Forming and solving equations involving algebra and other areas of mathematics such as area and perimeter.

COMMON MISCONCEPTIONS

Some students may think that it is always true that $a = 1$, $b = 2$, $c = 3$.
If $a = 2$ sometimes students interpret $3a$ as 32.
Making mistakes with negatives, including the squaring of negative numbers.

NOTES

Students will have encountered much of this before and you may wish to introduce solving equations using function machines.

Use formulae from mathematics and other subjects, expressed initially in words and then using letters and symbols.

Include substitution into the kinematics formulae given on the formula sheet, i.e. $v = u + at$, $v^2 - u^2 = 2as$, and $s = ut + \dfrac{1}{2}at^2$.