SUPER 12s

ALGEBRA

CURRICULUM MAP & INDEX

2 Algebra

2.1 Conventions

Level 1 Understanding algebraic language

e.g. term, coefficient, variable, expression, equation.

Level 2 Understanding algebraic conventions

e.g. $x^1 = x,\ a + 0 = a,\ 1y = y,\ a \times a = a^2,\ x \times x \times x = x^3,\ x^0 = 1$
Index laws

Level 3 Understanding algebraic conventions

e.g. $3 \times x = 3x,\ x \times 3 = 3x,\ x \times y = xy,\ y \times x = xy,\ 5 \div x = \frac{5}{x}$

Level 4 Writing algebraic expressions from worded descriptions.

e.g. Write an algebraic term for: x divided by 14.

Level 5 Writing algebraic expressions from worded descriptions involving two operations.

e.g. Write an algebraic expression for: x is multiplied by 2 and 3 added to the result.

Level 6 Understanding equivalent terms and expressions.

e.g. $2x + y = y + 2x$ and $\frac{-a}{b} = \frac{a}{-b} = -\frac{a}{b}$

Level 7 Understanding indices, powers, exponents and base.

e.g. In the term x^7 identify the exponent.

Level 8 Roots and radicals.

e.g. Write the term x radical 6.

Level 9 Multiplication of algebraic expressions. (Index laws)

e.g. Simplify: $x^2 \times x^3$

Level 10 Algebraic expressions with indices raised to a power. (Index laws)

e.g. Simplify: $(a^4)^3$

Level 11 Simplifying algebraic fractions that contain common variables raised to powers. (Index laws)

e.g. Simplify: $\frac{x^5}{x^2}$

Level 12 Writing algebraic expressions that involve negative indices. (Index law)

e.g. Write the following term without a negative index: $(3m)^{-2}$

Level 13 Writing algebraic expressions that involve negative numbers and negative indices.

e.g. Write the following term without negative indices: $(-3m)^{-2}$

Level 14 Writing algebraic expressions involving variables with negative indices raised to negative powers.

e.g. Write the following term without negative indices: $(x^2y^{-3})^{-2}$

Level 15 Writing algebraic expressions involving variables with negative indices in the numerator and denominator.

e.g. Write the following term without negative indices: $\frac{3x^2y^{-3}}{z^{-2}}$

Level 16 Writing algebraic expressions with negative indices in fractions raised to a power.

e.g. Write the following term without negative indices: $\left(\frac{3x^2y^{-3}}{z^{-2}}\right)^2$

Level 17 Writing algebraic expressions with negative indices in fractions raised to a negative power.

e.g. Write the following term without negative indices: $\left(\frac{3x^2y^{-3}}{z^{-2}}\right)^{-2}$

Level 18 Writing algebraic terms that involve variables with fractional indices. (Index laws)

e.g. $x^{\frac{1}{2}} = \sqrt{x}$ $x^{\frac{1}{3}} = \sqrt[3]{x}$ $x^{\frac{2}{3}} = x^{2\times\left(\frac{1}{3}\right)} = \sqrt[3]{x^2}$

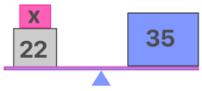
Level 19 Writing algebraic expressions that involve variables with negative fractional indices.

e.g. $x^{-\frac{1}{2}} = \frac{1}{\sqrt{x}}$ $x^{-\frac{1}{3}} = \frac{1}{\sqrt[3]{x}}$ $x^{-\frac{2}{3}} = x^{-2\times\left(\frac{1}{3}\right)} = \frac{1}{\sqrt[3]{x^2}}$

2.2 Writing equations

Level 1 Writing and solving algebraic equations represented by diagrams.

e.g. Write an equation that represents the unknown, then solve.



Level 2 Writing and solving algebraic equations from worded problems that involve one entity equated with a total by addition.

e.g. Eleven more than an unknown number 'x' totals 22. Write and equation to determine and then solve for the unknown number.

Level 3 Writing algebraic equations from worded problems that involve one operation.

e.g. Write an equation, then solve. A number g is multiplied by three and the result is fifty-four.

Level 4 Writing algebraic equations from worded problems that involve two operations.

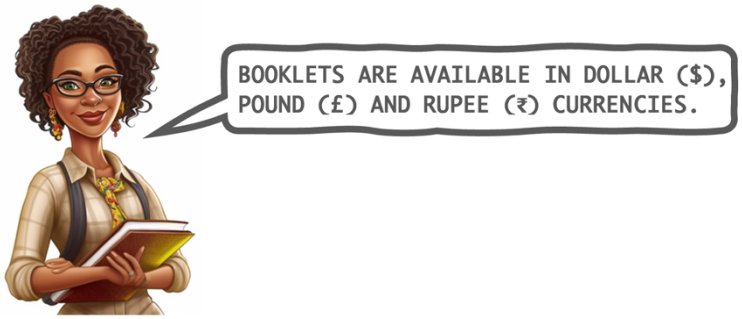
e.g. Write an equation, then solve. When one third of the number x is summed with five the result is ten.

Level 5 Writing and solving algebraic equations from worded problems that involve two unknowns linked by addition.

e.g. Dylan and Nathan must write a history essay. Dylan has written 863 more words than Nathan. If their combined word count is 4378, write an equation that involves addition and determine the number of words Nathan has written.

Level 6 Writing algebraic equations from worded problems that involve two unknowns linked by multiplication or division.

e.g. James and Cooper are saving their pocket money. James has saved only $\frac{2}{3}$ the amount of Cooper. Together they have saved a total of \$45. Write an equation and determine the amount of money Cooper has saved.



Level 7 Writing algebraic equations from worded problems that involve two operation and an understanding of the order of operations.

e.g. Write an equation, then solve. One third the value of seven less than x equals five.

Level 8 Writing algebraic equations from word problems that involve a variable on both sides of the equal sign.

e.g. Write an equation, then solve. The product of a number (x) and four is twelve more than twice the number.

Level 9 Writing algebraic equations from worded problems where two variables are linked with two operations.

e.g. Write an equation, then solve. One number is eleven more than the other and they add to twenty-nine.

Level 10 Writing algebraic equations from worded problems that involve consecutive numbers or consecutive even/odd numbers.

e.g. Write an equation, then solve. The sum of two consecutive numbers is equal to twenty-seven.

Level 11 From worded problems, write an equation to model the charges for a call-out or retainer/commission business, then substitute in values to solve.

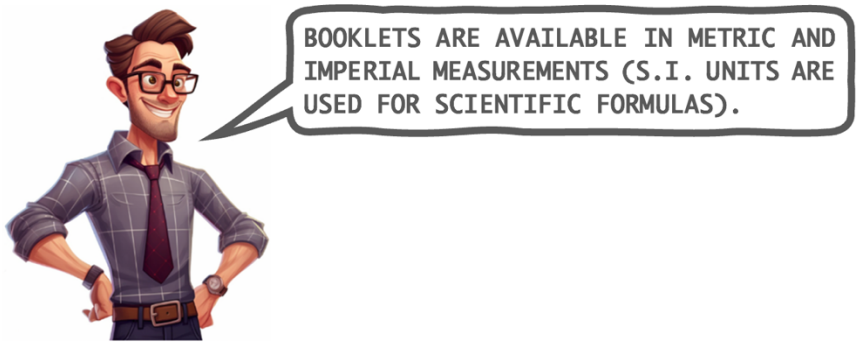
e.g. An electrician charges a call-out fee of $63 and an hourly rate of $42. Find the total cost of 3 hour of work.

Level 12 From worded problems, write an equation to model the charges for a call-out or retainer/commission business, then rearrange and substitute in values to solve.

e.g. An electrician charges $438 for completing a job. His hourly rate is $65. Calculate his call-out fee if the job takes 5 hours.

Level 13 From worded problems, source algebraic equations for geometric shapes and substitute values in to solve problems.

e.g. Calculate the volume of a cone with a radius of $5.4\,m$ and a height of $6.4\,m$.



Level 14 From worded problems, source algebraic equations for geometric shapes, rearrange equations and substitute values in to solve problems.

e.g. Calculate the height of a cone with a radius of $5.4\,m$ and volume of $34.4\,m^2$.

Level 15 Writing algebraic equations from worded problems that involve setting up simultaneous equations.

e.g. The dance team from Harper Secondary School are selling hot drinks to raise money. Yesterday, they sold 23 small and 17 large drinks, making $194. The day before, they sold 30 small and 22 large drinks and made $252. Write a set of simultaneous equations then determine how much they charged for each size drink.

Level 16 Writing algebraic equations from worded problems that involve rates related to speed.

e.g. A train travels from Town A to Town B at 60 km/h. Simultaneously, another train leaves Town B for Town A, travelling 20 km/h faster. If they pass each other after 3 hours, create an equation to then find the distance between the two towns.

Level 17 Writing algebraic equations from worded problems that involve rates related to speed and upstream/downstream scenarios.

e.g. An endurance swimmer can swim with a speed of 4 km/h in still water. If the speed of the current is 2 km/h, what will be the time taken by the person to go 8 km downstream?

Level 18 Writing and solving algebraic equations from word problems that involve rates related to shared work.

e.g. Mike and Susan can complete a puzzle in 3 hours if they work together. If Mike works alone, it takes him 7 hours. How long does it take Susan to complete the puzzle on her own?

Level 19 Writing algebraic equations from word problems that involve rates related to mixtures.

e.g. A farmer is mixing two types of fertilizer, one with 12% nitrogen and another with 20% nitrogen, to create a mixture with 17% nitrogen. How many kg of each should be mixed to make 50 kg of the mixture?

Level 20 From word problems, source algebraic equations for geometric shapes and calculate the scale of proportional increase or decrease in area or volume given a proportional change in length.

e.g. If the radius of a circle is increased by a factor of 3, by what proportion does its area increase?

Level 21 From word problems, source algebraic equations for geometric shapes that require the algebraic manipulation of equations to solve.

e.g. Find the area of a circle if its circumference is 38 cm.

2.3 Collecting like terms

Level 1 Identifying like terms.

e.g. $2x, \quad 2p, \quad 7x, \quad 5g$

Level 2 Collecting like terms through addition and subtraction.

e.g. $5x + 10x = 15x$

Level 3 Confirmation, through substitution, of the addition of like terms.

e.g. Show that $5x + 10x = 15x$ by substituting $x = 4$ into both sides of the equation

Level 4 Collecting like terms in expressions with more than one variable.

e.g. $5x + 2p + 10x - p = 15x + p$

Level 5 Collecting like terms in expressions with variables raised to different powers.

e.g. $5x^2 + 2x + 10x - 2x^2 = 3x^2 + 12x$

Level 6 Collecting like terms with multi-variable terms with indices.

e.g. $5ax^2 + 2ax + 7ax^2 - 10x - 2x^2 = 12ax^2 + 2ax - 10x - 2x^2$

2.4 Multiplication of terms

Level 1 Multiplication of algebraic terms. (Index laws)

e.g. $x \times x^2 = x^3$

Level 2 Multiplication of algebraic terms with constants and variables.

e.g. $5x \times 2x = 10x^2$

Level 3 Multiplication of algebraic terms involving negatives.

e.g. $5x \times -2x = -10x^2$

Level 4 Confirmation of algebraic multiplication through substitution.

e.g. Show that $5x \times 2x = 10x^2$ by substituting $x = 2$ into both sides of the equation.

Level 5 Multiplication of algebraic terms that involve multiple variables with indices.

e.g. $5xy \times 2xy = 10x^2y^2$

Level 6 Multiplication of algebraic terms that involve negatives and multiple variables with indices.

e.g. $5xy^2 \times -2x^3y = -10x^4y^3$

Level 7 Algebraic terms with indices raised to powers. (Index laws)

e.g. $(t^3)^5 = t^{15}$

Level 8 Algebraic terms that involve coefficients raised to powers. (Index laws)

e.g. $(2t^3)^2 = 4t^6$

Level 9 Algebraic terms involving negative coefficients raised to powers.

e.g. $(-2t^3)^3 = -8t^9$

Level 10 Multiplication of multiple algebraic terms.

e.g. $(3t^4)^2 \times (2s^2t)^3 = 72s^6t^{11}$

2.5 Algebraic fractions

Level 1 Writing algebraic expressions as fractions.

e.g. Write the following algebraic expression as a fraction.

$$(x + 7) \div y$$

Level 2 Simplifying algebraic fractions that contain common variables and numerical factors.

e.g. Simplify the following algebraic fraction.

$$\frac{4ac}{12bc}$$

Level 3 Simplifying algebraic fractions that contain common variables raised to powers.

e.g. Simplify the following algebraic fraction.

$$\frac{y^7}{y^2}$$

Level 4 Simplifying algebraic fractions that contain multiple variables raised to powers.

e.g. Simplify the following algebraic fraction.

$$\frac{x^2\, y^6}{x^5\, y^5}$$

Level 5 Simplifying algebraic fractions that contain common factors raised to powers.

e.g. Simplify the following algebraic fraction.

$$\frac{8\, x^3\, y^6}{24\, x^5\, y^4}$$

Level 6 Simplifying algebraic fractions that contain common numerical factors (including negatives) and multiple common variables raised to powers.

e.g. Simplify the following algebraic fraction.

$$\frac{-2\,x^3\,y^2 \times x\,y^3}{-4\,x^4 \times x^2\,y^4}$$

Level 7 Multiplying algebraic fractions.

e.g. Multiply the fractions.

$$\frac{2x}{7} \times \frac{3y}{4}$$

Level 8 Division of algebraic fractions.

e.g. Divide the following fractions and simplify.

$$\frac{2x}{7} \div \frac{4}{3y}$$

Level 9 Fraction equivalence with both positive and negative values.

e.g. Find the value of the equivalent fraction.

$$\frac{3x}{5} = \frac{[\quad]}{25}$$

Level 10 Adding and subtracting algebraic fractions with a common denominator.

e.g. Add the fractions.

$$\frac{2x}{4} + \frac{3x}{4}$$

Level 11 Adding and subtracting algebraic fractions where one denominator is a factor of the other.

e.g. Add the fractions.

$$\frac{2x}{8} + \frac{3x}{4}$$

Level 12 Adding and subtracting algebraic fractions with whole number terms.

e.g. Calculate and simplify.

$$\frac{2x}{3} + 3x$$

Level 13 Simplifying algebraic fractions containing common numerical factors and variables inside brackets raised to powers.

e.g. Simplify the following algebraic fraction.

$$\frac{4(x^3\,y^4)^2}{24\,x^3\,y^4}$$

Level 14 Simplifying algebraic fractions that contain negative indices.

e.g. Simplify the following algebraic fraction.

$$\frac{x^{-2}\,y^3}{x^3\,y^{-4}}$$

Level 15 Simplifying algebraic fractions that contain common numerical factors and variables inside brackets raised to negative powers.

e.g. Simplify the following algebraic fraction.

$$\frac{(2\,x^2\,y^3)^{-2}}{x^3\,(y^{-1})^3}$$

Level 16 Simplifying algebraic fractions where the whole fraction is raised to a power.

e.g. Simplify the following algebraic fraction.

$$\left(\frac{2x^2}{y^{-3}}\right)^{-2}$$

Level 17 Multiplying algebraic fractions that involve multiple variables raised to powers.

e.g. Multiply the fractions and simplify your answer.

$$\frac{2x^2y}{7} \times \frac{3y^4}{4x}$$

Level 18 Dividing algebraic fractions that involve multiple variables raised to powers.

e.g. Divide the fractions and simplify your answer.

$$\frac{2x^2y}{7} \div \frac{3y^4}{4x}$$

Level 19 Multiplying algebraic fractions that involve multiple variables where the fraction is raised to a power.

e.g. Multiply the fractions and simplify your answer.

$$\left(\frac{3x^2}{5}\right)^2 \times \left(\frac{3y^4}{2x}\right)^{-1}$$

Level 20 Dividing algebraic fractions that involve multiple variables where the fraction is raised to a power.

e.g. Divide the fractions and simplify your answer.

$$\left(\frac{3x}{5y^3}\right)^2 \div \left(\frac{3y}{2x^2}\right)^{-1}$$

Level 21 Adding and subtracting multiple terms, including algebraic fractions and whole number terms.

e.g. Add the fractions and simplify.

$$\frac{2x}{3} + 3x + \frac{4x}{5}$$

Level 22 Adding and subtracting algebraic fractions with multiple terms in the numerator.

e.g. Add the fractions and simplify.

$$\frac{x+2}{3} + \frac{x-4}{5}$$

Level 23 Adding and subtracting algebraic fractions with multiple terms in the numerator.

e.g. Add the fractions and simplify.

$$\frac{3x+2}{2} + \frac{2x-4}{3}$$

Level 24 Adding and subtracting algebraic fractions with variables in both the numerator and denominator.

e.g. Add the fractions and simplify.

$$\frac{3x}{2}+\frac{4}{x}$$

Level 25 Adding and subtracting algebraic fractions with variables raised to powers in the numerator and denominator.

e.g. Add the fractions and simplify.

$$\frac{5x}{2}+\frac{3}{x^2}$$

Level 26 Adding and subtracting algebraic fractions with multiple terms in the denominator.

e.g. Add the fractions and simplify.

$$\frac{5}{x-2}+\frac{4}{x+3}$$

Level 27 Simplifying factorised algebraic fractions by cancelling.

e.g. Simplify.

$$\frac{5(x-2)}{2(x-2)}$$

Level 28 Simplifying factorised algebraic fractions raised to powers by cancelling.

e.g. Simplify.

$$\frac{5(x-2)(x+4)^2}{15(x+4)(x-2)}$$

Level 29 Simplifying algebraic fractions by factorising and then cancelling common terms.

e.g. Simplify.

$$\frac{5x-10}{7x-14}$$

Level 30 Simplifying algebraic fractions by factorising the difference of perfect squares.

e.g. Simplify.

$$\frac{x^2 - 9}{x - 3}$$

Level 31 Simplifying algebraic fractions by factorising trinomials.

e.g. Simplify.

$$\frac{x^2 + 5x + 6}{x + 2}$$

Level 32 Multiplying algebraic fractions that involve factorised terms raised to powers.

e.g. Multiply the fractions then simplify.

$$\frac{5(x-3)^2}{6(x+4)} \times \frac{3(x+4)}{10(x-3)}$$

Level 33 Dividing algebraic fractions that involve factorised terms raised to powers.

e.g. Divide the fractions then simplify.

$$\frac{5(x-3)^2}{6(x+4)} \div \frac{15(x-3)}{2(x+4)}$$

2.6 Expanding brackets

Level 1 Expanding brackets using the distributive law with positive and negative numbers.

e.g. Use the distributive law to expand the following bracket.

$$3(x+5)$$

Level 2 Using the distributive law to expand brackets containing variables with coefficients.

e.g. Use the distributive law to expand the following bracket.

$$3(2a+6)$$

Level 3 Confirmation of the distributive law through substitution.

e.g. Show that $2(2x+3)=4x+6$ by substituting $x=2$ into both sides of the equation.

Level 4 Expanding brackets using the distributive law with negative terms.

e.g. Use the distributive law to expand the following bracket.

$$-3(a+6)$$

Level 5 Expanding brackets using the distributive law involving terms with coefficients and variables.

e.g. Use the distributive law to expand the following bracket.

$$2a(3a+2)$$

Level 6 Expanding brackets using the distributive law and collecting like terms.

e.g. Use the distributive law to expand then collect like terms.

$$5x(x-2)-3x^2$$

Level 7 Expanding sets of brackets, then collecting like terms.

e.g. Use the distributive law to expand, then collect like terms.

$$7(2a+3)-2(a+2)$$

Level 8 Expanding double brackets and collecting like terms.

e.g. Expand the brackets then collect like terms.

$$(b+2)(b+4)$$

Level 9 Expanding double brackets that contain negative terms and collecting like terms.

e.g. Expand the brackets then collect like terms.

$$(b-3)(b+4)$$

Level 10 Expanding double brackets that contain variables with a coefficient greater than one and collecting like terms.

e.g. Expand the brackets then collect like terms.

$$(2x+3)(5x+4)$$

Level 11 Expanding double brackets containing positive and negative variables and collecting like terms.

e.g. Expand the brackets then collect like terms.

$$(3y+7)(4y-2)$$

Level 12 Expanding perfect squares using the F.O.I.L method.

e.g. Expand the bracket then collect like terms.

$$(x-5)^2$$

Level 13 Expansion of perfect squares using the formula: $(x+n)^2 = x^2 + 2nx + n^2$.

e.g. Use the formula $(x+n)^2 = x^2 + 2nx + n^2$ to expand the following bracket.

$$(x+5)^2$$

Level 14 Expansion of perfect squares using the formula: $(x-n)^2 = x^2 - 2nx + n^2$.

e.g. Use the formula $(x-n)^2 = x^2 - 2nx + n^2$ to expand the following bracket.

$$(x-3)^2$$

Level 15 Using the F.O.I.L method to expand perfect squares containing a coefficient greater than 1.

e.g. Expand the bracket then collect like terms.

$$(3x-5)^2$$

Level 16 Using the formula $(ax+b)^2 = a^2x^2 + 2abx + b^2$ to expand binomials that involve a coefficient greater than 1.

e.g. Use the formula $(ax+b)^2 = a^2x^2 + 2abx + b^2$ to expand the following bracket.

$$(4x+9)^2$$

Level 17 Using the formula $(ax-b)^2 = a^2x^2 - 2abx + b^2$ to expand binomials that involve a coefficient greater than 1.

e.g. Use the formula $(ax-b)^2 = a^2x^2 - 2abx + b^2$ to expand the following bracket.

$$(2x-7)^2$$

Level 18 Using binomial expansion theory to expand binomials of order 2 that involve a coefficient greater than 1 and combine with like terms.

e.g. Expand the following bracket and collect like terms.

$$(3x-5)^2 + 2x^2 - 4$$

Level 19 Using binomial expansion to expand binomials of order 2 that involve a coefficient greater than 1 and combine with like terms.

e.g. Expand the following bracket and collect like terms.

$$2x^2(3x-5)^2$$

Level 20 Expanding binomials that are the difference of two perfect squares.

e.g. Expand the brackets then collect like terms.

$$(x+2)(x-2)$$

Level 21 Expanding binomials that are the difference of two squares using the formula $(a+b)(a-b)=a^2-b^2$.

e.g. Use the formula $(a+b)(a-b)=a^2-b^2$ to expand the brackets.

$$(x+5)(x-5)$$

Level 22 Expanding binomials that are the difference of two perfect squares using the formula $(ax+b)(ax-b)=a^2x^2-b^2$.

e.g. Use the formula $(ax+b)(ax-b)=a^2x^2-b^2$ to expand the brackets.

$$(2x+5)(2x-5)$$

Level 23 Multiplying binomials with trinomials.

e.g. Expand the brackets then collect like terms.

$$(3x+5)(2x^2+4x-1)$$

Level 24 Combining function notation and polynomial expansion.

e.g. The following functions are defined as:
$A(x)=2x \quad B(x)=3x^2+2x-2$
Determine: $3A(x)\,2B(x)$

Level 25 Expanding binomials that contain fractions.

e.g. Use the distributive law to expand the following bracket.

$$-\frac{1}{3}\left(3c+\frac{5}{4}\right)$$

Level 26 Expanding binomials that contain fractions and collecting like terms.

e.g. Use the distributive law to expand the following bracket and collect like terms.

$$-\frac{2}{3}(3x+2)-\frac{x}{4}$$

Level 27 Expanding double brackets that contain fractions.

e.g. Expand the brackets and collect like terms.

$$\left(\frac{3x}{2}+\frac{1}{2}\right)\left(\frac{x}{4}-6\right)$$

Level 28 Using the formula $(x+n)^2=x^2+2nx+n^2$ to expand brackets that involve fractions.

e.g. Expand and collect like terms.

$$\left(\frac{x}{4}+6\right)^2$$

Level 29 Expanding brackets that are the difference of squares that involve fractions.

e.g. Expand and collect like terms.

$$\left(\frac{x}{4}+6\right)\left(\frac{x}{4}-6\right)$$

2.7 Factorising

Level 1 Factorising binomial expressions that contain a common numeric factor.

e.g. $3x + 9 = 3(x + 3)$

Level 2 Factorising binomial expressions that contain a common numeric factor.

e.g. $4x + 6 = 2(2x + 3)$

Level 3 Factorising binomial expressions that contain negative terms.

e.g. $-4x - 6 = -2(2x + 3)$

Level 4 Factorising binomial expressions that contain a common variable.

e.g. $x^2 + 3x = x(x + 3)$

Level 5 Factorising binomial expressions that contain a common numeric factor and variable.

e.g. $15x^2 - 10x = 5x(3x - 2)$

Level 6 Factorising binomial expressions that contain a common numeric factor and multiple variables.

e.g. $6x^2y^3 + 9x^2y = 3xy(2xy^2 + 3x)$

Level 7 Factorising quadratic expressions containing positive terms and where $a = 1$.

e.g. $x^2 + 5x + 6 = (x + 3)(x + 2)$

Level 8 Factorising quadratics expressions that contain positive and negative terms and where $a = 1$.

e.g. $x^2 + x - 6 = (x + 3)(x - 2)$

Level 9 Factorising quadratic expressions that contain a common numerical factor in each term.

e.g. $2x^2 - 8x - 42 = 2(x + 3)(x - 7)$

Level 10 Factorising quadratics that are perfect squares.

e.g. $x^2 - 8x + 16 = (x - 4)^2$

Level 11 Factorising by looking for a common binomial.

e.g. $5(x + 3) - y(x + 3) = (x + 3)(5 - y)$

Level 12 Factorising by grouping pairs of terms and then looking for a common binomial.

e.g. $3x + 12 - xy - 4y = (x + 4)(3 - y)$

Level 13 Factorising quadratics, where $a > 1$ and all terms are positive, by splitting the middle term.

e.g. $6x^2 + 23x + 7 = (3x + 1)(2x + 7)$

Level 14 Factorising quadratics, where $a > 1$ with both positive and negative terms, by splitting the middle term.

e.g. $12x^2 + 11x - 15 = (4x - 3)(3x + 5)$

Level 15 Factorising quadratics, where $a = 1$ with both positive and negative terms, by completing the square.

e.g. $x^2 + 6x + 13 = (x + 3)^2 - 4$

Level 16 Factorising quadratics, where $a > 1$ with both positive and negative terms, by completing the square.

e.g. $9x^2 + 24x + 9 = (3x + 4)^2 - 7$

2.8 Rearranging equations

Level 1 Rearranging equations that involve the multiplication and division of variables.

e.g. Rearrange the equation to make t the subject.

$$s = \frac{d}{t}$$

Level 2 Rearranging equations that involve addition, subtraction, multiplication, and division of variables.

e.g. Rearrange the equation to make x the subject.

$$2x + a = b$$

Level 3 Rearranging equations that involve multiplication and division of variables with subscripts and the scientific understanding of Δ.

e.g. Rearrange the equation to make μ_0 the subject.

$$B = \frac{\mu_0 I}{2\pi r}$$

Level 4 Rearranging equations that involve multiple fractional terms.

e.g. Rearrange the equation to make V_p the subject.

$$\frac{V_p}{V_s} = \frac{n_p}{n_s}$$

Level 5 Rearranging equations that involve brackets.

e.g. Rearrange the equation to make x the subject.

$$a = 2(x - 3y)$$

Level 6 Rearranging equations that involve indices.

e.g. Rearrange the equation to make r the subject.

$$A = \pi r^2$$

Level 7 Rearranging equations that involve indices and the addition and subtraction of terms.

e.g. Rearrange the equation to make a the subject.

$$a^2 + b^2 = c^2$$

Level 8 Rearranging equations that involve indices, fractions and the addition and subtraction of terms.

e.g. Rearrange the equation to make r the subject.

$$\frac{T^2}{r^3} = \frac{4\pi^2}{GM}$$

Level 9 Rearranging equations that involve trigonometric ratios.

e.g. Rearrange the equation to make θ the subject.

$$\sin\theta = \frac{4}{d}$$

Level 10 Rearranging equations that involve trigonometric ratios, fractions, and multiple variables.

e.g. Rearrange the equation to make θ the subject.

$$\frac{2\pi \tan\theta}{7} = \frac{c}{d}$$

2.9 Substitution

Level 1 Evaluating terms by substituting positive values for variables.

e.g. Evaluate the term $7x$ if $x = 3$

Level 2 Evaluating terms by substituting positive or negative values for variables.

e.g. Evaluate the term $\frac{21}{-t}$ if $t = -3$

Level 3 Evaluating expressions with multiple terms by substituting positive values for variables.

e.g. Evaluate the expression $10y - 3b$ if $b = 4$ and $y = 2$

Level 4 Evaluating expressions with multiple terms by substituting positive and negative values for variables.

e.g. Evaluate the expression $9x - 2t - 4$ if $x = -4$ and $t = 2$

Level 5 Evaluating expressions involving brackets and multiple terms by substituting positive values for variables.

e.g. Evaluate the expression $(3x - 1)(2x + 2)$ if $x = 3$

Level 6 Evaluating expressions that involve brackets and multiple terms by substituting positive and negative values for variables.

e.g. Evaluate the expression $(3x - 1)(3x - 2)$ if $x = -2$

Level 7 Evaluating terms that involve fractions and multiple variables with indices by substituting positive values for variables.

e.g. Evaluate the term $\frac{2x^3}{y}$ if $x = 2 \; and \; y = 3$

Level 8 Evaluating terms that involve fractions and multiple variables with indices by substituting positive and negative values for variables.

e.g. Evaluate the term $\frac{2x^3}{y}$ if $x = -2 \; and \; y = -3$

Level 9 Substituting values in for variables to determine if the entered values satisfy the equation.

e.g. Does $(-2,3)$ satisfy the equation $x^2 - 5y = -11$

Level 10 Understanding function notation to determine the value of a function given the input value.

e.g. Given $f(x) = 3x + 5$, determine $f(2)$

Level 11 Evaluating expressions that involve fractions, roots and multiple variables by substituting positive and negative values.

e.g. Evaluate $\frac{a}{\sqrt{b-2}} \; when \; a = 13 \; and \; b = 6$

Level 12 Evaluating expressions that involve fractions, indices, roots and multiple variables by substituting positive and negative values.

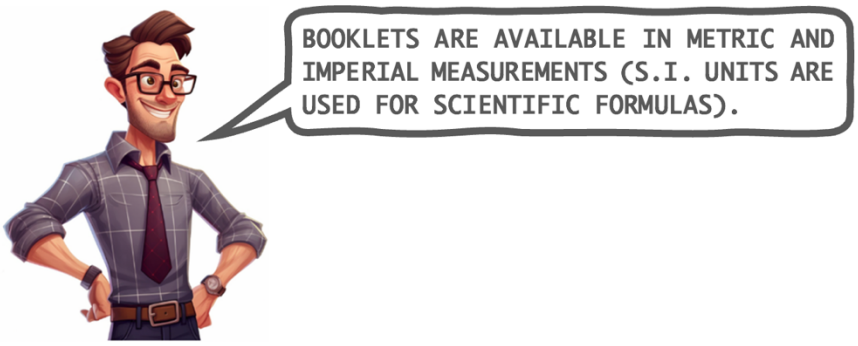
e.g. Evaluate $\frac{\sqrt{a+b}}{c^2} - 3 \; when \; a = 13, b = 51 \; and \; c = 2$

Level 13 Substituting values into common mathematical formulae.

e.g. The total surface area of a cylinder is given by: $S = 2\pi r^2 + 2\pi rh. \; Determine \; S, \; when \; r = 2 \; m \; and \; h = 7 \; m$

Level 14 Substituting values into common physics and chemistry formulae.

e.g. Einstein's energy mass equation is given by: $E = mc^2$. *Determine* $E(J)$ *when* $m = 2.37 \times 10^4\ kg$ *and* $c = 3 \times 10^8\ ms^{-1}$



2.10 Solving equations

Level 1 Solving equations with the addition/subtraction of integers.

e.g. Solve for the unknown

$$\blacksquare + 13 = 25$$

Level 2 Introduction of variables & solving equations with the addition/subtractions of integers.

e.g. Solve the equation

$$t + 4 = 55$$

Level 3 Introduction of variables & solving equations with the multiplication/division of integers.

e.g. Solve the equation

$$4t = 40$$

Level 4 Introduction of variables & solving equations with the multiplication/division of integers.

e.g. Solve the equation

$$\frac{y}{4} = 40$$

Level 5 Introduction of variables & solving equations with the multiplication/division of integers.

e.g. Solve the equation

$$\frac{3y}{4} = 9$$

Level 6 Solving equations with multiple terms.

e.g. Solve the equation

$$2y + 3 = 9$$

Level 7 Solving equations with multiple terms.

e.g. Solve the equation

$$\frac{2y}{3} + 3 = 9$$

Level 8 Solving equations with multiple terms in the numerator of a fraction.

e.g. Solve the equation

$$\frac{2y + 5}{3} = 9$$

Level 9 Solving equations with brackets.

e.g. Solve the equation

$$2(x - 3) = 9$$

Level 10 Solving equations with multiple terms and the variable on both sides of the equal sign.

e.g. Solve the equation

$$3 - 2y = 9 - y$$

Level 11 Solving equations with multiple terms and requiring the expansion of brackets.

e.g. Solve the equation

$$3(y + 5) + 2y = 9$$

Level 12 Solving equations with multiple terms and requiring the expansion of brackets.

e.g. Solve the equation

$$3(y + 5) = 2(y - 1)$$

Level 13 Solving equations with multiple terms and requiring the expansion of brackets.

e.g. Solve the equation

$$3(y+5)-4y=2(y-1)+7$$

Level 14 Solving equations with fractional terms.

e.g. Solve the equation

$$\frac{x}{5}+\frac{2x}{3}=13$$

Level 15 Solving equations with variables in the denominator of fractional terms.

e.g. Solve the equation

$$\frac{3}{2x}-\frac{1}{x}=14$$

Level 16 Solving equations containing multi-term fractions.

e.g. Solve the equation

$$\frac{x+2}{3}+\frac{x-5}{4}=9$$

Level 17 Solving factorised quadratic equations.

e.g. Solve the equation

$$(x-2)(x+3)=0$$

Level 18 Solving factorised quadratic equations.

e.g. Solve the equation

$$(3x-2)(7x+3)=0$$

Level 19 Solving quadratic equations that don't contain a middle 'x' term.

e.g. Solve the equation

$$x^2+3=28$$

Level 20 Factorising and solving quadratic equations that don't contain a constant term.

e.g. Solve the equation

$$x^2 + 2x = 0$$

Level 21 Factorising and solving quadratic equations.

e.g. Solve the equation

$$x^2 - 2x + 5 = 0$$

Level 22 Solving equations with only one term containing a variable raised to a power greater than 2.

e.g. Solve the equation

$$y^3 + 2 = 29$$

Level 23 Solving equations with only one term containing the variable raised to a power greater than 2.

e.g. Solve the equation

$$\frac{y^3}{3} + 2 = 29$$

Level 24 Solving equations with the variable raised to a power greater than 2.

e.g. Solve the equation

$$\frac{(y+1)^3}{3} + 2 = 29$$

Level 25 Solving equations that involve roots of the variable.

e.g. Solve the equation

$$\sqrt[3]{x+2} = 5$$

Level 26 Solving equations that involve the variable in the index.

e.g. Solve the equation

$$3^x = 9$$

Level 27 Solving equations with an index variable and requiring all terms to be converted to the same base.

e.g. Solve the equation

$$27^x = 9$$

Level 28 Solving equations with the variable as part of an expression in the index.

e.g. Solve the equation

$$27^{2x+1} = 9^{4x}$$

Level 29 Solving equations involving the variable as part of an expression in the index and requires converting all terms to the same base, including fractions converted to a negative index.

e.g. Solve the equation

$$4^{-2x} = \frac{1}{16}$$

Level 30 Solving equations that involve the variable as part of a fractional index.

e.g. Solve the equation

$$\frac{1}{\sqrt[x]{5}} = 125$$

Level 31 Solving equations that involve the variable as an index.

e.g. Solve the equation

$$\frac{2^{3x}}{8^{x-2}} = 32$$

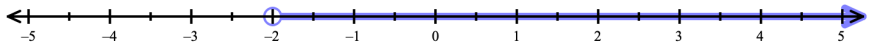
2.11 Solving inequalities

Level 1 Graphing inequalities on a number line.

e.g. Graph the inequality $x < 3$ on the number line.

Level 2 Writing inequalities from a graphical representation.

e.g. Write the inequality represented by



Level 3 Solving inequalities by adding and subtracting integers and graphing the solution on a number line.

e.g. Solve for the unknown and graph the solution on the number line.

$$x + 4 > 3$$

Level 4 Solving inequalities with multiplication and division of positive and negative numbers.

e.g. Solve for the unknown.

$$-5x \leq 35$$

Level 5 Solving inequalities involving multiple terms with positive and negative numbers.

e.g. Solve for the unknown.

$$4 - \frac{2x}{5} > 3$$

Level 6 Solving inequalities involving multiple terms with the variable appearing on both sides of the inequality.

e.g. Solve for the unknown.

$$5 - 2x > -7x + 3$$

Level 7 Solving inequalities involving multiple terms with the variable appearing on both sides of the inequality and requiring the expansion of brackets.

e.g. Solve for the unknown.

$$7(5-2x) > -3x+1$$

Level 8 Solving inequalities involving fractional terms.

e.g. Solve for the unknown.

$$\frac{7x}{2}+\frac{x}{5} > 1$$

2.12 Simultaneous equations

Level 1 Solving simultaneous equations by substitution.

e.g. $x + 3y = 6$
$x = y + 2$

Level 2 Solving simultaneous equations by elimination.

e.g. $x - y = 2$
$x + 3y = 6$

Level 3 Solving simultaneous equations by elimination that require the multiplication of one equation.

e.g. $x - y = 2$
$3x + 2y = 6$

Level 4 Solving simultaneous equations by elimination that require the multiplication of both equations.

e.g. $3x + 2y = 8$
$2x + 5y = -2$