Strand 4: Algebra

This strand builds on the relations-based approach of junior cycle with its five main objectives

1. to make use of letter symbols for numeric quantities
2. to emphasise relationship based algebra
3. to connect graphical and symbolic representations of algebraic concepts
4. to use real life problems as vehicles to motivate the use of algebra and algebraic thinking
5. to use appropriate graphing technologies (graphing calculators, computer software) throughout the strand activities.

Learners build on their proficiency in moving among equations, tables and graphs and become more adept at solving real-world problems.

Students learn about	Students working at FL should be able to	In addition, students working at OL should be able to	In addition, students working at HL should
4.1 Expressions	– evaluate expressions given the value of the variables – expand and simplify expressions	– factorise expressions of order 2 – add and subtract expressions of the form • $(ax+by+c)\pm\ldots\pm(dx+ey+f)$ • $(ax^2+bx+c)\pm\ldots\pm(dx^2+ex+f)$ where $a,b,c,d,e,f\in\mathbf{Z}$ • $\frac{a}{bx+c}\pm\frac{q}{px+r}$ where $a,b,c,p,q,r\in\mathbf{Z}$ – use the associative and distributive properties to simplify expressions of the form • $(bx+cy+d)+\ldots+e(fx+gy+h)$ • $(x\pm y)(w\pm z)$ – rearrange formulae	– perform the arithmetic operations of addition, subtraction, multiplication and division on polynomials and rational algebraic expressions paying attention to the use of brackets and surds
4.2 Solving equations	– select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to equations of the form: • $f(x)=g(x)$ with $f(x)=ax+b$, $g(x)=cx+d$ where $a,b,c,d\in\mathbf{Z}$ • $f(x)=0$ with $f(x)=ax^2+bx+c$ where $b^2\geq 4ac$; $a,b,c\in\mathbf{Z}$ and interpret the results	– select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to equations of the form: • $f(x)=g(x)$ with $f(x)=ax+b$, $g(x)=cx+d$ where $a,b,c,d\in\mathbf{Q}$ • $f(x)=g(x)$ with $f(x)=\frac{a}{bx+c}\pm\frac{q}{px+r}$; $g(x)=\frac{e}{f}$ where $a,b,c,d,e,f,p,q,r\in\mathbf{Z}$ • $f(x)=k$ with $f(x)=ax^2+bx+c$ (and not necessarily factorisable) where $a,b,c\in\mathbf{Q}$ and interpret the results – select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to • simultaneous linear equations with two unknowns and interpret the results • one linear equation and one equation of order 2 with two unknowns (restricted to the case where either the coefficient of x or the coefficient of y is ± 1 in the linear equation) and interpret the results – form quadratic equations given whole number roots	– select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to equations of the form: • $f(x)=g(x)$ with $f(x)=\frac{ax+b}{ex+f}\pm\frac{cx+b}{px+q}$; $g(x)=k$ where $a,b,c,d,e,f,p,q\in\mathbf{Z}$ – use the *Factor Theorem* for polynomials – select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to • cubic equations with at least one integer root • simultaneous linear equations with three unknowns • one linear equation and one equation of order 2 with two unknowns and interpret the results

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4.3 Inequalities	– select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to inequalities of the form: • $g(x) \leq k$, $g(x) \geq$ k, • $g(x) < k$, $g(x) > k$, where $g(x) = ax + b$ and $a, b, k \in \mathbf{Z}$	– select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to inequalities of the form: • $g(x) \leq k$, $g(x) \geq k$, $g(x) < k$, $g(x) > k$, where $g(x) = ax + b$ and $a\ b,\ k \in \mathbf{Q}$	– select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to inequalities of the form: • $g(x) \leq k$, $g(x) \geq k$, $g(x) < k$, $g(x) > k$, where $g(x) = ax^2 + bx + c$ or $g(x) = \frac{ax+b}{cx+d}$ and $a, b, c, d, k \in \mathbf{Q}$, $x \in \mathbf{R}$ – use notation |x| – select and use suitable strategies (graphic, numeric, algebraic, mental) for finding solutions to inequalities of the form: $\|x - a\| < b$, $\|x - a\| > b$ and combinations of these, where $a, b \in \mathbf{Q}$, $x \in \mathbf{R}$
4.4 Complex Numbers		See strand 3, section 3.1	– use the *Conjugate Root Theorem* to find the roots of polynomials – work with complex numbers in rectangular and polar form to solve quadratic and other equations including those in the form $z^n = a$, where $n \in \mathbf{Z}$ and $z = r\,\text{Cos}\,\theta + \text{iSin}\,\theta$ – use De Moivre's Theorem – prove De Moivre's Theorem by induction for $n \in \mathbf{N}$ – use applications such as n^{th} roots of unity, $n \in \mathbf{N}$ and identities such as $\text{Cos}\,3\theta = 4\,\text{Cos}^3\,\theta - 3\,\text{Cos}\,\theta$

Students learn about	Students should be able to
4.5 Synthesis and problem-solving skills	– explore patterns and formulate conjectures – explain findings – justify conclusions – communicate mathematics verbally and in written form – apply their knowledge and skills to solve problems in familiar and unfamiliar contexts – analyse information presented verbally and translate it into mathematical form – devise, select and use appropriate mathematical models, formulae or techniques to process information and to draw relevant conclusions.