THE ACADEMY OF ST NICHOLAS	Y12 Pure	CH04 4.1,4.2,4.3,4.4	Graphs Graphs: cubic, quartic and reciprocal	Lessons 3

Essential Knowledge Milestones

- understand and use graphs of functions;
- be able to sketch curves defined by simple equations including polynomials;
- be able to use intersection points of graphs to solve equations.

Assumed Prior Knowledge/ Links / Interleaving

- To recognise, 3 graph types when sketched
- Understand that 1/0 = ……..and how it is shown on a graph

Teaching Points

- Students should be familiar with the general shape of cubic curves from GCSE (9-1) Mathematics, so a good starting point is asking students to identify key features and draw sketches of the general shape of a positive or negative cubic. Equations can then be given from which to sketch curves.
- Quartic equations will be new to students and they may benefit from initially either plotting graphs by hand or using a graphical calculator or graphing software to look at the shape of the curve.
- Cubic and quartic equations given at this point should either already be factorised or be easily simplified (e.g. $y = x^3 + 4x^2 + 3x$) as students will not yet have encountered algebraic division.
- The coordinates of all intersections with the axes will need to be found. Where equations are already factorised, students will need to find where they intercept the axes. Repeated roots will need to be explicitly covered as this can cause confusion.
- Students should also be able to find an equation when given a sketch on which all intersections with the axes are given. To do this they will need to be confident multiplying out multiple brackets.
- Reciprocal graphs in the form $y = \frac{a}{x}$ are covered at GCSE but those in the form $y = \frac{a}{x^2}$ will be new. When sketching reciprocal graphs such as $y = \frac{a}{x}$ and $= \frac{a}{x^2}$, the asymptotes will be parallel to the axes.
- Intersecting points of graphs can be used to solve equations, a curve and a line and two curves should be covered. When finding points of intersection students should be encouraged to check that their answers are sensible in relation to the sketch.

Potential Barriers to Access/Misconceptions

- When sketching cubic graphs, most students are able to gain marks by knowing the basic shape and sketching it passing through the origin. Recognising whether the cubic is positive or negative sometimes causes more difficulty. Students sometimes fail to recognise the significance of a square factor in the factorised form of a polynomial.
- When sketching graphs, marks can easily be lost by not labelling all the key points or labelling them incorrectly e.g. (0, 6) instead of (6, 0).

Opportunities for Reasoning/Problem Solving/Proofs

- Students should be able to justify the number of solutions to simultaneous equations using the intersections of two curves.
- Students can be given sketches of curves or photographs of curved objects (e.g. roller coasters, bridges, etc.) and asked to suggest possible equations that could have been used to generate each sketch.

	Questions & Prompts
	• Give me an example of a number that is equal to $3\sqrt{2}$ …and another….and another • Change one number in $(2+\sqrt{8})(4-\sqrt{2})$ so that the product is a rational number. • $\sqrt{a+b} = \sqrt{a}+\sqrt{b}$. $\sqrt{a \times b} = \sqrt{a} \times \sqrt{b}$. Always true, sometimes true, never true? • Give me an example of a number between $5\sqrt{6}$ and $6\sqrt{5}$.

Key Mathematical Vocabulary	intersection points, polynomials

Personal Development	**Notes**	**Resources**
Pupils are taught that they must show 'ambition' in their assignments by attempting to meet all criteria in their homework, with honesty with regards what support they have had to complete the assignment		