THE ACADEMY OF St NICHOLAS	**Y12 Pure**	**CH05** 5.1,5.2,5.3,5.4,5.5	**Coordinate geometry in the (x, y) plane** **Straight Line graphs**	**Lessons** **5**

Essential Knowledge Milestones	**Teaching Points**
- understand and use the equation of a straight line; - know and be able to apply the gradient conditions for two straight lines to be parallel or perpendicular; - be able to find lengths and areas using equations of straight lines; - be able to use straight-line graphs in modelling.	- Students should be encouraged to draw sketches when answering questions or, if a diagram is given, annotate the diagram. - Equations can be given or asked for in the forms $y = mx + c$ and $ax + by + c = 0$ where a, b and c are integers. Students will need to be familiar with both forms, so questions should be asked where different forms are given or required in the answer. Given either form, students should be able to find the intercepts with the axes and the gradient. The x-intercept often causes students more difficulty, so will need more practice, but is useful for sketches and questions involving area or perimeter. - Students should be able to find the equation of a line given the gradient and a point, either the formula $y - y_1 = m(x - x_1)$ can be used or the values substituted into $y = mx + c$. To find the equation of a line from two points the gradient can be found and then one of the previous two methods used or the formula $\frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$ can be used. If this formula is used, care needs to be taken to ensure that the y-values are substituted into the correct places and that negative signs are taken into account. It should be emphasised that in the majority of cases, the form $y - y_1 = m(x - x_1)$ is far more efficient and less prone to errors than other methods.

Assumed Prior Knowledge/ Links / Interleaving

- GCSE: Equation of a line, Parallel and perpendicular lines, Pythagoras, Conversion,
- Make shapes using lines and the axes; students can then be asked to find the area or perimeter of composite shapes. Answers should be given in exact form to practise combining and simplifying surds.
- Real-life situations such as conversions can be modelled using straight-line graphs, this is likely to be familiar from GCSE (9-1) Mathematics.
- Students should also be familiar with finding the relationship between two variables and expressing this using the proportion symbol ∝ or using an equation involving a constant (k). This can be extended to straight-line graphs through the origin with a gradient of k. Students should be able to calculate and interpret the gradient.
- GCSE: Simultaneous equations, Completing the square

- The gradient conditions for parallel and perpendicular lines may be remembered from GCSE (9-1), but are still worth revising. They need to be well understood as they are used further when dealing with circles and in differentiation. Students should be able to identify whether lines are parallel, perpendicular or neither and find the equation of a parallel or perpendicular line when given a point on the line.
- The length of a line segment is found by using Pythagoras' theorem, which can be written as the formula $d = \sqrt{(x - x_1)^2 + (y_2 - y_1)^2}$. This can be linked to proof with students being encouraged to show how to go from Pythagoras to the formula. Answers to length and distance questions are likely to be given in surd form, giving further practice in simplifying surds. Students should be encouraged to give answers in exact form unless specified otherwise.

Potential Barriers to Access/Misconceptions	Opportunities for Reasoning/Problem Solving/Proofs
- In exams, students should be encouraged to quote formulae before using them. This allows method marks to be awarded even if arithmetical slips are made or incorrect values substituted. - Questions may specify a particular form for an answer (for example integer coefficients). Emphasise to students the importance of following these instructions carefully so as not to lose marks. - Students should be encouraged to draw diagrams while working on solutions as this often results in fewer mistakes and can act as a sense check for answers. At the same time, where diagrams are given in questions, students should be aware that these are not to be relied upon and 'spotting' answers by looking at a diagram without providing evidence to support this will not gain full marks. However, candidates should be encouraged to use any diagrams provided to help them answer the question. - The usual sorts of algebraic and numerical slips cause marks to be lost and students should be encouraged to carefully check their working. A common error is to incorrectly calculate the gradient of a straight line when it is given in the form $ax + by + c = 0$, so students should be encouraged to practice this technique. - When finding gradients using $\frac{x_1-x_2}{y_1-y_2}$ or $\frac{y_1-y_2}{x_2-x_1}$ instead of $\frac{y_1-y_2}{x_1-x_2}$ - Except for the mid-point formula, all formulae should have a minus sign in the binomial term. Students using a '+' instead; for example, $y_2 + y_1$ when calculating gradients. - Difficulty dealing with fractional and/or negative gradients when finding the equations of perpendicular lines.	- To help students see how much information is given in the equation of a line, a good activity is to give an equation and ask students to find everything they know about that line, e.g. the intercepts, a point on the line, the gradient, a sketch, a parallel line, etc. - Students can be given sketches and asked to suggest equations that would/would not work. - Modelling with straight-line graphs gives the opportunity to collect data that can then be plotted and a line of best fit used to find an equation. It might also be possible to compare the data to a theoretical model. Students should be encouraged to consider strengths and limitations of modelling. - Dynamic geometry programs can be used to make changes and observe the effect, helping students to discover and visualise the effect of changing equations.
	Questions & Prompts
	- Make up three questions that show you understand how to choose from $y = mx + c$, OR $y - y_1 = m(x - x_1)$, $\frac{y-y_1}{y_2-y_1} = \frac{x-x_1}{x_2-x_1}$ when finding the equation of a straight line. - Tell me three ways, which are essentially different, of determining whether three points A, B and C lie on a straight line.

Key Mathematical Vocabulary	Equation, bisect, centre, coefficient, constant, gradient, intercept, isosceles, linear, midpoint, parallel, perpendicular, proportion, Pythagoras, simultaneous, tangent.

Personal Development	Notes	Resources
Learn to accept that initial answers will require modification or additional notes to ensure that method marks are picked up and exam technique is improved		