3 Coordinate geometry

Syllabus ref.	Learning objectives	Suggested teaching activities
C3.1 and E3.1	Demonstrate familiarity with Cartesian coordinates in two dimensions.	Revise coordinates in two dimensions. Draw a picture by joining dots on a square grid. Draw x and y axes on the grid and write down the coordinates of each dot. **(I)** Ask other learners to draw these pictures from a list of coordinates only.
C3.2 and E3.2	Find the gradient of a straight line. Calculate the gradient of a straight line from the coordinates of two points on it.	Use a diagram to help you define a line with a positive gradient as one sloping upwards, and a line with a negative gradient as one sloping downwards. Use simple examples to show how to calculate the gradient (positive, negative or zero) of a straight line from a graph using vertical distance divided by horizontal distance in a right-angled triangle: $\text{gradient} = \frac{\text{change in } y \text{ coordinates}}{\text{change in } x \text{ coordinates}}$ Extend this to consider the gradient of the line x = constant. Use examples to show how to calculate the gradient of a straight line from the coordinates of two points on it, firstly by drawing the line and then without drawing the line. Use $\text{gradient} = \frac{\text{change in } y \text{ coordinates}}{\text{change in } x \text{ coordinates}}$. Explain the common error of subtracting the coordinates the opposite way around on the numerator to the denominator causing the sign to be incorrect. The Maths is Fun website (www.mathsisfun.com) has a clear explanation for this objective. Search “Equation of a line from two points”. The underground maths website (https://undergroundmathematics.org) uses an interactive applet to help learners explore how to calculate the gradient of a straight line from the coordinates of two points. You can use this to arrive at the general formula $y-y_1=m(x-x_1)$. The link includes a clear explanation and examples, and links it to the work learners have already done on transformations of graphs (E2.11). Search for ‘The equation of a straight line’. **(I)**

Syllabus ref.	Learning objectives	Suggested teaching activities
E3.3 (note there is no C3.3)	Calculate the length and the coordinates of the midpoint of a straight line from the coordinates of its end points.	Revise Pythagoras' theorem from Unit 4. Use examples to show how to calculate the length of a straight line segment from the coordinates of its end points using a sketch. **Extension activity:** To challenge the learners, do this using the formula $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$. Use examples to show how to find the coordinates of the midpoint of a straight line from the coordinates of its end points. Include examples working backwards, e.g. when an end point and a midpoint are known, find the other end point. **(I)**
C3.4 and E3.4	Interpret and obtain the equation of a straight line graph in the form $y = mx + c$. Problems will involve finding the equation where the graph is given.	Revise drawing a graph of $y = mx + c$ from a table of values. Interpret the meaning of m and c from the equation using the terms gradient and intercept. Starting with a straight line graph, show how its equation ($y = mx + c$) can be obtained. **(I)** To interpret the meaning of an equation, explain how an equation simply gives the relationship between the x and y coordinates on the line, e.g. for the equation $y = 2x$ this means the y ordinate is always double the x ordinate. Use this to identify if a point lies on the line, e.g. which of these points: (2, 8), (–4, 8), (7, 14), (20, 10), (0, 0) lies on the line $y = 2x$? Ask learners to come up similar questions. **(I)** Then give these questions to others in a group to identify which points do not lie on a given line.
C3.5	Determine the equation of a straight line parallel to a given line. e.g. find the equation of a line parallel to $y = 4x – 1$ that passes through (0, –3).	Use examples to show how to find the equation of a straight line parallel to a given line, e.g. find the equation of a line parallel to $y = 4x – 1$ that passes through (0, –3).

Syllabus ref.	Learning objectives	Suggested teaching activities
E3.6	Find the gradient of parallel and perpendicular lines, e.g. find the gradient of a line perpendicular to $y = 3x + 1$ find the equation of a line perpendicular to one passing through the coordinates (1, 3) and (–2, –9).	Use examples to show that parallel lines have the same gradient. Include examples where the equation is given implicitly, e.g. which of these lines are parallel? $y = 2x$, $y + 2x = 10$, $y – 2x + 3$, $2y = 2x + 7$, etc. Use an odd-one-out activity with three or more examples, where one of the lines is not parallel to the others and ask learners to identify which one is the odd-one-out and why. Ask learners to come up with their own set of odd one out examples. Find the gradient of perpendicular lines by using the fact that if two lines are perpendicular the product of their gradients is –1, e.g. find the gradient of a line perpendicular to $y = 3x + 1$. Use a variety of examples linking earlier topics from this unit, e.g. find the equation of a line perpendicular to one passing through the coordinates (1, 3) and (–2, –9). You could use the following resources to assess learners' understanding of this objective along with objective E.3.2 and C3.4) **(I) (F)**: • Parallel lines: http://www.mathsisfun.com/algebra/line-parallel-perpendicular.html • Lots of lines!: https://undergroundmathematics.org/geometry-of-equations/lots-of-lines

Past and specimen papers

Past/specimen papers and mark schemes are available to download at www.cambridgeinternational.org/support **(F)**

E3.2: Paper 41 June 2017 Q7(a)

C3.4: Specimen Paper 3 Q7(a); Specimen Paper 2 Q5

E3.6: Paper 41 June 2017 Q7 (c) and (d)