Coordinate geometry (AS)

C1 Understand and use the equation of a straight line, including the forms $y - y_1 = m(x - x_1)$ and $ax + by + c = 0$; gradient conditions for two straight lines to be parallel or perpendicular. Be able to use straight line models in a variety of contexts.

C2 Understand and use the coordinate geometry of the circle including using the equation of a circle in the form $(x - a)^2 + (y - b)^2 = r^2$; completing the square to find the centre and radius of a circle; use of the following properties: the angle in a semicircle is a right angle, the perpendicular from the centre to a chord bisects the chord, the radius of a circle at a given point on its circumference is perpendicular to the tangent to the circle at that point.

For a brief commentary on this content go to the MEI outline SoW.

Pre-requisites

- Transition to A level Maths: Essential Skills: Within the Sketching section see 'Linear sketching' and 'Other sketching'.
- GCSE: Knowledge of Pythagoras' Theorem, straight line graphs and circle theorems.
- AS Surds & indices: Fluency in working with surds is useful.
- AS Quadratic functions: Students will need to be able to complete the square.

Common student errors

- When finding gradients, using $\frac{x_1-x_2}{y_1-y_2}$ or $\frac{y_1-y_2}{x_2-x_2}$ instead of $\frac{y_1-y_2}{x_1-x_2}$.
- Thinking that the equation of a circle is of the form $(x - a)^2 + (y - b)^2 = r$ instead of $(x - a)^2 + (y - b)^2 = r^2$.
- Difficulty dealing with fractional and/or negative gradients when finding the equations of perpendicular lines.

Teaching it!

- A series of seven videos designed to support students on this topic.
- Tilted square: A task intended for use in the first coordinate geometry lesson. (Solution)
- Equation of a circle: Simple GeoGebra file. Ideas for accompanying questions included in SoW.
- Circle Patterns: A Desmos Classroom activity about similarities & differences between circles.
- Teddy Bear: A rich task from Underground Mathematics exploring equations of circles.
- Perpendicular lines (student task): Autograph, Casio, GeoGebra
- Equations of circles (student task): Casio, Desmos

Getting them thinking

- Tell me three ways, which are essentially different, of determining whether three points A, B and C lie on a straight line.
- Change one number in $(x - 3)^2 + (y - 6)^2 = 16$ so the resulting circle lies in exactly three quadrants. This GeoGebra file illustrates the problem and solution dynamically.
- Prove that the product of the gradients of perpendicular lines (which are not parallel to the axes) is -1.
- Prove that for any integers m, n where $m > n > 0$ the triple $(m^2 - n^2,\ 2mn,\ m^2 + n^2)$ is a Pythagorean triple.