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| **UNIT 6: Real-life and algebraic linear graphs, quadratic and cubic graphs, the equation of a circle, plus rates of change and area under graphs made from straight lines** |

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**SPECIFICATION REFERENCES**

N13 use standard units of mass, length, time, money and other measures (including standard compound measures) using decimal quantities where appropriate

A8 work with coordinates in all four quadrants

A9 plot graphs of equations that correspond to straight-line graphs in the coordinate plane; use the form *y* = *mx* + *c* to identify parallel **and perpendicular lines**; find the equation of the line through two given points, or through one point with a given gradient

A10 identify and interpret gradients and intercepts of linear functions graphically and algebraically

A11 identify and interpret roots, intercepts, turning points of quadratic functions graphically; …

A12 recognise, sketch and interpret graphs of linear functions, quadratic functions, simple cubic functions, the reciprocal function  with *x* ≠ 0, …

A14 plot and interpret … graphs of non-standard functions in real contexts to find approximate solutions to problems such as simple kinematic problems involving distance, speed and acceleration

A15 **calculate or estimate gradients of graphs and areas under graphs (including quadratic and non-linear graphs) and interpret results in cases such as distance–time graphs, velocity–time graphs … (this does not include calculus)**

A16  **recognise and use the equation of a circle with centre at the origin; find the equation of a tangent to a circle at a given point**

A17 solve linear equations in one unknown … (including those with the unknown on both sides of the equation); find approximate solutions using a graph

A18 solve quadratic equations (**including those that require rearrangement**) algebraically by factorising, **by completing the square and by using the quadratic formula**; find approximate solutions using a graph

R1 change freely between related standard units (e.g. time, length, area, volume/capacity, mass) and compound units (e.g. speed, rates of pay, prices, density, pressure) in numerical and algebraic contexts

R10 solve problems involving direct … proportion, including graphical … representations

R11 use compound units such as speed, … unit pricing, …

R14 … recognise and interpret graphs that illustrate direct and inverse proportion

**PRIOR KNOWLEDGE**

Students can identify coordinates of given points in the first quadrant or all four quadrants.

Students can use Pythagoras’ Theorem and calculate the area of compound shapes.

Students can use and draw conversion graphs for these units.

Students can use function machines and inverse operations.

**KEYWORDS**

Coordinate, axes, 3D, Pythagoras, graph, speed, distance, time, velocity, quadratic, solution, root, function, linear, circle, cubic, approximate, gradient, perpendicular, parallel, equation

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| **6c. Quadratic, cubic and other graphs** (A11, A12, A14, A16, A18) | **Teaching time**5-7 hours |

**OBJECTIVES**

By the end of the sub-unit, students should be able to:

* Recognise a linear, quadratic, cubic, reciprocal and circle graph from its shape;
* Generate points and plot graphs of simple quadratic functions, then more general quadratic functions;
* Find approximate solutions of a quadratic equation from the graph of the corresponding quadratic function;
* Interpret graphs of quadratic functions from real-life problems;
* Draw graphs of simple cubic functions using tables of values;
* Interpret graphs of simple cubic functions, including finding solutions to cubic equations;
* Draw graphs of the reciprocal function  with *x* ≠ 0 using tables of values;
* Draw circles, centre the origin, equation *x*2 + *y*2 = *r*2.

**POSSIBLE SUCCESS CRITERIA**

Select and use the correct mathematical techniques to draw linear, quadratic, cubic and reciprocal graphs.

Identify a variety of functions by the shape of the graph.

**OPPORTUNITIES FOR REASONING/PROBLEM SOLVING**

Match equations of quadratics and cubics with their graphs by recognising the shape or by sketching.

**COMMON MISCONCEPTIONS**

Students struggle with the concept of solutions and what they represent in concrete terms.

**NOTES**

Use lots of practical examples to help model the quadratic function, e.g. draw a graph to model the trajectory of a projectile and predict when/where it will land.

Ensure axes are labelled and pencils used for drawing.

Graphical calculations or appropriate ICT will allow students to see the impact of changing variables within a function.