UNIT 13 Graphs

NC: Algebra 2d

	St	Ac	Ex	Sp
TOPICS (Text and Practice Books)				
13.1 *Positive Coordinates*	✓	-	-	-
13.2 *Coordinates*	✓	✓	-	-
13.3 *Plotting Straight Lines*	✓	✓	-	-
13.4 *Plotting Curves*	✓	✓	-	-
13.5 *Gradient*	✓	✓	✓	✓
13.6 *Applications of Graphs*	✓	✓	✓	✓
13.7 *Scatter Plots and Lines of Best Fit*	✓	✓	✓	✓
13.8 *The Equation of a Straight Line*	✗	✓	✓	✓
13.9 *Horizontal and Vertical Lines*	✗	✓	✓	✓
13.10 *Solution of Simultaneous Equations by Graphs*	✗	✓	✓	✓
13.11 *Graphs of Common Functions*	✗	✓	✓	✓
13.12 *Graphical Solutions of Equations*	✗	✓	✓	✓
Activities				
13.1 *Correlation*	✓	✓	✓	✓
13.2 *Line of Best Fit*	✓	✓	✓	✓
13.3 *Dipstick Problem*	✗	✗	✓	✓
OH Slides				
13.1 *Coordinates*	✓	✓	-	-
13.2 *Gradients*	✓	✓	✓	✓
13.3 *Plotting Curves*	✓	✓	-	-
13.4 *Speed-Time Graph*	✓	✓	✓	✓
13.5 *Area Under Speed-Time Graph: Distance*	✓	✓	✓	✓
13.6 *Horizontal and Vertical Lines*	✗	✓	✓	✓
13.7 *Equations of Straight Lines*	✗	✓	✓	✓
13.8 *Graphical Solutions of Simultaneous Equations*	✗	✓	✓	✓
13.9 *Graphs of Common Functions*	✗	✓	✓	✓
Mental Tests				
13.1	✗	✓	✓	✓
13.2	✗	✓	✓	✓
Revision Tests				
13.1	✓	✓	-	-
13.2	✗	✓	✓	✓
13.3	✗	✓	✓	✓

UNIT 13 *Graphs* Teaching Notes

Background and Preparatory Work

The inspiration behind the development of graphs to represent functions is commonly credited to *René Descartes* (1596-1650) but the much earlier work of the Frenchman, *Nicole d'Oresme* (1323–1382) represented the real starting point. He was essentially a clergyman, being appointed canon and later dean of Rouen, and in 1370, appointed chaplain to King Charles V. His contribution to this area of maths was to find the logical equivalence between tabulating and graphing values. He proposed the use of a graph for plotting a variable magnitude when one value depends on another.

See, for example, the references to *Descartes* and *d'Oresme* on the internet at

http://www-groups.dcs.st-and.ac.uk

It is possible that the work of *Descartes* was influenced by *d'Oresme's* work, which was reprinted several times during the century following its first publication; but, despite this possible influence, the concept of the use of coordinate axes for representing functions is clearly a mathematical landmark.

Nowadays, we take coordinate axes very much for granted, and a function, and the graph to represent it, are almost regarded as being totally equivalent. Indeed, for the functions dealt with in this Unit, these is little difference, but it should be noted that not all functions can be adequately represented by a graph.

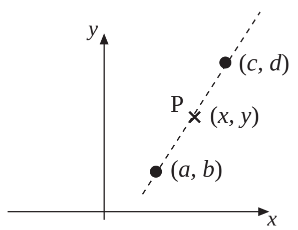
e.g. $f(x) = \begin{cases} 1 \text{ if } x \text{ is rational} \\ 0 \text{ if } x \text{ is irrational} \end{cases}$

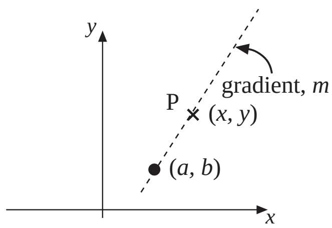
There should also be a clear distinction made between graphs of, for example, straight lines, circles, etc. which are precise, and the graphs of lines or curves which are used to represent data. The former are exact, and, for example, a straight line is consequently determined by either

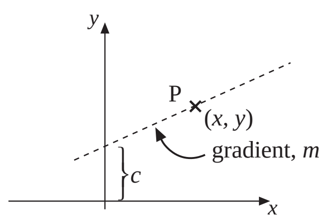
two points

or

one point and *a gradient*







This results in the equation

$$\frac{y-b}{x-a} = \frac{d-b}{c-a}$$

or

$$\frac{y-b}{x-a} = m$$

The form typically used in this Unit, which reflects the National Curriculum requirements, is

$$y = mx + c$$

– but please note that all these are equivalent.

This last of these equation is of most use when attempting to represent data points by a straight lime relationship (i.e. modelling), when it is easy to read off values for both m and c. So, in this case, you are turning experimental data into an algebraic relationship. This link between formal algebra and visual geometry lies behind the use of graphs in modelling.

One other point that is worth stressing is the use of a graphical approach to solving equations. Whilst this is of some benefit in finding *approximate* solutions to cubic equations, or other more complicated functions, there is little point in using a graphical approach to, for example, solve simultaneous linear equations – except that this is what most candidates will be expected to do in their exams!

Unit 13.10

Teaching Points

Introduction

This is a key topic, bringing together earlier work on functions and straying, deliberately, into the statistics areas of correlation and lines of best fit.

T 13.7
A 13.2 and 13.3

The abilities to be able to both visualise the shape of common graphs (particularly for the nonstandard routes) and to plot graphs, using a series of points, are key skills.

T 13.11 and T 13.4
OS 13.9 and 13.3

This Unit also deals with straightforward applications of graphs, e.g. currency conversion, temperature conversion and speed-time graphs, and introduces the concept of distance travelled being the area under a speed-time graph. This topic is dealt with further in Unit 17 for the *Express/Special* route.

OS 13.4
OS 13.5

Finally in the Unit, the graphical approaches to solving two equations is developed.

T 13.11 and OS 13.8

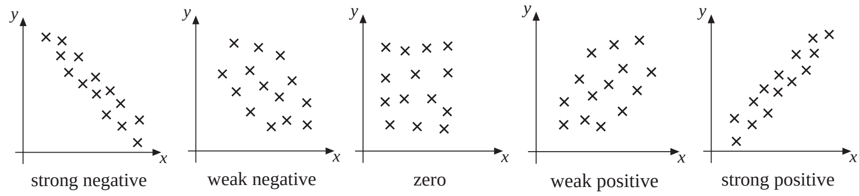
Language / Notation

- There are a number of important words introduced here as well as others that have been met before; for example
  - *coordinates*
  - *gradient*
  - *intercept (with y-axis)*
  - *scatter plot*
  - *line of best fit*
  - *linear, quadratic, cubic, reciprocal functions*

Key Points

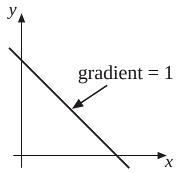
- A linear relationship between y and x means that there is a straight line relationship of the form $y = mx + c$.
- The accuracy of a graphical approach to solving equations depends on the accuracy to which the graphs are drawn
- The lines of best fit should pass through the mean value of the x and y values of the data points.

- Non-standard candidates should be familiar with graphs of linear, quadratic, cubic and reciprocal functions.
- The actual shape of a graph will depend on the scale used for each coordinate axis.
- Correlation is classified as



Misconceptions

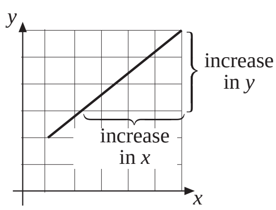
- That the point with coordinates (a, b) means $y = a, \quad x = b$.
- Gradients are always positive, e.g.



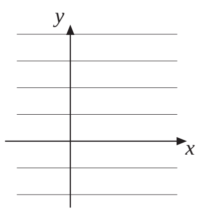
- That the x and y axes always have the same scale.

Key Concepts

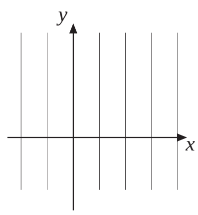
- The equation of a straight line is $y = mx + c$ where m is the gradient and c the y-intercept.
- The gradient of a straight line is the $\dfrac{\text{increase in } y}{\text{increase in } x}$ and can be positive or negative.



- Lines with zero gradient are of the form y = constant, and are parallel to the x-axis.



- Lines with infinite gradient are of the form x = constant, and are parallel to the y-axis.



- The area under a speed-time graph represents the distance travelled.