Coordinates Learning objectives

Learning objectives

This is the first of three units based on analytic geometry, which brings algebra and geometry together. The other two units are *Straight Lines* and *Using Graphs to Solve Equation*s. After completing this unit you should

- be able to identify and illustrate points in two dimensions with positive coordinates
- be able to identify and illustrate points in two dimensions
- be confident in plotting straight lines
- be confident in plotting curves
- be able to find the mid-point of a line segment.

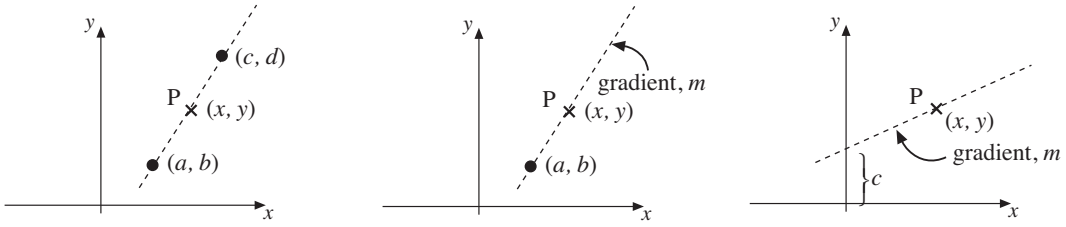
G1 *Coordinates* Introduction

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 *CXC* requirements, is

$$y=mx+c$$

– but please note that all these are equivalent.

The last of these equations is of most use when attempting to represent data points by a straight line 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!

Key points and principles

- Any point in 2 dimensions is uniquely defined by its coordinates (x, y)
- Any two distinct points are sufficient to define a straight line.
- Any point in 3 dimensions is uniquely defined by its coordinates (x, y, z).

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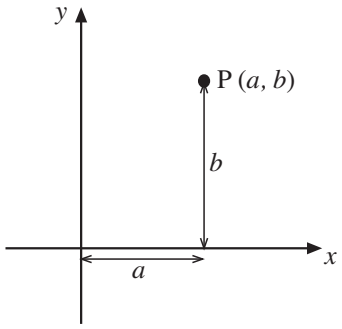
Facts to remember

- The point with coordinates (a, b) means that $x = a,\ y = b$.

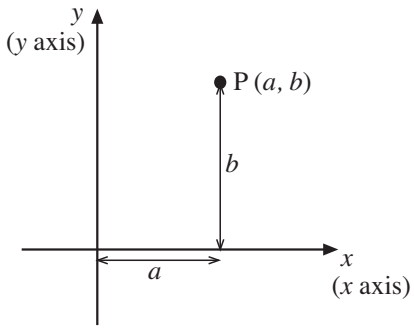


- The mid-point of the line segment joining the points (a, b) and (c, d) is given by $\left(\frac{a+c}{2}, \frac{b+d}{2}\right)$.

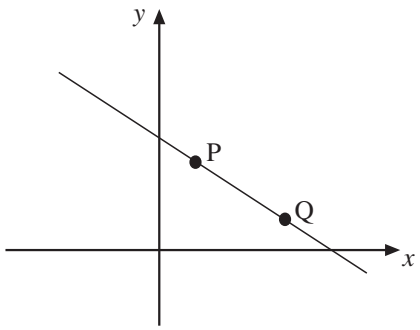
Glossary of terms

Coordinates (x, y) means that the point P with coordinates (a, b) is such that $x = a,\ y = b$.

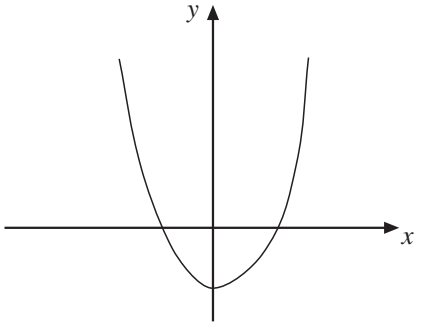
Coordinate axes these are shown on the diagram opposite.



Straight line is defined by any two points on the line P and Q in the diagram opposite.



Curves these are lines that are not straight (see diagram opposite).



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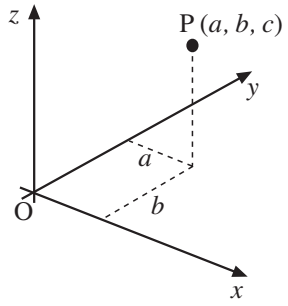
Three-dimensional coordinates mean that a point P (a, b, c) is such that

$$x = a,\ y = b,\ z = c$$

(see diagram opposite).



Line segment this is any part of a straight line between two points.

Mid-point of line segment This is the point X in the line segment PQ, such that

$$\text{length PX} = \text{length XQ}.$$

The coordinates of X are

$$\left(\frac{a+c}{2}, \frac{b+d}{2}\right)$$