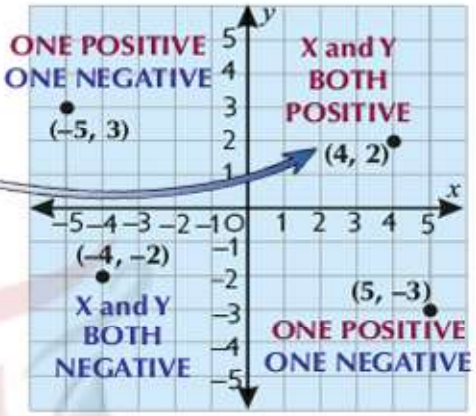
Coordinates

To start off with, here's some basic stuff about coordinates which will be really useful for the rest of this section.

The Four **Quadrants**

1) A graph has four different quadrants (regions). The top-right region is the easiest because here all the coordinates in it are positive.
2) You have to be careful in the other regions though, because the x- and y-coordinates could be negative, and that makes them much more difficult.
3) Coordinates are always written in brackets like this: (x, y) — remember x is across, and y is up.

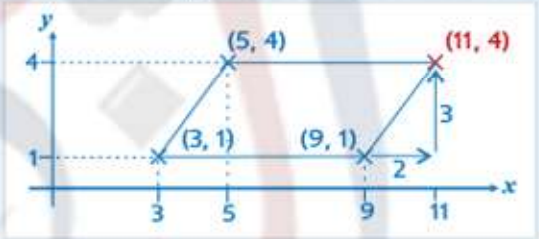


Finding Coordinates Using **Geometrical Information**

EXAMPLE: **A parallelogram has vertices (3, 1), (5, 4) and (9, 1). The x and y coordinates of its fourth vertex are both positive. What are their values?**

Do a quick sketch and it's very easy — just mark in the 4th vertex by eye.

Check: to get from (3, 1) to (5, 4) you go along 2 and up 3 — the missing point needs to be the same distance from (9, 1).



Finding the **Midpoint** of a Line Segment

Finding the coordinates of a midpoint is pretty easy...

A line segment is part of a line. Lines continue forever in both directions, but line segments have two end points. Things that are actually line segments are often referred to as lines though.

Find the average of the two x-coordinates, then do the same for the y-coordinates. These will be the coordinates of the midpoint.

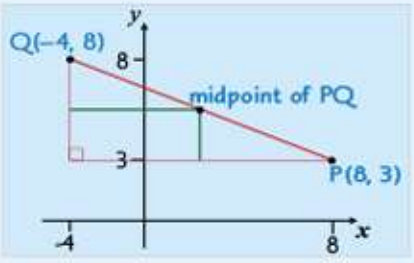
Extended

EXAMPLE: **Point P has coordinates (8, 3) and point Q has coordinates (–4, 8). Find the midpoint of the line PQ.**

See p.152 for finding the length of a line segment.

1) Average of x-coordinates $= \frac{8 + (-4)}{2} = 2$
2) Average of y-coordinates $= \frac{3 + 8}{2} = 5.5$

So, coordinates of midpoint = (2, 5.5)



Extended

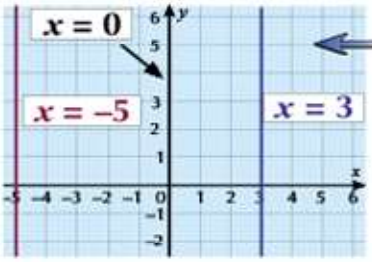
Midpoints — add the x's together and halve, then do the same for the y's

Don't forget the basics otherwise you'll lose marks needlessly — x comes before y in (x, y), and x goes aCROSS while y goes up and down. Finding a line's midpoint is as simple as finding the average of the x's and y's.

Straight-Line Graphs

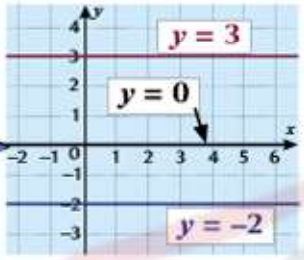
There are some straight lines you should be able to immediately recognise from their equation.

Horizontal and Vertical lines: 'x = a' and 'y = a'



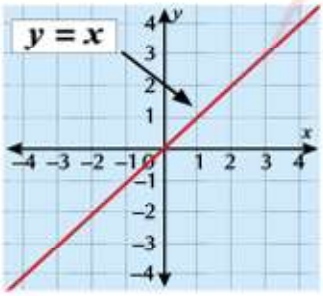
$x = a$ is a vertical line through a on the x-axis

$y = a$ is a horizontal line through a on the y-axis



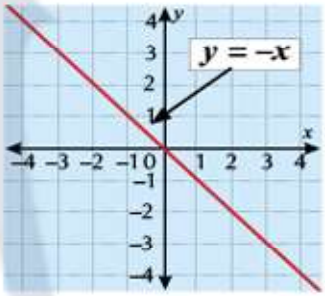
A common error is to mix up $x = 3$ and $y = 3$, etc. Remember — all the points on $x = 3$ have an x-coordinate of 3, and all the points on $y = 3$ have a y-coordinate of 3.

The Main Diagonals: 'y = x' and 'y = –x'



$y = x$ is the main diagonal that goes UPHILL from left to right.
The x- and y-coordinates of each point are the same.

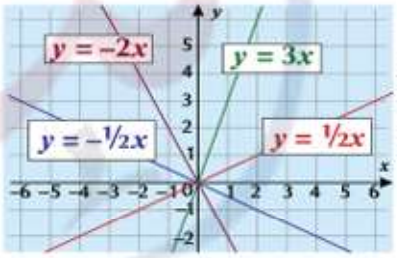
$y = -x$ is the main diagonal that goes DOWNHILL from left to right.
The x- and y-coordinates of each point are negatives of each other, e.g. (–4, 4).



Other Sloping Lines Through the Origin: 'y = ax' and 'y = –ax'

$y = ax$ and $y = -ax$ are the equations for A SLOPING LINE THROUGH THE ORIGIN

The value of a (known as the gradient) tells you the steepness of the line. The bigger a is, the steeper the slope. A MINUS SIGN tells you it slopes DOWNHILL.



See p.87 for how to find a gradient.

Learn to Recognise Straight Lines from Their Equations

All other straight-line equations just contain 'something x, something y and a number'.

EXAMPLE: **Decide whether each of the following are equations of straight lines.**

$2y - 4x = 7$ $\quad y = x^2 + 3$ $\quad xy + 3 = 0$ $\quad 6y - 8 = x$ $\quad \frac{2}{y} - \frac{1}{x} = 7$

Straight lines: $2y - 4x = 7$, $6y - 8 = x$

These equations only have something x, something y and a number. These 'terms' can be added or subtracted in any order.

Not straight lines: $y = x^2 + 3$, $xy + 3 = 0$, $\frac{2}{y} - \frac{1}{x} = 7$

x^2, xy, $\frac{2}{y}$ and $\frac{1}{x}$ mean that these aren't straight-line equations.

REVISION TIP

Simple lines you have to learn

Vertical line: $x = a$, horizontal line: $y = a$, main diagonals: $y = x$ and $y = -x$. Other types of straight line are a bit harder, but drawing a sketch will help if you're stuck — see the next page for more.

Plotting Straight-Line Graphs

You could be asked to draw a straight-line graph in the exam. We'll cover two methods on this page.

The 'Table of 3 Values' Method

You can easily draw the graph of any equation using this easy method:

Don't forget to use a ruler to draw your line — you can lose exam marks if you don't.

1) Choose 3 values of x and draw up a table.
2) Work out the corresponding y-values.
3) Plot the coordinates and draw the line.

If it's a straight-line equation, the 3 points will be in a straight line with each other. If they aren't, you need to go back and CHECK YOUR WORKING.

EXAMPLE: **Draw the graph of $y = 2x - 3$ for values of x from –1 to 4.**

1) Draw up a table with some suitable values of x.

x	0	2	4
y			

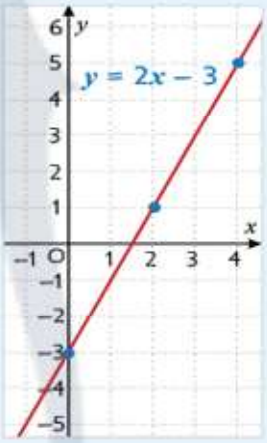
2) Find the y-values by putting each x-value into the equation:

When $x = 4$, $y = 2x - 3$
$= 2 \times 4 - 3 = 5$

x	0	2	4
y	–3	1	5

3) Plot the points and draw the line.

The table gives the points (0, –3), (2, 1) and (4, 5)



The 'x = 0, y = 0' Method

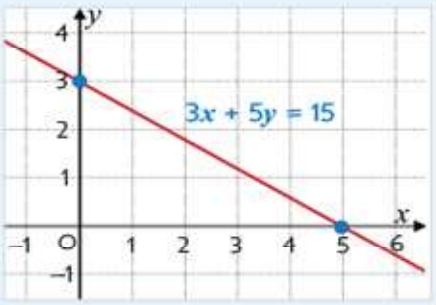
1) Set $x = 0$ in the equation, and find y — this is where it crosses the y-axis.
2) Set $y = 0$ in the equation and find x — this is where it crosses the x-axis.
3) Plot these two points and join them up with a straight line.

Make sure it's definitely a straight line before using this method — have a look at the previous page to see how you can check.

EXAMPLE: **Draw the graph of $3x + 5y = 15$ between $x = -1$ and $x = 6$.**

Putting $x = 0$ gives "$5y = 15$" $\Rightarrow$ $y = 3$
Putting $y = 0$ gives "$3x = 15$" $\Rightarrow$ $x = 5$

So plot (0, 3) and (5, 0) on the graph and join them up with a straight line.



Drawing straight-line graphs isn't as scary with these simple methods

This page gives you two simple methods for drawing straight-line graphs. Usually, you'll be able to use whichever you find easier — but learn them both, just in case you're told to use a specific one in the exam.