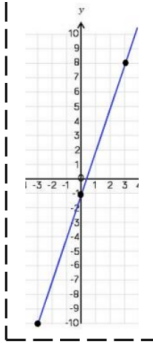
Plotting straight line graphs (R)

$y = 3x - 1$ → 3 x the x coordinate then – 1

x	-3	0	3
y	-10	-1	8

Draw a table to display this information

This represents a coordinate pair (-3, -10)

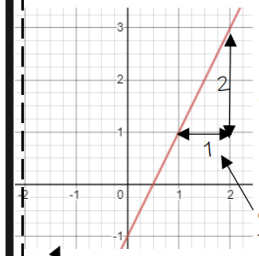


You only need two points to form a straight line

Plotting more points helps you decide if your calculations are correct (if they do make a straight line)

Remember to join the points to make a line

Calculating the gradient

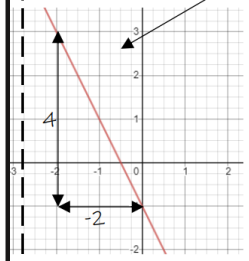


Draw a right angled triangle between 2 points.

The gradient equals: change in y / change in x

e.g. 2 ÷ 1 = 2
The gradient is 2

This graph slopes up from left to right so the gradient is positive. If it sloped up from right to left the gradient would be negative.



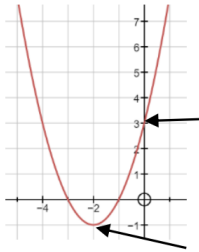
e.g. 4 ÷ -2 = -2
The gradient is -2

Quadratic Graphs

$y = x^2 + 4x + 3$

If x^2 is the highest power in your equation then you have a quadratic graph

It will have a parabola shape



Intersection with the y axis

Quadratic graphs are always symmetrical with the turning point in the middle

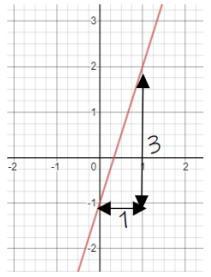
Substitute the x values into the equation of your line to find the y coordinates

x	-4	-3	-2	-1	0	1
y	3	0	-1	0	3	8

Coordinate pairs for plotting $(-3, 0)$

Plot all of the coordinate pairs and join the points with a curve (freehand)

Finding the equation of a graph



The general form of the equation of a straight line graph is y = mx + c where m is the gradient and c is the y-intercept.

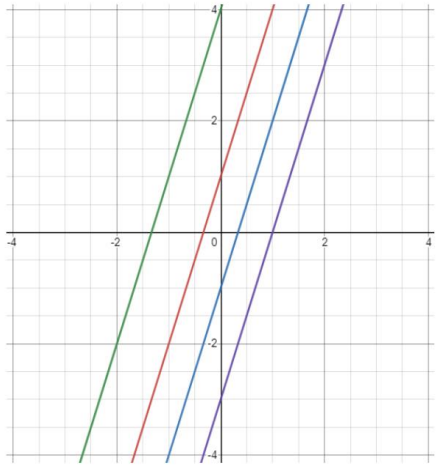
Gradient is 3 ÷ 1 = 3 so m = 3

It crosses at (0, -1) so c = -1

So the equation is y = 3x - 1

Parallel lines

2 or more linear graphs which are parallel will have the same gradient.



These 4 graphs all have a gradient of 3 and are the graphs

y = 3x + 4

y = 3x + 1

y = 3x – 1

y = 3x – 3

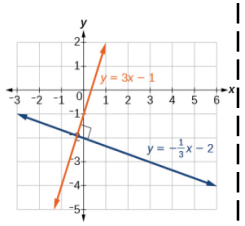
Any other graph with a gradient of 3 will also be parallel to these

Perpendicular lines

If two graphs are perpendicular then they meet at right angles to each other (90°).

Their gradients have the relationship: gradient of line 1 x gradient of line 2 = - 1

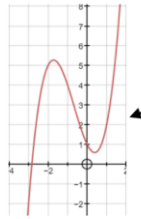
e.g. y = 3x - 1 and y = $-\frac{1}{3}x$ - 2 are perpendicular to each other because $3 \times -\frac{1}{3} = -1$



Interpret other graphs

Cubic Graphs

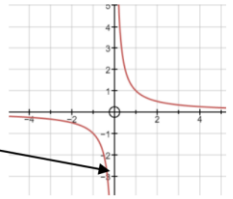
$y = x^3 + 2x^2 - 2x + 1$



If x^3 is the highest power in your equation then you have a cubic graph

Reciprocal Graphs

$y = \frac{1}{x}$

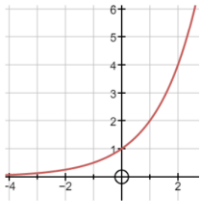


Reciprocal graphs never touch the y axis
This is because x cannot be 0
This is an asymptote

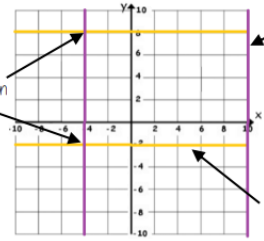
Exponential Graphs

$y = 2^x$

Exponential graphs have a power of x



Lines parallel to the axes (R)



All the points on this line have a x coordinate of 10

Intersection points

All the points on this line have a y coordinate of -2

'a' can be ANY postive or negative value including 0

Lines parallel to the **y axis** take the form **x = a** and are **vertical**

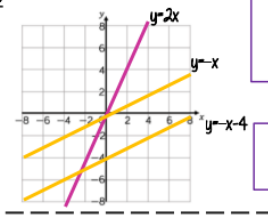
Lines parallel to the **x axis** take the form **y = a** and are **horizontal**

e.g (3, -2) (7, -2) (-2, -2) all lay on this line because the y coordinate is -2

Compare Gradients

$y = mx + c$

The **coefficient** of x (the number in front of x) tells us the gradient of the line



The **greater** the gradient – the **steeper** the line

Parallel lines have the **same** gradient

Positive gradients

Negative gradients

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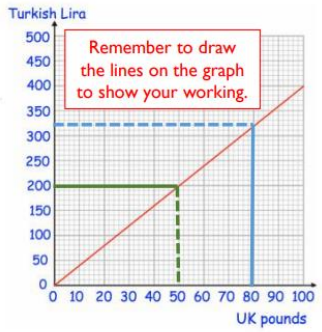
Conversion graphs



Change £80 into Turkish lira

1) Start at 80 on the horizontal axes as this for pounds and go up vertically until you reach the line
2) From the line, read horizontally until you get to the axis showing lira

Change 600 Turkish lira to pounds

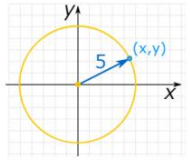
As this value is not shown by the graph, we have to use a value that is to help.

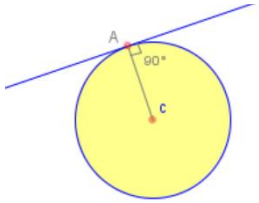
1) Start at 200 on the vertical axes and go across horizontally until you reach the line. From the line, read vertically until you get to the axes.
2) 200 lira = £50
   600 lira = £150

The equation of a circle

The equation of a circle with centre (0,0) and radius r: $x^2 + y^2 = r^2$

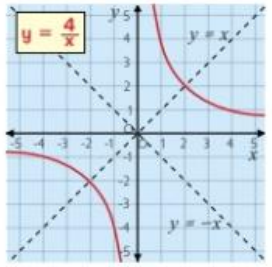
A tangent touches the circle at one point and the radius is perpendicular to this point.





$x^2 + y^2 = 25$

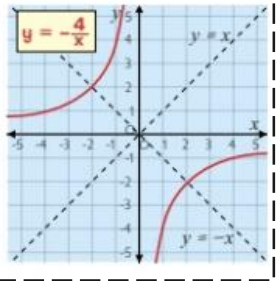
1/x (Reciprocal) Graphs: y = A/x or xy = A



These are all the same basic shape, except the negative ones are in opposite quadrants to the positive ones (as shown). The two halves of the graph don't touch. The graphs don't exist for x = 0.

They're all symmetrical about the lines y = x and y = −x.

(You get this type of graph with inverse proportion — see p.63)



Sketching Quadratics

If you're asked to sketch a graph, you won't have to use graph paper or be dead accurate — just find and label the important points and make sure the graph is roughly in the correct position on the axes.

EXAMPLE: Sketch the graph of $y = -x^2 - 2x + 8$, labelling the turning point and x-intercepts with their coordinates.

1. Find all the information you're asked for.

Solve $-x^2 - 2x + 8 = 0$ to find the x-intercepts (see p.34).

$-x^2 - 2x + 8 = -(x + 4)(x - 2) = 0$ so $x = -4$, $x = 2$

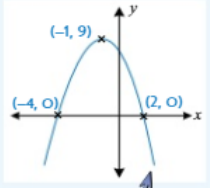
Use symmetry to find the turning point of the curve.

The x-coordinate of the turning point is halfway between -4 and 2.

$x = \frac{-4 + 2}{2} = -1$

$y = -(-1)^2 - 2(-1) + 8 = 9$

So the turning point is (–1, 9).



2. Use the information you know to sketch the curve and label the important points.

The x^2 is negative, so the curve is n-shaped.

Graphs Can Show Billing Structures

Many bills are made up of two charges — a fixed charge and a cost per unit. E.g. You might pay £11 each month for your phone line, and then be charged 3p for each minute of calls you make.

EXAMPLE: This graph shows how a broadband bill is calculated.

a) How many gigabytes (GB) of Internet usage are included in the basic monthly cost?

18 GB

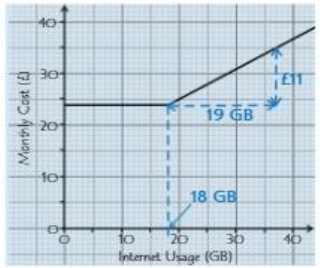
The first section of the graph is horizontal. You're charged £24 even if you don't use the Internet during the month. It's only after you've used 18 GB that the bill starts rising.

b) What is the cost for each additional gigabyte (to the nearest 1p)?

Gradient of sloped section = cost per GB

$\frac{\text{vertical change}}{\text{horizontal change}} = \frac{11}{19} = £0.5789...$ per GB

To the nearest 1p this is £0.58



No matter what the graph, the gradient is always the y-axis unit PER the x-axis unit (see p.57).

Equation of a Line Through Two Points

1. Use both points to find gradient.
2. Substitute one point into $y = mx + c$.
3. Rearrange to find 'c'.
4. Write equation as $y = mx + c$.

EXAMPLE

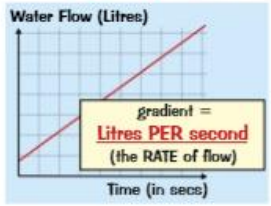
Find the equation of the straight line that passes through (–2, 12) and (4, –6).

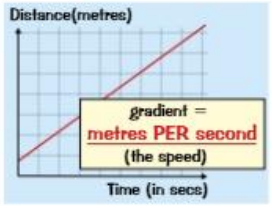
1. $m = \frac{-6 - 12}{4 - (-2)} = \frac{-18}{6} = -3$
2. Sub in (4, –6): $-6 = -3(4) + c \Rightarrow -6 = -12 + c$
3. $c = -6 + 12 = 6$
4. $y = -3x + 6$

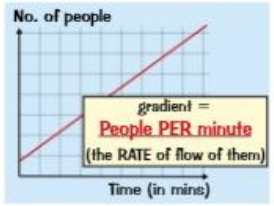
The Gradient of a Graph Represents the Rate

No matter what the graph may be, the meaning of the gradient is always simply:

(y-axis UNITS) PER (x-axis UNITS)







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