Y10 Maths Knowledge Organiser Higher Tier: Advanced Graphs

What must I be able to do?	Key vocabulary	
New content:	**Acceleration**	Rate of increase or decrease of velocity.
☐ Read and use velocity/time graphs ➢ Mathswatch 216a (GCSE)	**Tangent**	A straight line which touches a curve at one point only.
☐ Estimate the area under a curve and interpret the meaning ➢ Mathswatch 216a (GCSE)	**Cubic graph**	A graph where the highest power is x^3.
☐ Find the gradient of a point on a curve ➢ Mathswatch 216b (GCSE)	**Exponential graph**	A graph of the form $y = a^x$ where a is a constant.
☐ Find the equation of a tangent to a circle ➢ Mathswatch 197 (GCSE)	**Reciprocal graph**	A graph of the form $y = \frac{1}{x}$
☐ Recognise and plot cubic, exponential and reciprocal graphs ➢ Mathswatch 161 and 194 (GCSE)	**Function**	A relationship between two sets of values. It turns an input into an output.
☐ Transform a graph ➢ Mathswatch 196a and 196b (GCSE)	**Invariant**	A property which does not change.

Velocity/time graphs

A velocity/time graph has many of the same features as a speed/time graph.

Time is on the horizontal axis, velocity on the vertical axis.

The **gradient of the line** represents the **acceleration or deceleration** of the object (how quickly it is speeding up or slowing down). A positive gradient is an increase in velocity and a negative gradient is a decrease in velocity. A straight line means they have constant acceleration/deceleration.

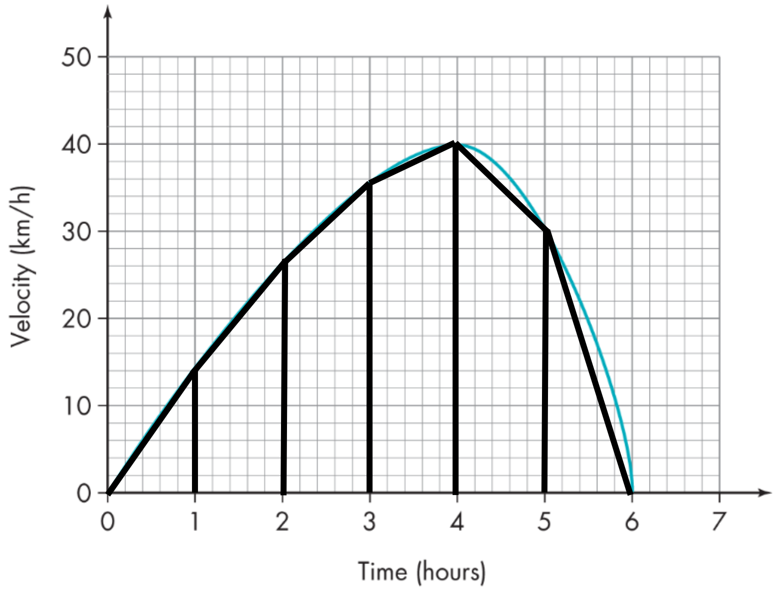
A horizontal line will have a gradient of 0 and shows the object is travelling at a constant velocity.

The **area under** a velocity/time graph represents the **distance** travelled.

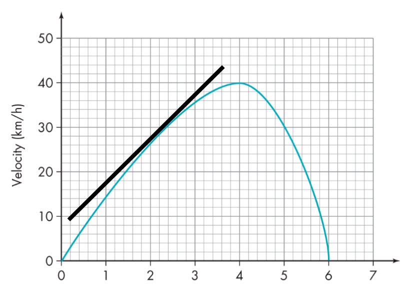
The **area under a curved graph** can be estimated by splitting the shape into **equal width** sections e.g. trapeziums and triangles.

If the trapeziums are generally below the curve it will be an underestimate, if they are above the curve it will be an overestimate.

Remember: area of a trapezium = $\frac{1}{2}(a+b)h$



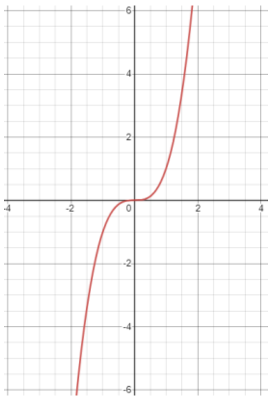
To estimate the **gradient of a curved line** at a particular point in time you must **draw a tangent** at that point and then calculate the gradient of the tangent.



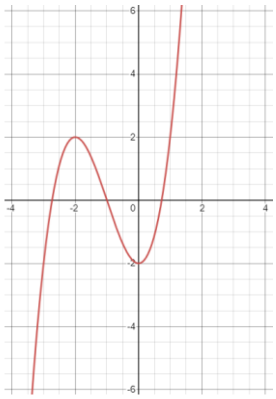
Equations of other types of graphs

Cubic graphs:

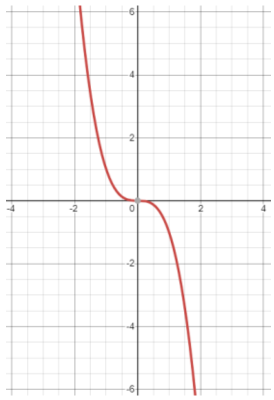
$y = x^3$



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



$y = -x^3$

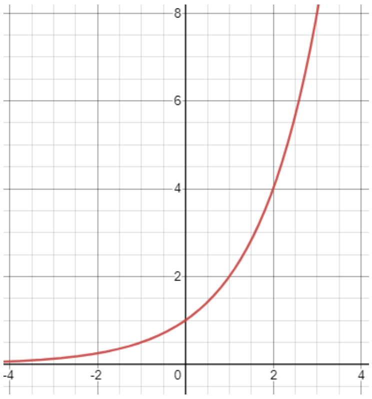


Has a maximum of two turning points.

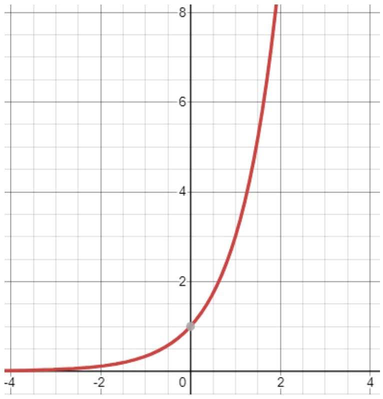
y-axis goes from negative to positive.

Exponential graphs

$y = 2^x$



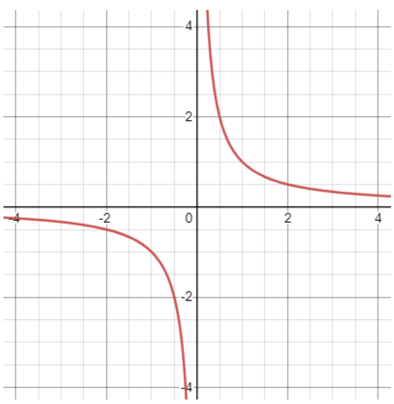
$y = 3^x$



All basic exponential curves will pass through the coordinate (0,1).

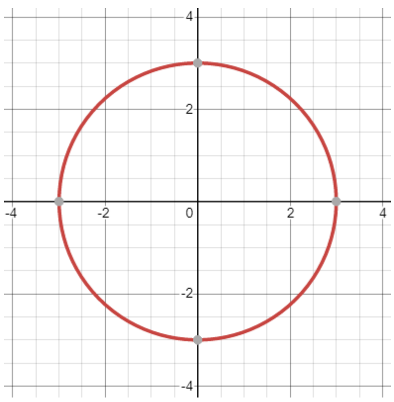
Reciprocal graphs

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



Equation of a circle

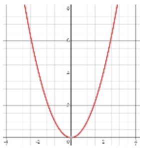
$x^2 + y^2 = 9$

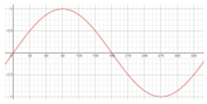


The basic equation of a circle which is centered on the origin (0,0) is $x^2 + y^2 = r^2$ where r is the radius of the circle.

Transformations of graphs

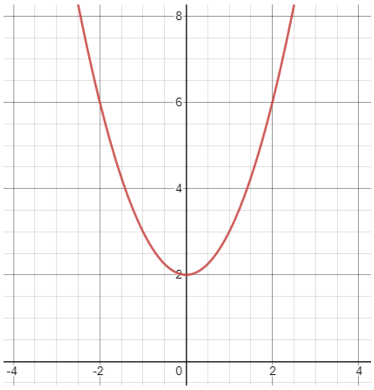
All of the following graphs show example transformations of the graph $y = x^2$ or $y = \sin x$





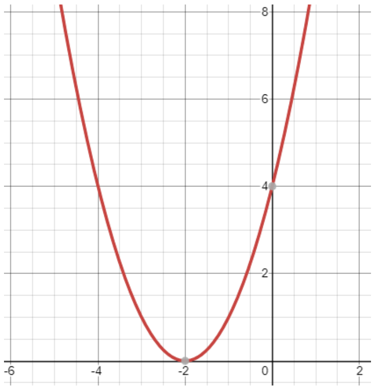
Translations

$f(x) + a$ represents a translation by the vector $\begin{pmatrix} 0 \\ a \end{pmatrix}$



$y = x^2 + 2$

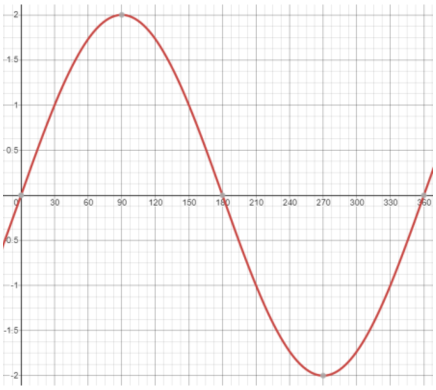
$f(x + a)$ represents a translation by the vector $\begin{pmatrix} -a \\ 0 \end{pmatrix}$



$y = (x + 2)^2$

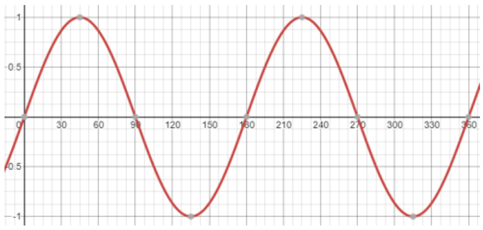
Stretches

$af(x)$ represents a stretch parallel to the y-axis with a scale factor of a



$y = 2\sin x$

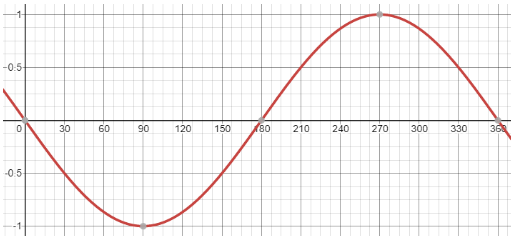
$f(ax)$ represents a stretch parallel to the x-axis with a scale factor of $\frac{1}{a}$



$y = \sin 2x$

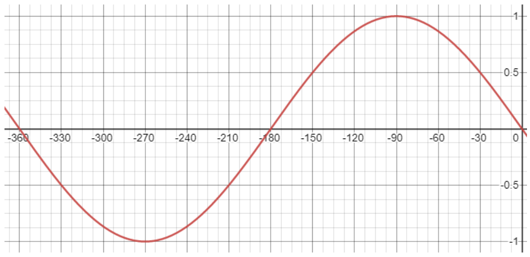
Reflections

$-f(x)$ represents a reflection in the x-axis



$y = -\sin x$

$f(-x)$ represents a reflection in the y-axis



$y = \sin(-x)$

GLUE

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