## **Graphs of Functions**

Related Functions

When two functions are related, their graphs will be similar. The graphs might be:
- Translated (moved – either upwards, downwards, left or right, or a combination of these).
- Reflected (either horizontally, vertically or both).
- Scaled (stretched or squashed by a scale factor – either vertically, horizontal or both).

Rule one: $f(x)+a$

When you add or take away a number from an entire function, the graph is translated up (or down if a is negative) by a units. **The y-coordinates of every point on the graph increase by a.**
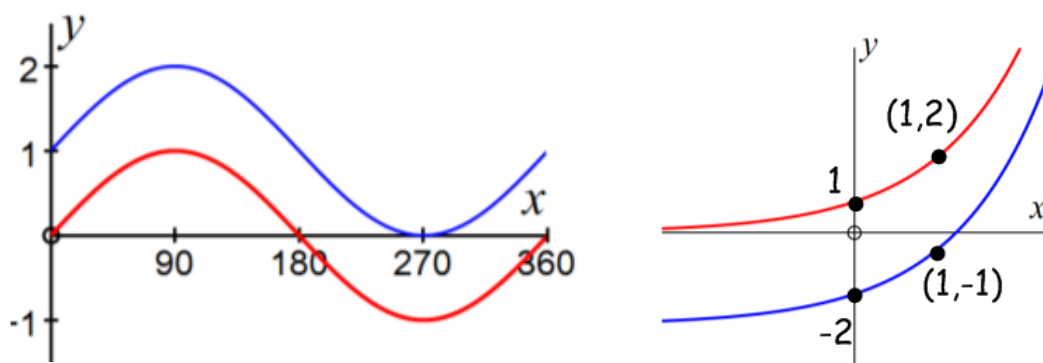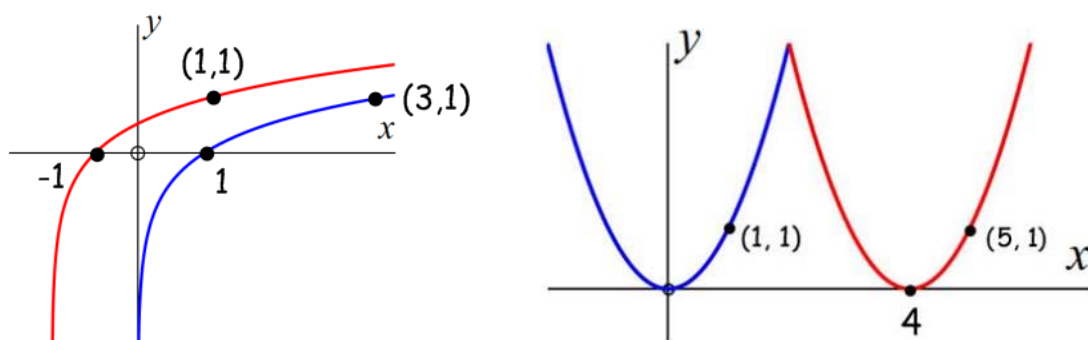

The diagram on the *left* shows the graph of $y=\sin x$, and the graph of $y=\sin x+1$, which has been **translated up** 1 unit. The *y*-coordinates of every point on the graph have increased by 1.

The diagram on the *right* shows the graph of $y=2^x$, and of $y=2^x-3$, which has been **translated down** 3 units. The *y*-coordinates of every point on the graph have decreased by 3.

Rule two: $f(x+a)$

When you add or take away a number from x (inside a bracket), the graph moves left (or right if a is negative) by a units. **The x coordinates of every point on the graph <u>decrease</u> by a.**
If a is added, the graph 'moves' to the <u>left</u>. If a is subtracted, the graph 'moves' to the <u>right</u>.

The diagram on the *left* shows the graph of $y=\log_3 x$, and the graph of $y=\log_3(x+2)$, which has been **translated left** 2 units. The *x*-coordinates of every point on the graph have decreased by 2.

The diagram on the *right* shows the graph of $y=x^2$, and that of $y=(x-4)^2$, which has been **translated right** 4 units. The *x*-coordinates of every point on the graph have increased by 4.