

Graphs of Functions

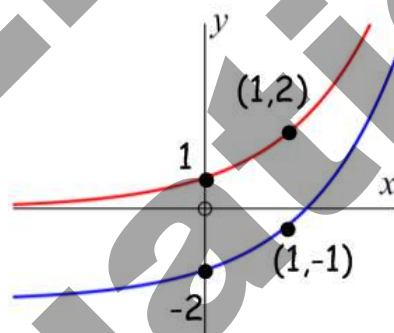
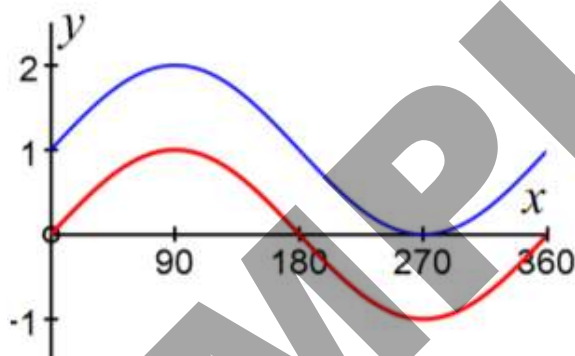
Related Functions

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 .**

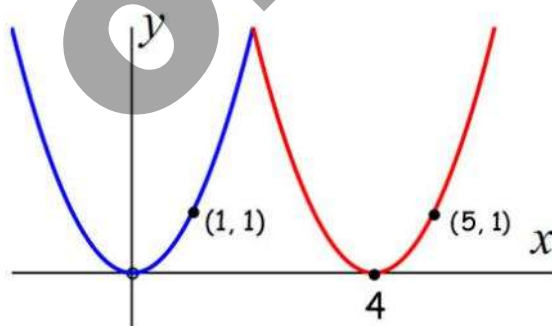
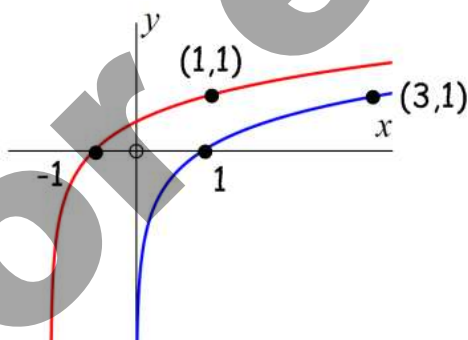


The diagram on the *left* shows the graph of $y = \sin x$, and the graph of $y = \sin x + 1$, which has been **translated up** 1 unit. The y -coordinates of every point on the graph have increased by 1.

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 decrease by a .** If a is added, the graph 'moves' to the left. If a is subtracted, the graph 'moves' to the right.



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.