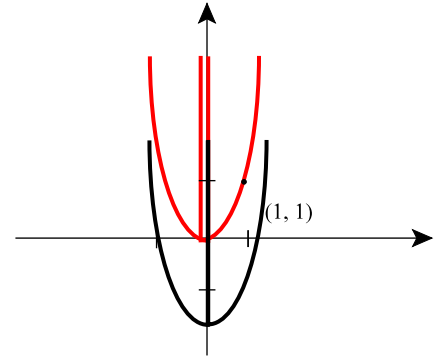


Calculus I, Graph Transformations
Abedi

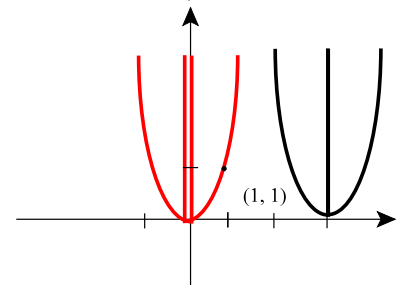
1. Vertical Translation:

$$y = f(x) + k \begin{cases} k > 0 & \text{Shift the graph of } y = f(x) \text{ up } k \text{ units} \\ k < 0 & \text{Shift the graph of } y = f(x) \text{ down } k \text{ units} \end{cases}$$



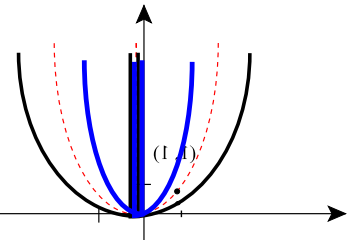
2. Horizontal Translation:

$$y = f(x - k) \begin{cases} k > 0 & \text{Shift the graph of } y = f(x) \text{ right } k \text{ units} \\ k < 0 & \text{Shift the graph of } y = f(x) \text{ left } k \text{ units} \end{cases}$$



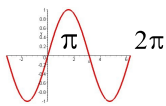
3. Vertical Expansion:

$$y = af(x) \begin{cases} a > 1 & \text{Vertically expand(stretch) the graph of } y = f(x) \text{ by multiplying each } y \text{ value by } a \\ 0 < a < 1 & \text{Vertically contract(compress) the graph of } y = f(x) \text{ by multiplying each } y \text{ value by } a \end{cases}$$

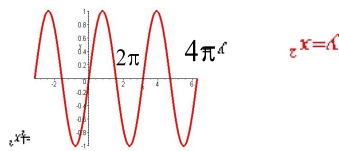


4. Horizontal Expansion:

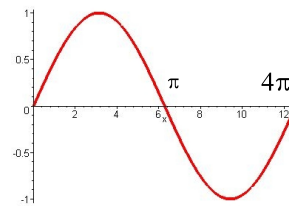
$$y = f(bx) \begin{cases} b > 1 & \text{Horizontally contract(compress) the graph of } y = f(x) \text{ by multiplying each } x \text{ value by } \frac{1}{b} \\ 0 < b < 1 & \text{Horizontally expand(stretch) the graph of } y = f(x) \text{ by multiplying each } x \text{ value by } \frac{1}{b} \end{cases}$$



$$y = \sin x$$



$$y = \sin 2x^{x=\pi/4}$$



$$y = \sin\left(\frac{1}{2}x\right)$$

5. Reflection:

$$y = -f(x)$$

Reflect the graph of $y = f(x)$ across the x -axis

$$* y = f(-x)$$

Reflect the graph of $y = f(x)$ across the y -axis

