Function (Graph) Transformation Summary

Original Function $y = f(x)$ Let c be a positive real number.

1) $y = f(x) + c$

Graph is shifted up c units. Add c to the y-coordinate.

2) $y = f(x) - c$

Graph is shifted down c units. Subtract c from the y-coordinate.

3) $y = f(x - c)$

Graph is shifted *right* c units. Add c to the x-coordinate.

4) $y = f(x + c)$

Graph is shifted *left* c units. Subtract c from the x-coordinate.

5) $y = -f(x)$

Graph is reflected vertically over the x-axis.

Multiply the y-coordinate by -1.

6) $y = f(-x)$

Graph is reflected horizontally about the y-axis.

Multiply the x-coordinate by -1.

7) $y = c\ f(x)$

Graph is stretched vertically by a factor c.

Multiply the y-coordinate by c.

8) $y = \frac{1}{c} f(x)$

Graph is compressed vertically by a factor c.

Divide the y-coordinate by c (multiply by $\frac{1}{c}$).

9) $y = f(cx)$

Graph is *compressed* horizontally by a factor c.

Divide the x-coordinate by c (multiply by $\frac{1}{c}$).

10) $y = f\left(\frac{1}{c}x\right)$

Graph is *stretched* horizontally by a factor c.

Multiply the x-coosdinate by c (divide by $\frac{1}{c}$).