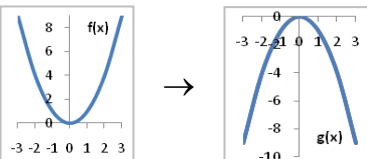
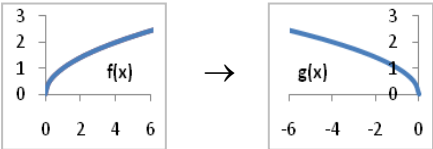
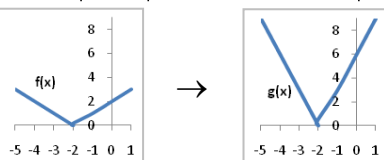
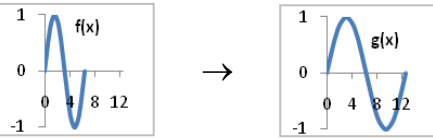
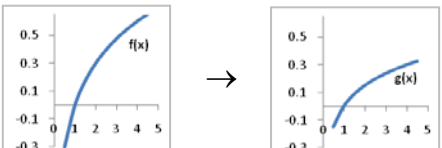
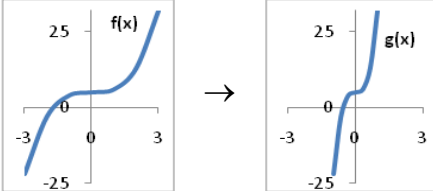
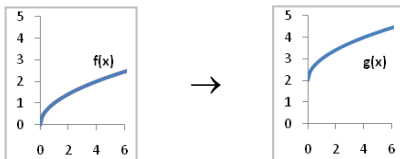
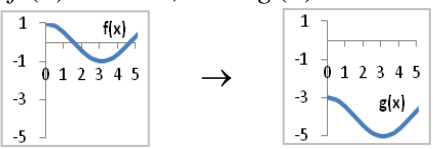
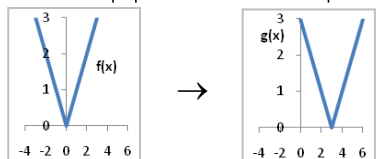
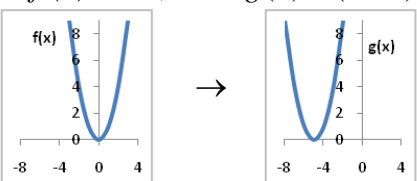


Transformations of Functions

Transformations must be performed in the following order: Reflections, Stretches, Translations (RST)

	Vertical (Intuitive/The Way You Would Think)	Horizontal (Backwards/Counter-intuitive)
Reflections	$g(x) = -f(x)$ <p>If $f(x) = x^2$, then $g(x) = -x^2$</p>  <p style="text-align: center;">Vertically reflected over the x - axis</p>	$g(x) = f(-x)$ <p>If $f(x) = \sqrt{x}$, then $g(x) = \sqrt{-x}$</p>  <p style="text-align: center;">Horizontally reflected over the y - axis</p>
Stretches	$g(x) = 3f(x)$ <p>If $f(x) = x+2$, then $g(x) = 3 x+2$</p>  <p style="text-align: center;">$g(x)$ is "3 times as tall as" $f(x)$</p>	$g(x) = f(.5x)$ <p>If $f(x) = \sin(x)$, then $g(x) = \sin(.5x)$</p>  <p style="text-align: center;">$g(x)$ is NOT half, but "2 times as wide as" $f(x)$</p>
Compressions	$g(x) = .5f(x)$ <p>If $f(x) = \log x$, then $g(x) = .5 \log x$</p>  <p style="text-align: center;">$g(x)$ is "half as tall as" $f(x)$</p>	$g(x) = f(3x)$ <p>If $f(x) = x^3 + 5$, then $g(x) = (3x)^3 + 5$</p>  <p style="text-align: center;">$g(x)$ is NOT 3 times, but "one-third as wide as" $f(x)$</p>
Translations (Shifts)	$g(x) = f(x) + 2$ <p>If $f(x) = \sqrt{x}$, then $g(x) = \sqrt{x} + 2$</p>  <p style="text-align: center;">$g(x)$ is $f(x)$ shifted 2 units up</p> $g(x) = f(x) - 4$ <p>If $f(x) = \cos x$, then $g(x) = \cos x - 4$</p>  <p style="text-align: center;">$g(x)$ is $f(x)$ shifted 4 units down</p>	$g(x) = f(x-3)$ <p>If $f(x) = x$, then $g(x) = x-3$</p>  <p style="text-align: center;">$g(x)$ is $f(x)$ shifted 3 units right</p> $g(x) = f(x+5)$ <p>If $f(x) = x^2$, then $g(x) = (x+5)^2$</p>  <p style="text-align: center;">$g(x)$ is $f(x)$ shifted 5 units left</p>

Transformation Examples

$$y = e^{-x}$$

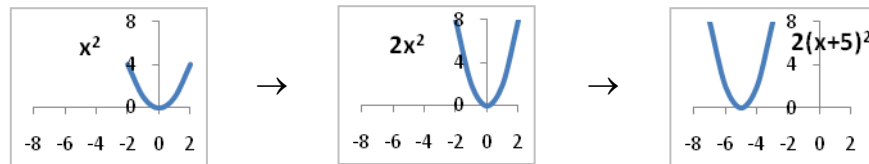
The $-$ indicates that the graph was Horizontally Reflected over the y-axis.



$$g(x) = 2(x+5)^2$$

The 2 indicates that the graph was Vertically Stretched by a **factor of 2** (twice as tall).

The $+5$ indicates that the graph was Horizontally Shifted by **5 units to the left**.



$$h(x) = -\sqrt{4x+3}$$

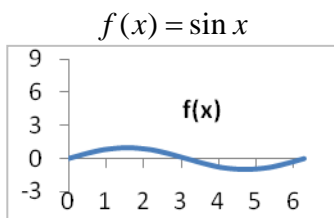
The $-$ indicates that the graph was Vertically Reflected over the x-axis.

The 4 indicates that the graph was Horizontally Compressed by a **factor of .25** (1/4 as wide).

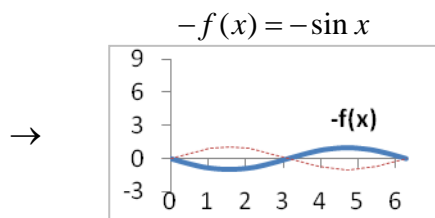
The $+3$ indicates that the graph was Vertically Shifted by **3 units up**.



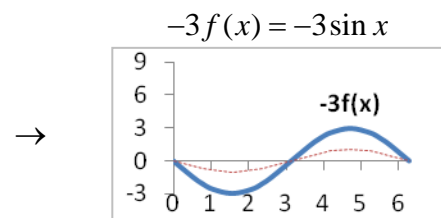
$$g(x) = -3\sin\left(2\left(x - \frac{\pi}{2}\right)\right) + 6$$



The basic function

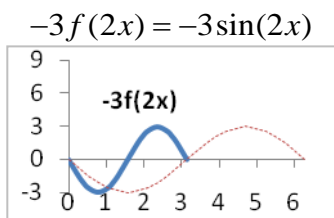


Vertically reflected over x-axis



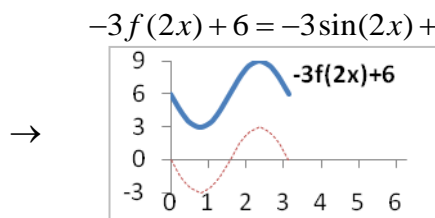
Vertically stretched by a factor of 3

This is called the AMPLITUDE



Horizontally compressed

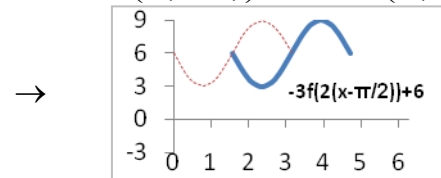
by a factor of $\frac{1}{2}$



Vertically shifted 6 units up

This is called the MIDLINE

$$g(x) = -3f\left(2\left(x - \frac{\pi}{2}\right)\right) + 6 = -3\sin\left(2\left(x - \frac{\pi}{2}\right)\right) + 6$$



Horizontally shifted $\frac{\pi}{2}$ units right

This is called the PHASE SHIFT

The PERIOD has been reduced to π