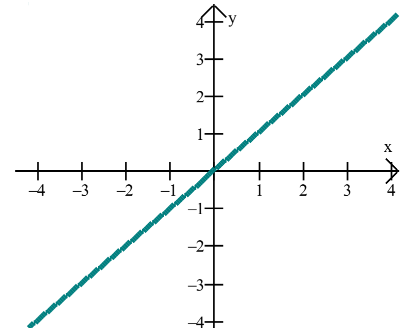
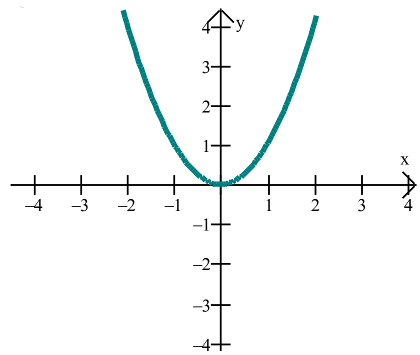
1.3: Twelve Basic Functions

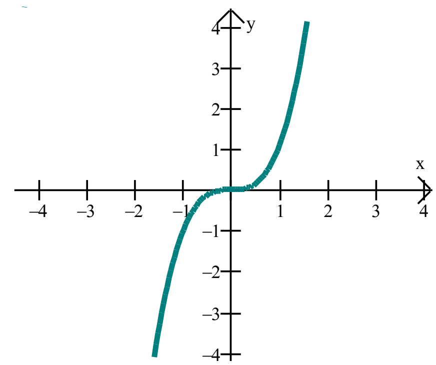
$f(x) = x$



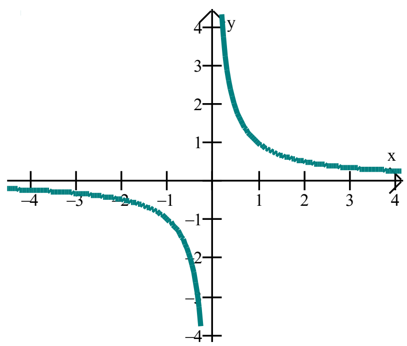
$f(x) = x^2$



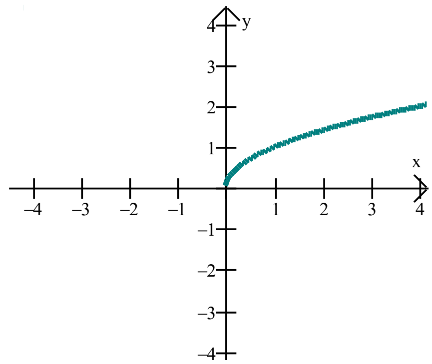
$f(x) = x^3$



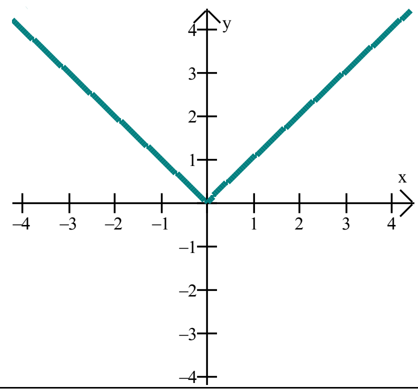
$f(x) = \dfrac{1}{x}$



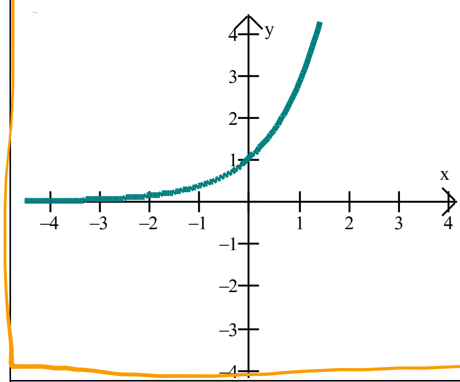
$f(x) = \sqrt{x}$



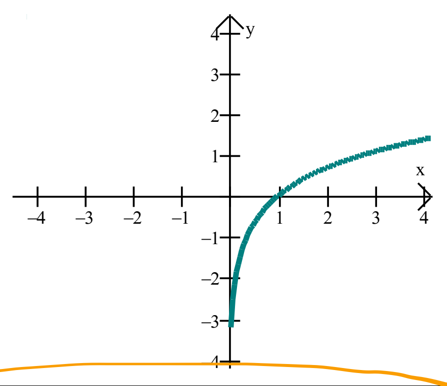
$f(x) = |x|$



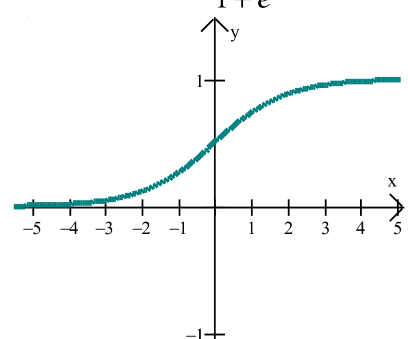
$f(x) = e^x$



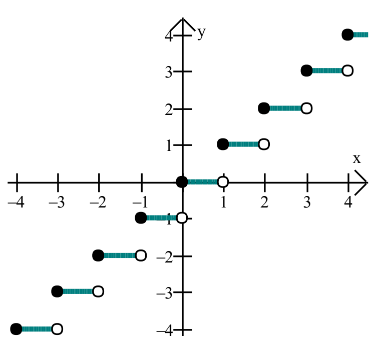
$f(x) = \ln x$



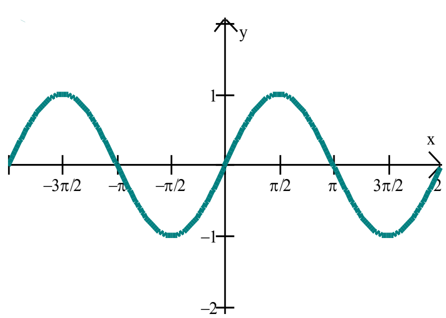
$f(x) = \dfrac{1}{1+e^{-x}}$



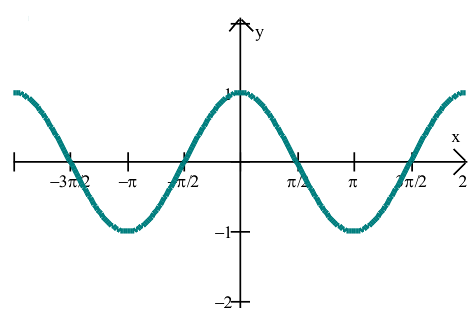
$f(x) = \text{int}(x)$



$f(x) = \sin x$



$f(x) = \cos x$



1.6: Graphical Transformations

Translations

Horizontal Translation (shift):

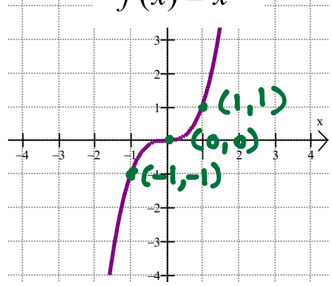
$f(x-h)$
opposite

Vertical Translation (shift):

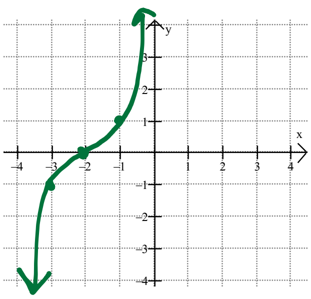
$f(x)+k$

Example 1: Use the graph of $f(x)$ below to graph each new graph.

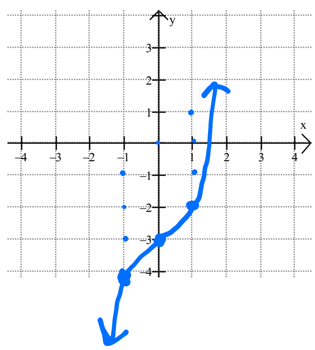
$f(x)=x^3$



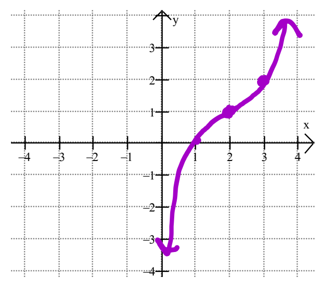
a) $y=(x+2)^3$



b) $y=x^3-3$



c) $y=(x-2)^3+1$



Reflections

Across the x-axis:

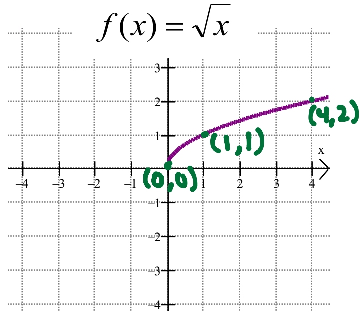
$-f(x)$

Across the y-axis:

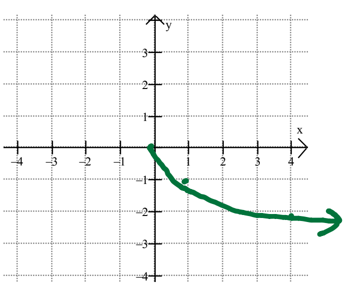
$f(-x)$

Example 2: Use the graph of $f(x)$ below to graph each new graph.

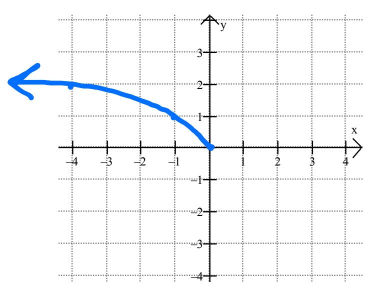
$f(x)=\sqrt{x}$



a) $y=-\sqrt{x}$



b) $y=\sqrt{-x}$



Stretches and Shrinks

Vertical Stretch or Shrink

$af(x)$

$|a|>1$ stretch $\quad |a|<1$ shrink

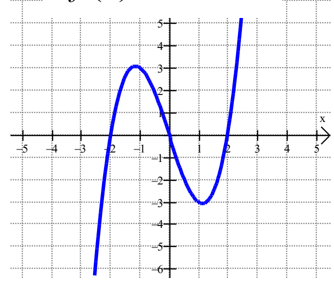
Horizontal Stretch or Shrink

$f(ax)$

$|a|>1$ shrink $\quad |a|<1$ stretch

Example 3: Use the graph of $f(x)$ below to graph each new graph. Use a table of values to create the graph.

$f(x)=x^3-4x$

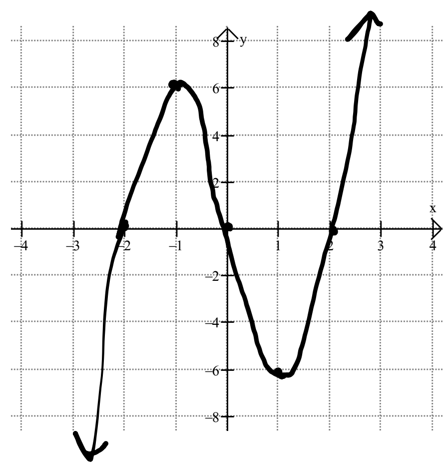


a) $y=2(x^3-4x)$

$y=2((-3)^3-4(-3))$
$=2(-27+12)$
$=2(-15)=-30$

$y=2((-2)^3-4(-2))$
$=2(-8+8)$
$=2(0)=0$

x	y
–3	–30
–2	0
–1	6
0	0
1	–6
2	0
3	30



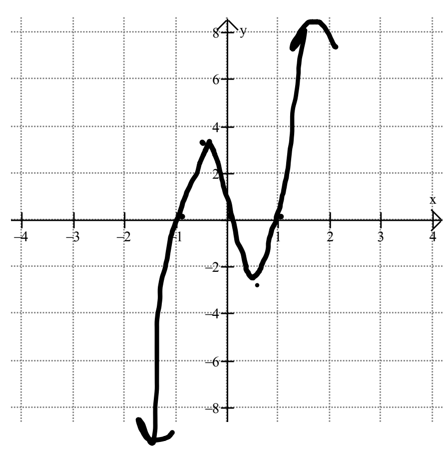
Vertical stretch by a factor of 2.

b) $y=(2x)^3-4(2x)$

$y=(2\cdot(-1))^3-4(2\cdot -1)$
$=(-2)^3-4(-2)$
$=-8+8$

Horizontal shrink by a factor of $\frac{1}{2}$.

x	y
–2	-48
–1	0
0	0
1	0
2	48
-.5	3
.5	-3



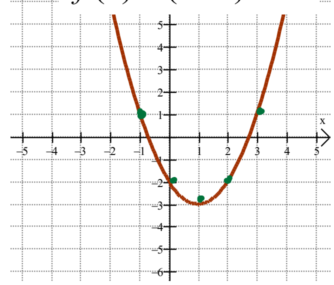
Absolute Value Compositions

$|f(x)|$ makes all y-values positive

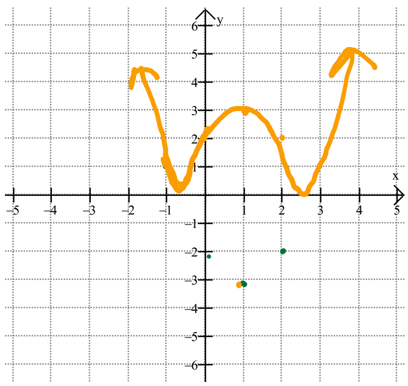
$f(|x|)$ reflects positive x-values across the y-axis

Example 4: Use the graph of $f(x)$ below to graph each new graph.

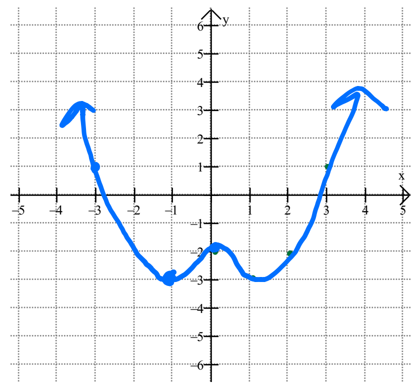
$$f(x) = (x-1)^2 - 3$$



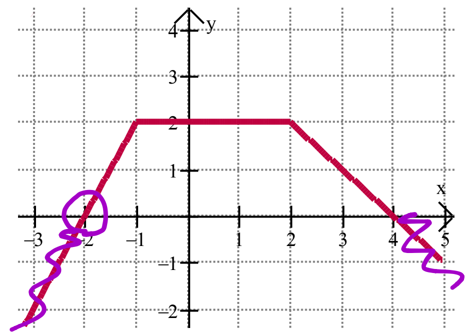
a) $y = \left|(x-1)^2 - 3\right|$



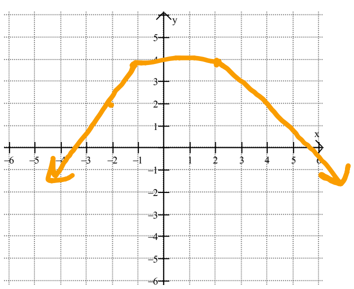
b) $y = (|x|-1)^2 - 3$



Example 5: Use the graph of $f(x)$ below to graph each new function below.

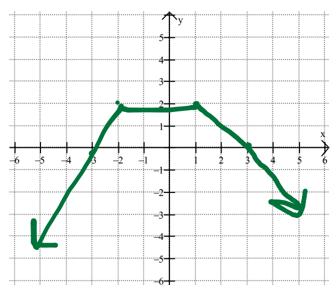


a) $f(x)+2$



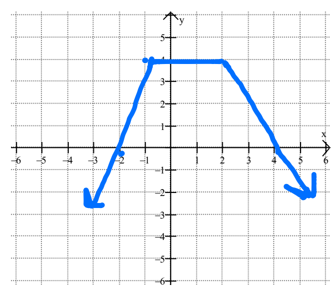
Vertical shift by a factor of 2.

b) $f(x+1)$



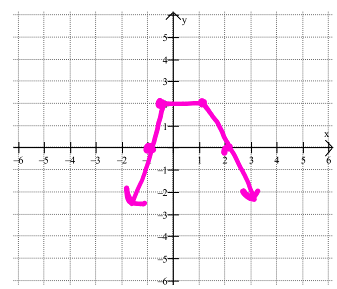
Horizontal shift by a factor of -1

c) $2f(x)$



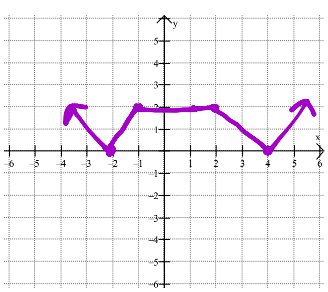
Vertical stretch by a factor of 2

d) $f(2x)$



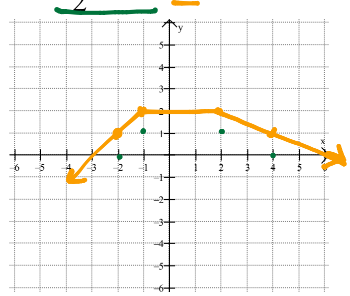
Horizontal stretch by a factor of ½

e) $|f(x)|$



All y-values made Positive

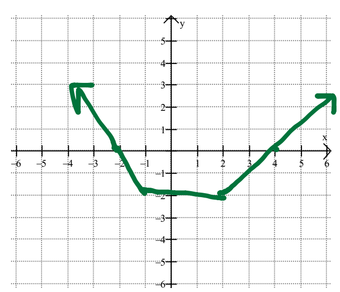
f) $\frac{1}{2}f(x)+1$



Vertical shrink by a factor

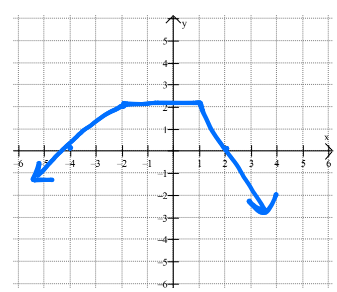
Horizontal shift by a factor of 1.

g) $-f(x)$



Reflected across the x-axis

h) $f(-x)$



Reflected across the y-axis