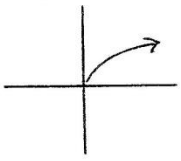
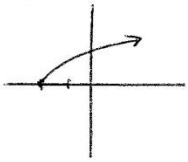
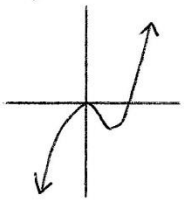
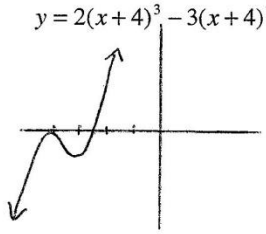
TRANSFORMATIONS

Section 2.3
(class notes)

Things that you can do to a function that will result in a reflection across the x or y-axis OR will result in a shift to the right, left, up or down.
OR will result in a vertical stretch or shrink.

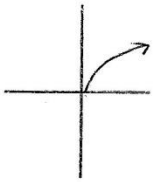
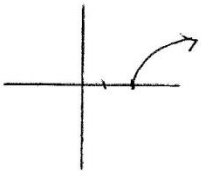
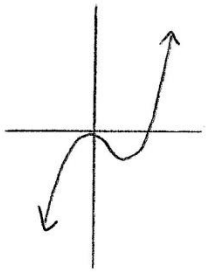
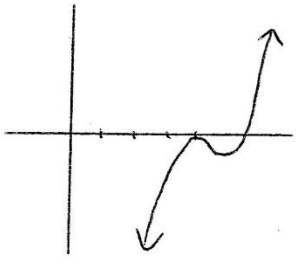
1) **Replace x with (x + c)**

(The graph of function #2 will be function #1 **shifted left c units.**)

	① **y = f(x)**	② **y = f(x+c)**
ex:	$y = \sqrt{x}$ 	$y = \sqrt{x+2}$ 
ex:	$y = 2x^3 - 3x^2$ 	$y = 2(x+4)^3 - 3(x+4)^2$ 

Replace x with (x – c)

(The graph of function #2 will be function #1 **shifted right c units.**)

	y = f(x)	**y = f(x-c)**
ex:	$y = \sqrt{x}$ 	$y = \sqrt{x-2}$ 
ex:	$y = 2x^3 - 3x^2$ 	$y = 2(x-4)^3 - 3(x-4)^2$ 

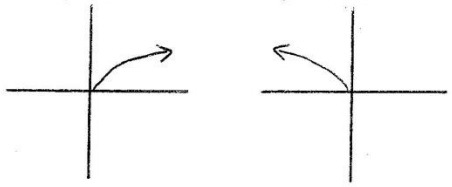
2) **Replace x with –x**

(The graph of function #2 will be function #1 **reflected across the y-axis..**

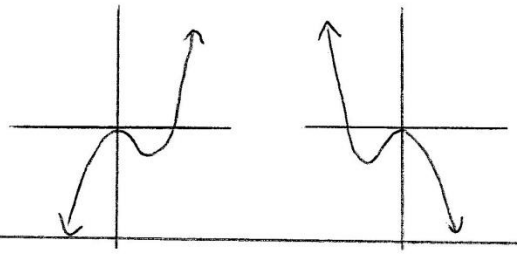
① ②

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

ex: $y = \sqrt{x}$ $y = \sqrt{-x}$



ex: $y = 2x^3 - 3x^2$ $y = 2(-x)^3 - 3(-x)^2$



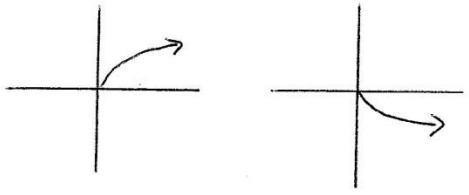
3) **Take the opposite of the whole function.**

(The graph of function #2 will be function #1 **reflected across the x-axis**.)

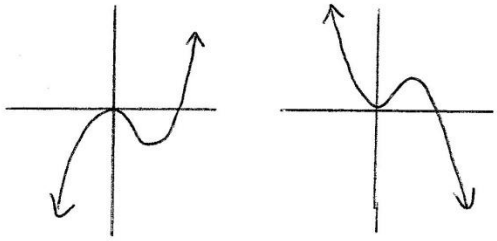
y = f(x) **y = -f(x)**

① ②

ex : $y = \sqrt{x}$ $y = -\sqrt{x}$

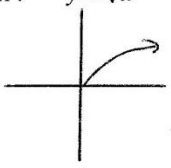
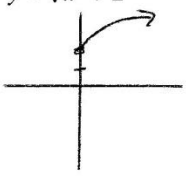
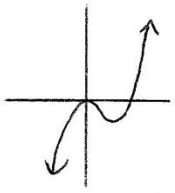
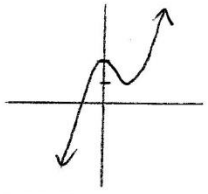


ex : $y = 2x^3 - 3x^2$ $y = -(2x^3 - 3x^2)$



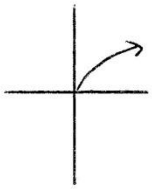
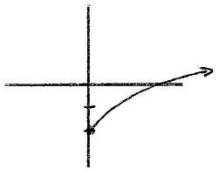
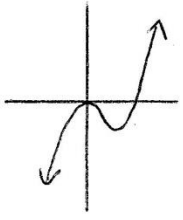
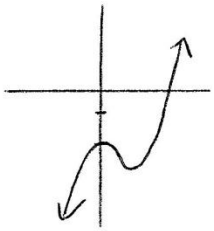
4) **Add a number to the whole function.**

(The graph of function #2 will be function #1 **shifted up c units**.)

	① $y = f(x)$	② $y = f(x) + c$
ex :	$y = \sqrt{x}$	$y = \sqrt{x} + 2$
		
ex :	$y = 2x^3 - 3x^2$	$y = 2x^3 - 3x^2 + 2$
		

Subtract a number from the whole function.

(The graph of function #2 will be function #1 **shifted down c units.**)

	① $y = f(x)$	② $y = f(x) - c$
ex :	$y = \sqrt{x}$	$y = \sqrt{x} - 2$
		
ex :	$y = 2x^3 - 3x^2$	$y = 2x^3 - 3x^2 - 2$
		

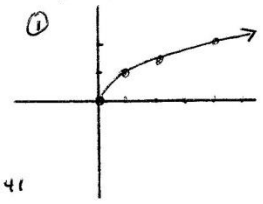
5) **Multiply the whole function by a number:** $y = a\,f(x)$

If $a > 1$, then vertically <u>stretch</u> the function by a factor of *a*.

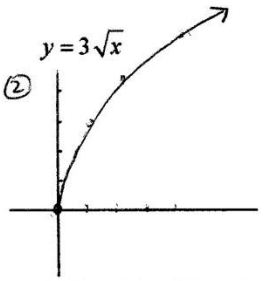
y = f(x) **y = *a* f(x)**

example: $y = \sqrt{x}$ $y = 3\sqrt{x}$

(The graph of function #2 will be stretched by a factor of 3.)



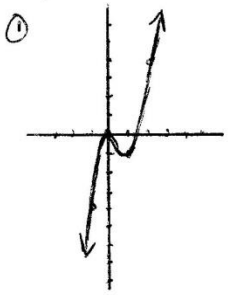
x	y
0	0
1	1
2	$\sqrt{2} \approx 1.41$
4	2



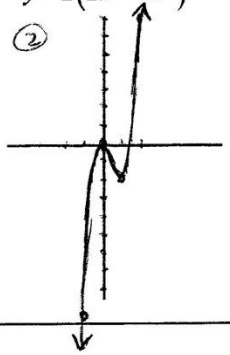
x	y
0	0
1	3
2	4.24
4	6

example: $y = 2x^3 - 3x^2$ $y = 2(2x^3 - 3x^2)$

(The graph of function #2 will be stretched by a factor of 2.)



x	y
-1	-5
0	0
1	-1
2	4



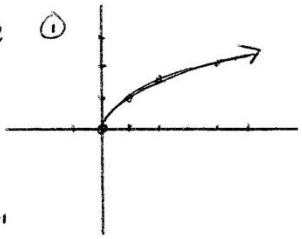
x	y
-1	-10
0	0
1	-2
2	8

If $-1 < a < 1$, then vertically <u>shrink</u> the function by a factor of *a*.

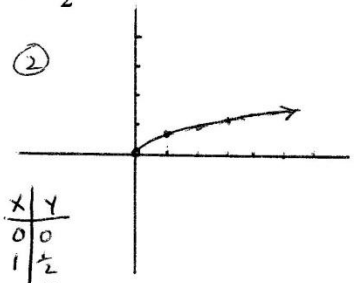
y = f(x) **y = *a* f(x)**

example: $y = \sqrt{x}$ $y = \frac{1}{2}\sqrt{x}$

(The graph of function #2 will shrink by a factor of ½ .)



x	y
0	0
1	1
2	$\sqrt{2} \approx 1.41$
4	2



x	y
0	0
1	$\frac{1}{2}$
2	$\frac{\sqrt{2}}{2} \approx .7$
4	1