

Mechatronics Engineering
First Grade
Calculus



Lesson 4

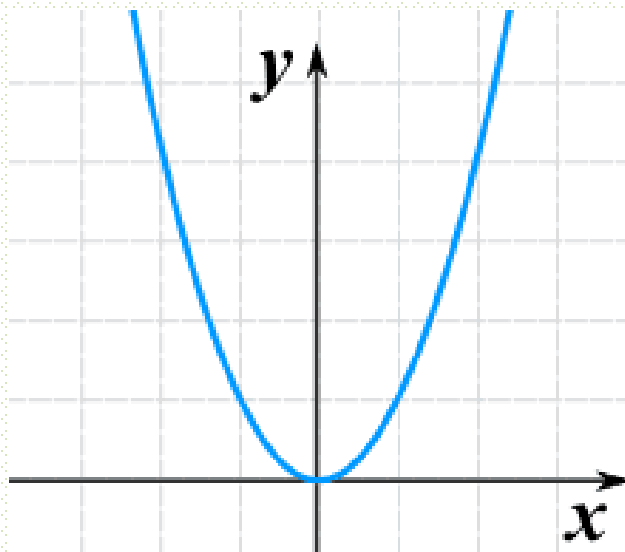
Function Transformation

By: Rasha Alkabbanie (MSc)

$y = f(x) + C$	<ul style="list-style-type: none"> • $C > 0$ moves it up • $C < 0$ moves it down
$y = f(x + C)$	<ul style="list-style-type: none"> • $C > 0$ moves it left • $C < 0$ moves it right
$y = C \cdot f(x)$	<ul style="list-style-type: none"> • $C > 1$ stretches it in the y-direction • $0 < C < 1$ compresses it
$y = f(Cx)$	<ul style="list-style-type: none"> • $C > 1$ compresses it in the x-direction • $0 < C < 1$ stretches it
$y = -f(x)$	<ul style="list-style-type: none"> • Reflects it about x-axis
$y = f(-x)$	<ul style="list-style-type: none"> • Reflects it about y-axis

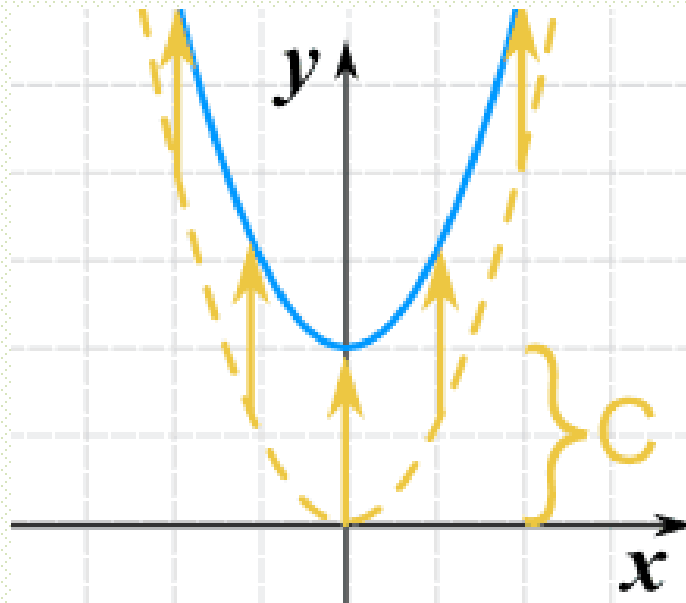
Let us start with a function, in this case it is $f(x) = x^2$, but it could be anything:

$$f(x) = x^2$$

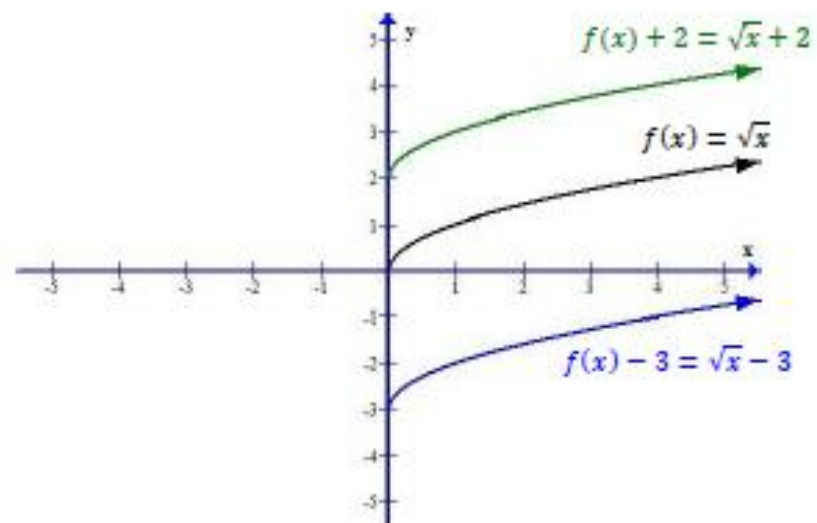
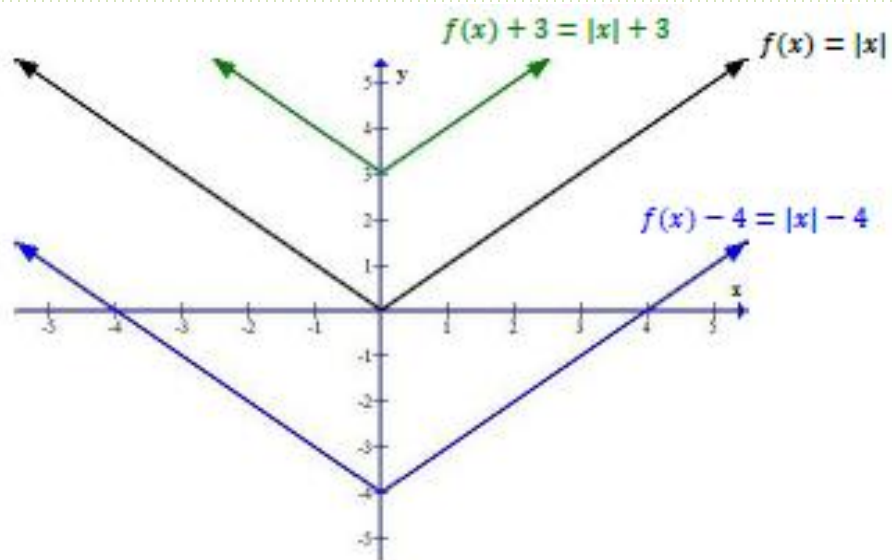


$$y = f(x) + C$$

- $C > 0$ moves it up
- $C < 0$ moves it down

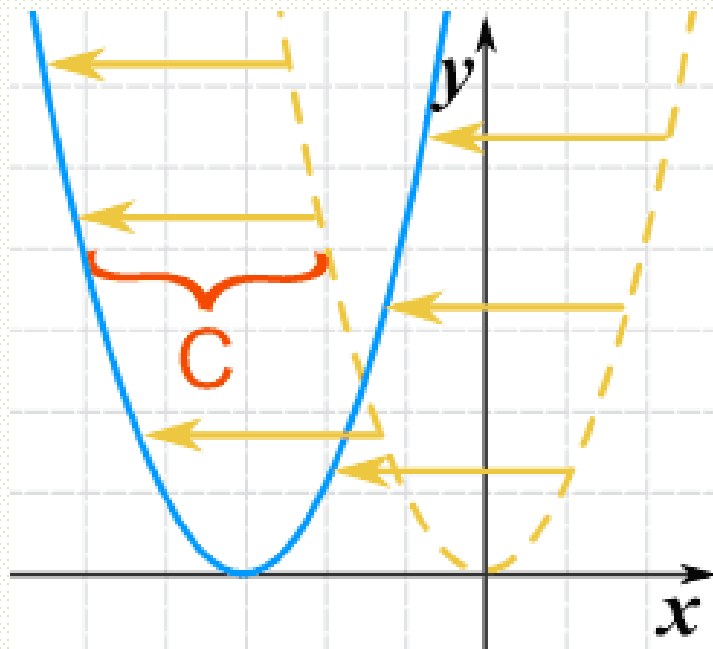


$$g(x) = x^2 + C$$

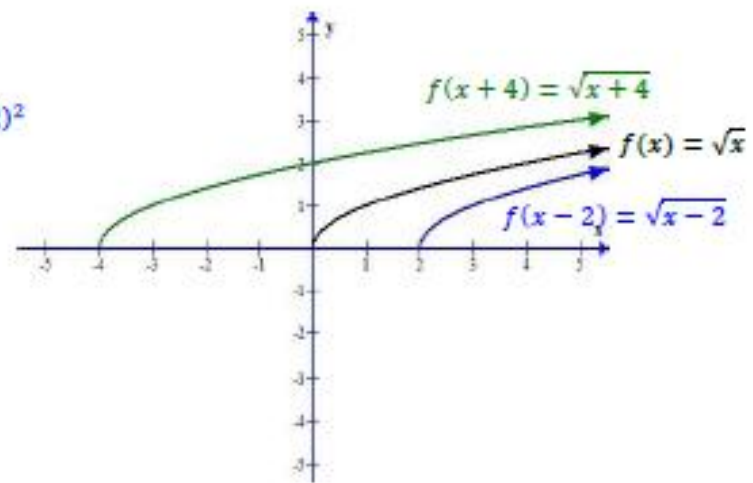
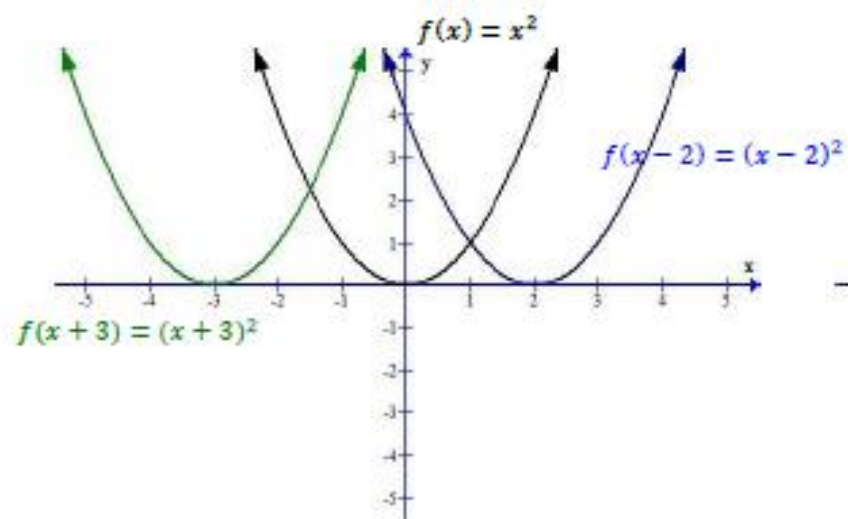


$$y = f(x + C)$$

- $C > 0$ moves it left
- $C < 0$ moves it right

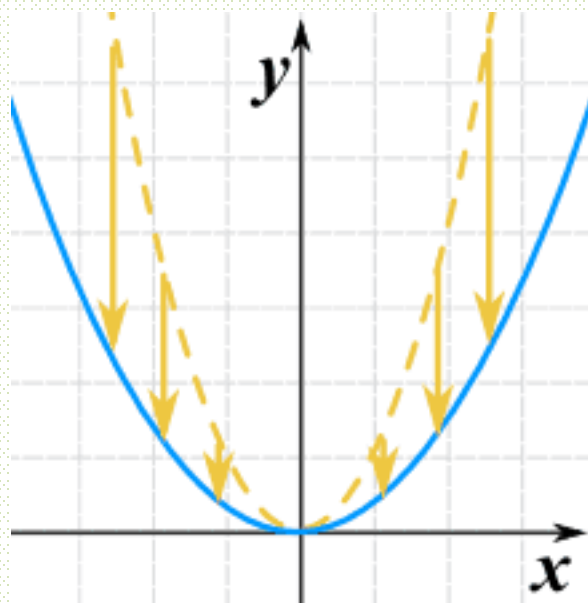


$$g(x) = (x+C)^2$$

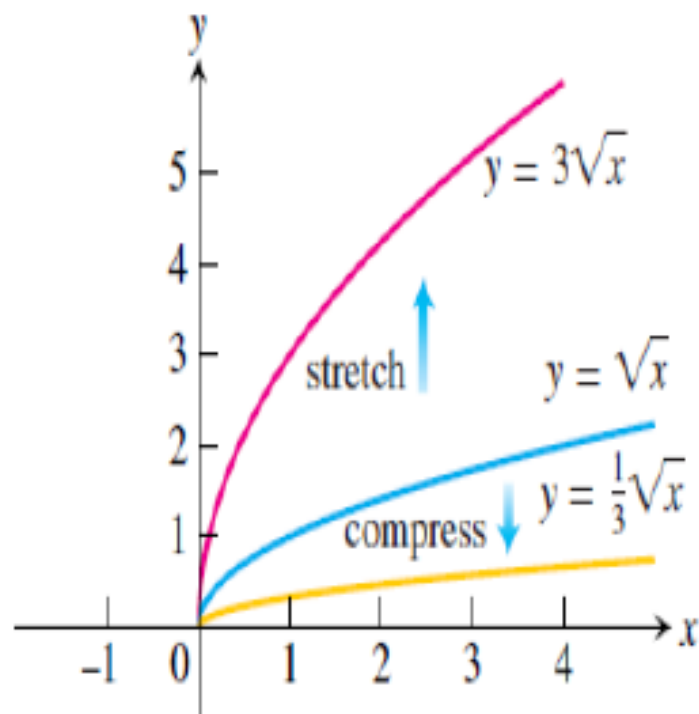


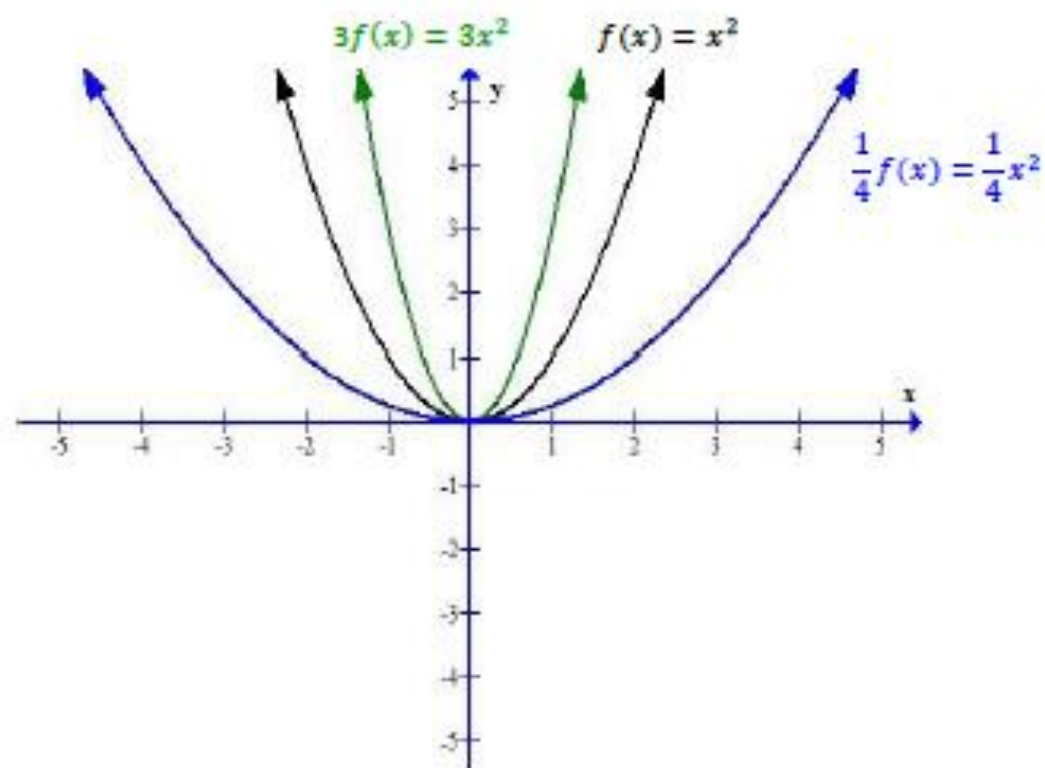
$$y = C \cdot f(x)$$

- $C > 1$ stretches it in the y-direction
- $0 < C < 1$ compresses it



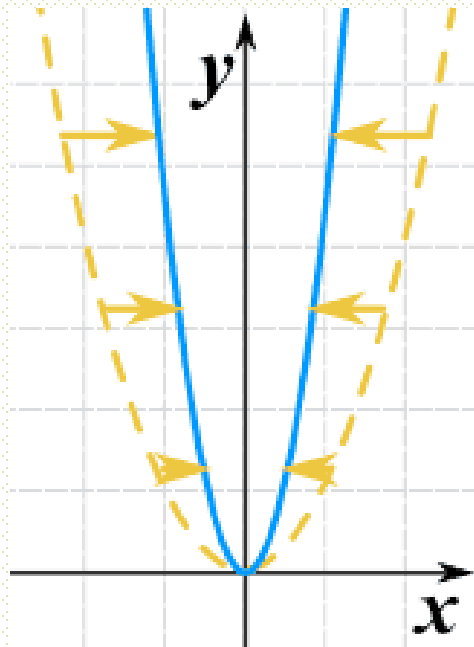
$$g(x) = 0.35(x^2)$$



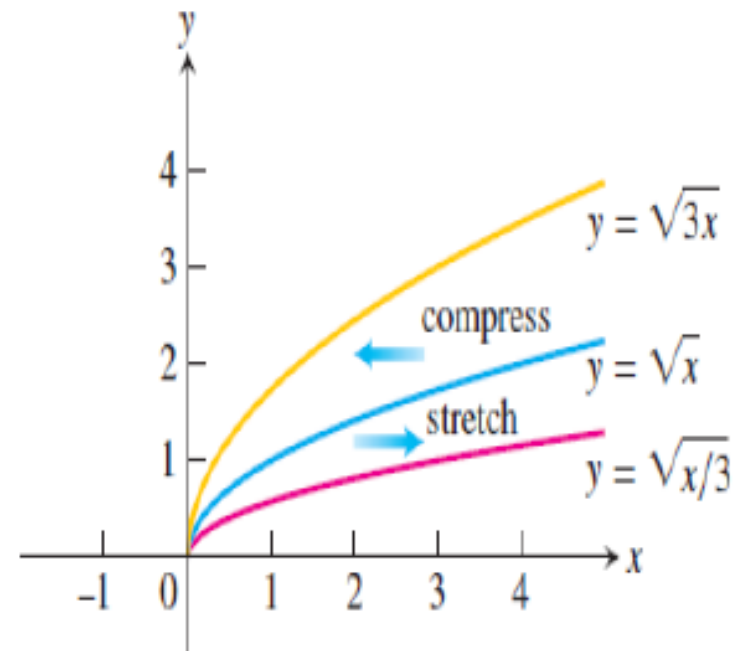


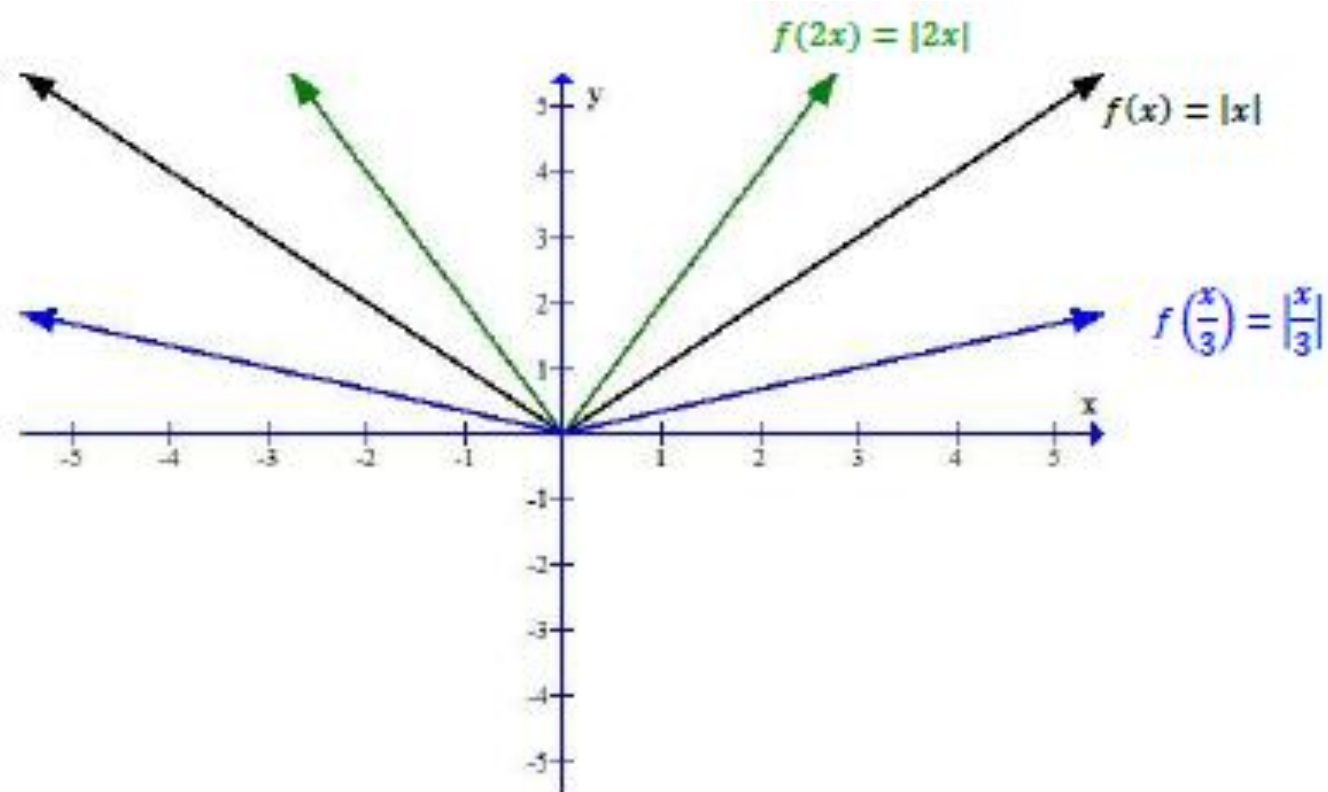
$$y = f(Cx)$$

- $C > 1$ compresses it in the x-direction
- $0 < C < 1$ stretches it



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



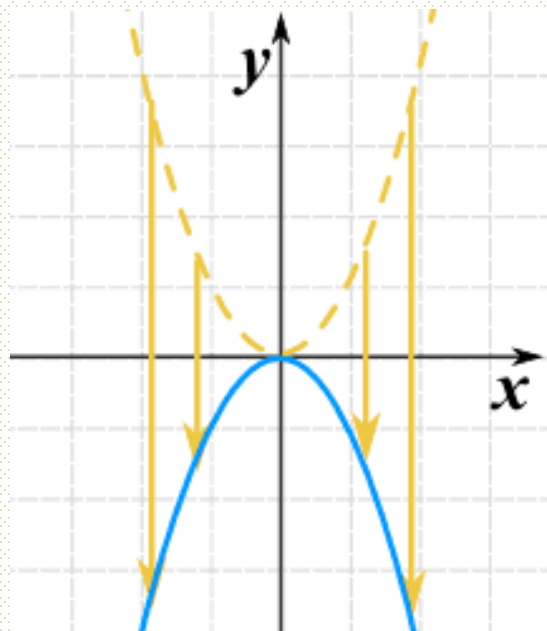


$$y = -f(x)$$

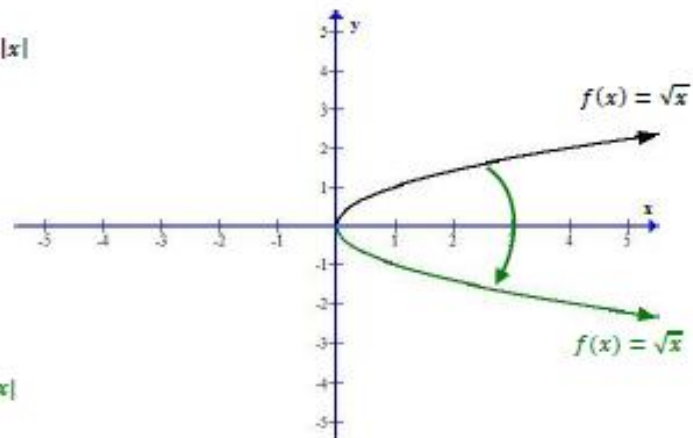
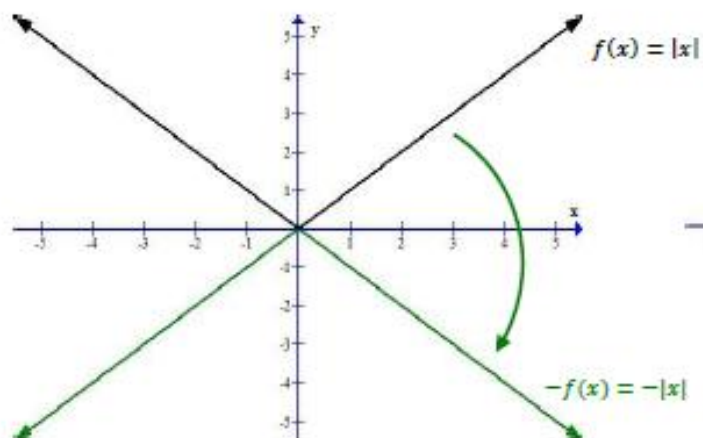
- Reflects it about x-axis

$$y = f(-x)$$

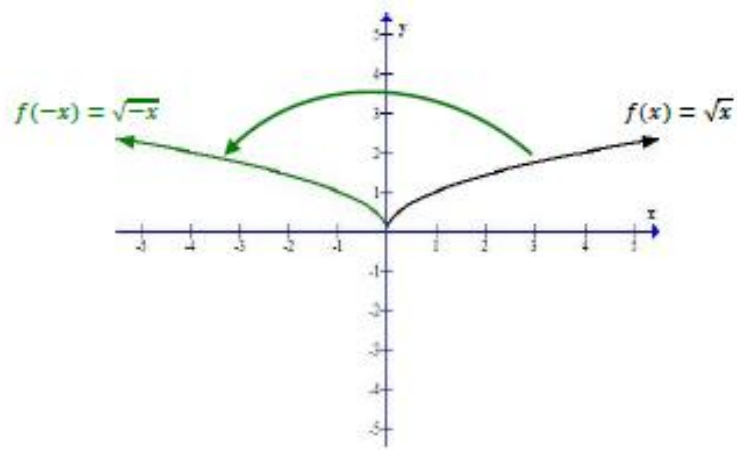
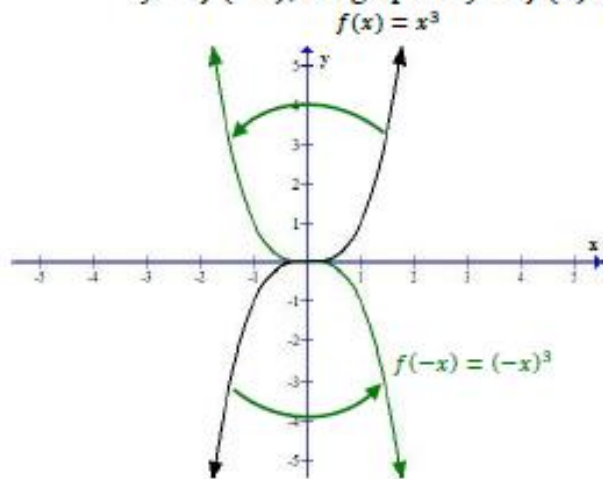
- Reflects it about y-axis



$$g(x) = -(x^2)$$

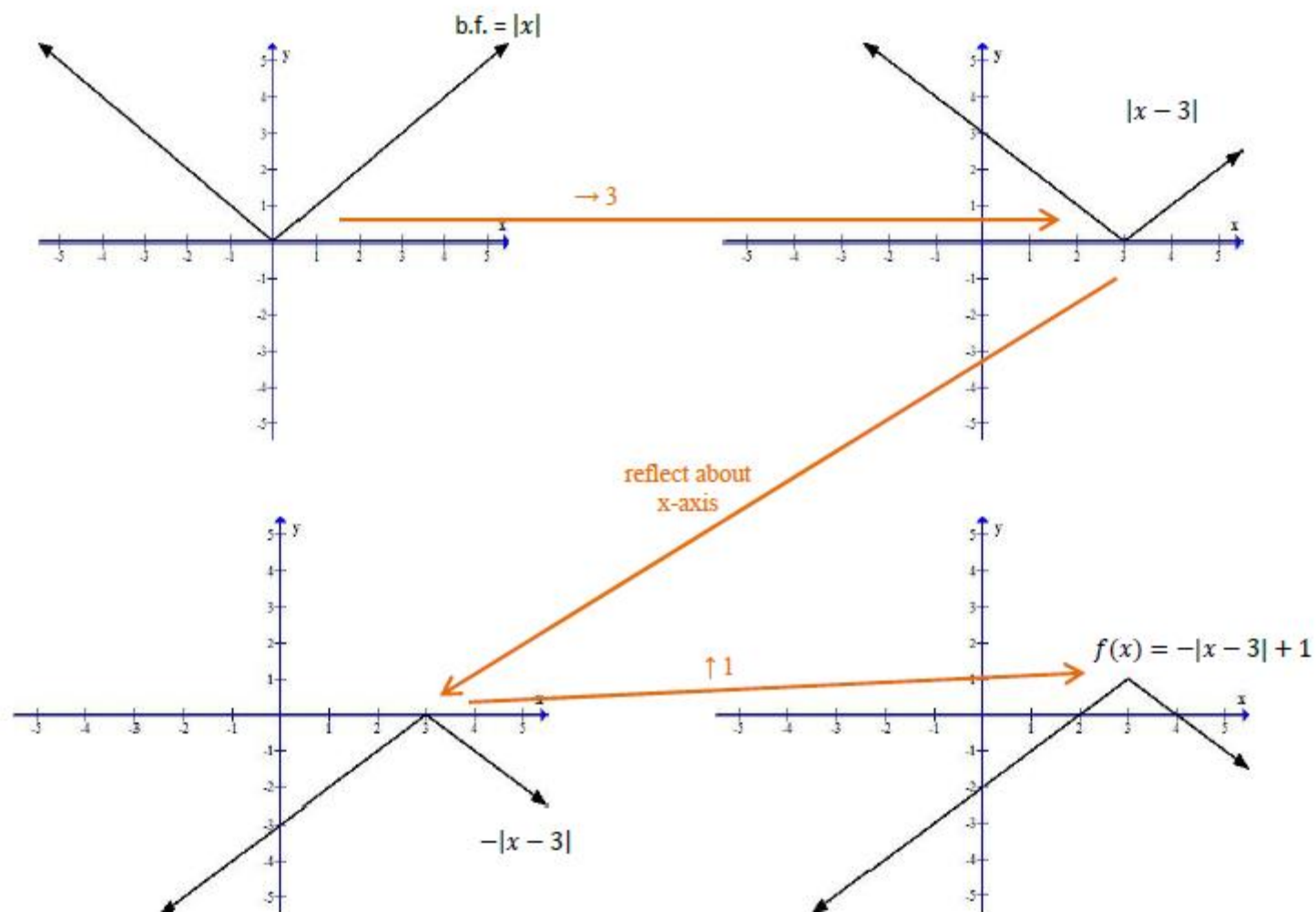


On the other hand, if the variable is multiplied by -1, where $y = f(x)$ becomes $y = f(-x)$, the graph of $y = f(x)$ is reflected across the y-axis.



Exercises

2. $f(x) = -|x - 3| + 1$
 b.f. = $|x|$, $\rightarrow 3$, reflect about x-axis, $\uparrow 1$

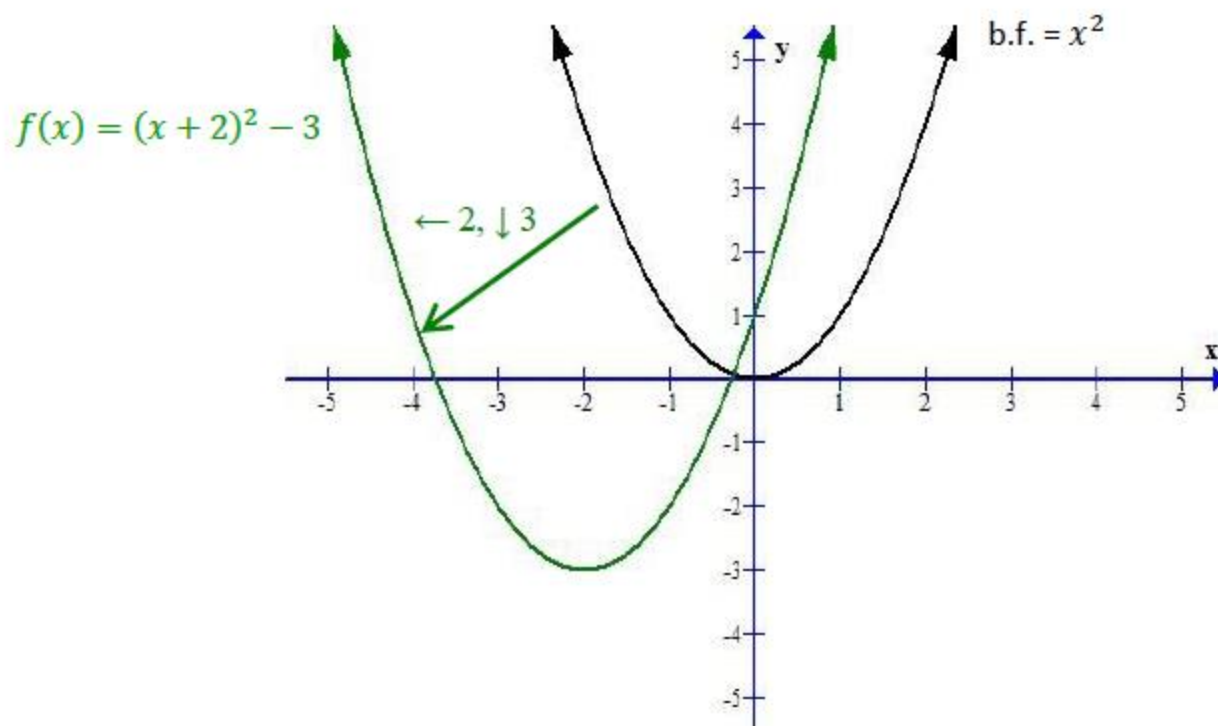


$$\text{Domain} = (-\infty, \infty)$$

$$\text{Range} = (-\infty, 1]$$

Examples: Graph the following functions and state their domain and range:

1. $f(x) = (x + 2)^2 - 3$
basic function (b.f.) = x^2 , $\leftarrow 2, \downarrow 3$

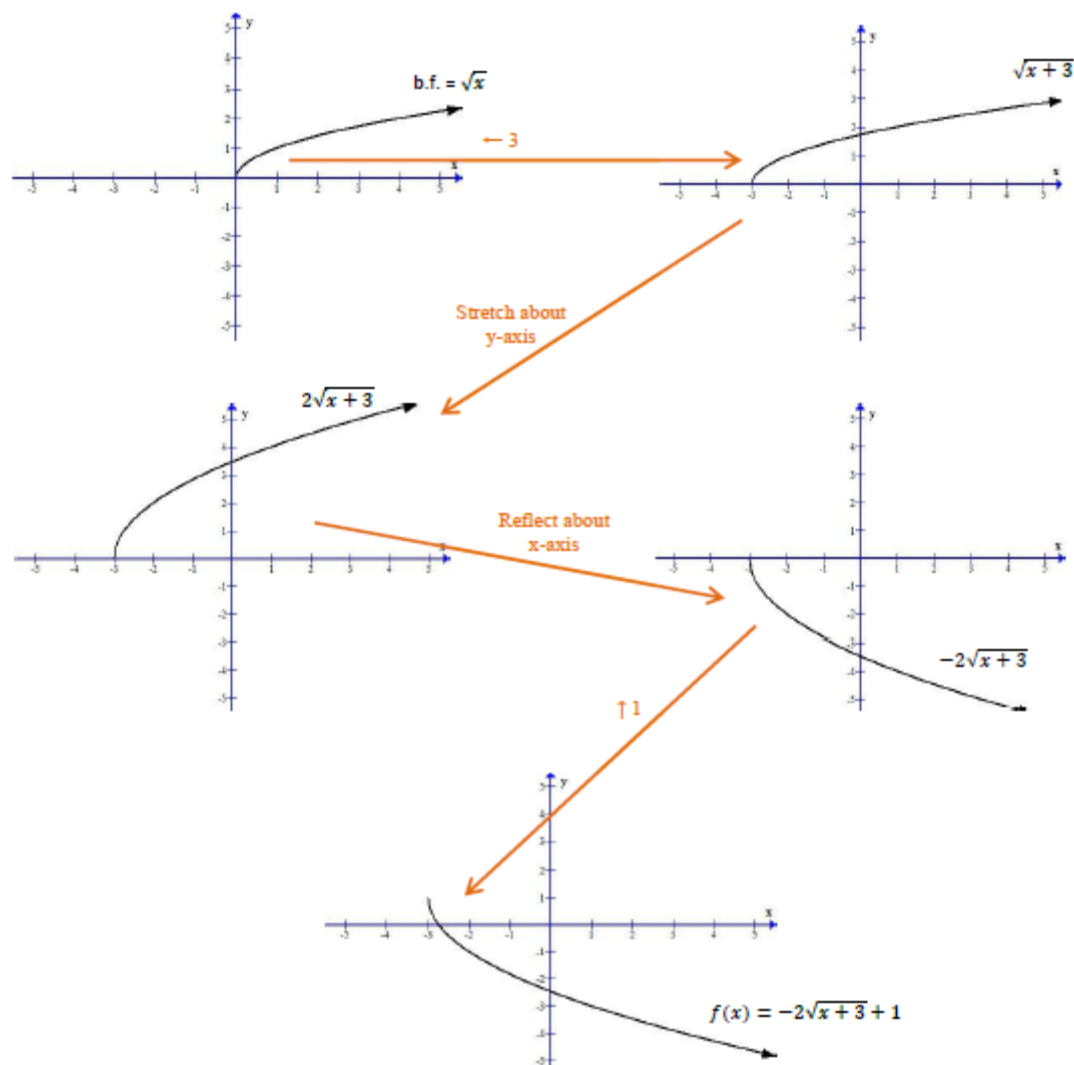


$$\text{Domain} = (-\infty, \infty)$$

$$\text{Range} = [-3, \infty)$$

3. $f(x) = -2\sqrt{x+3} + 1$

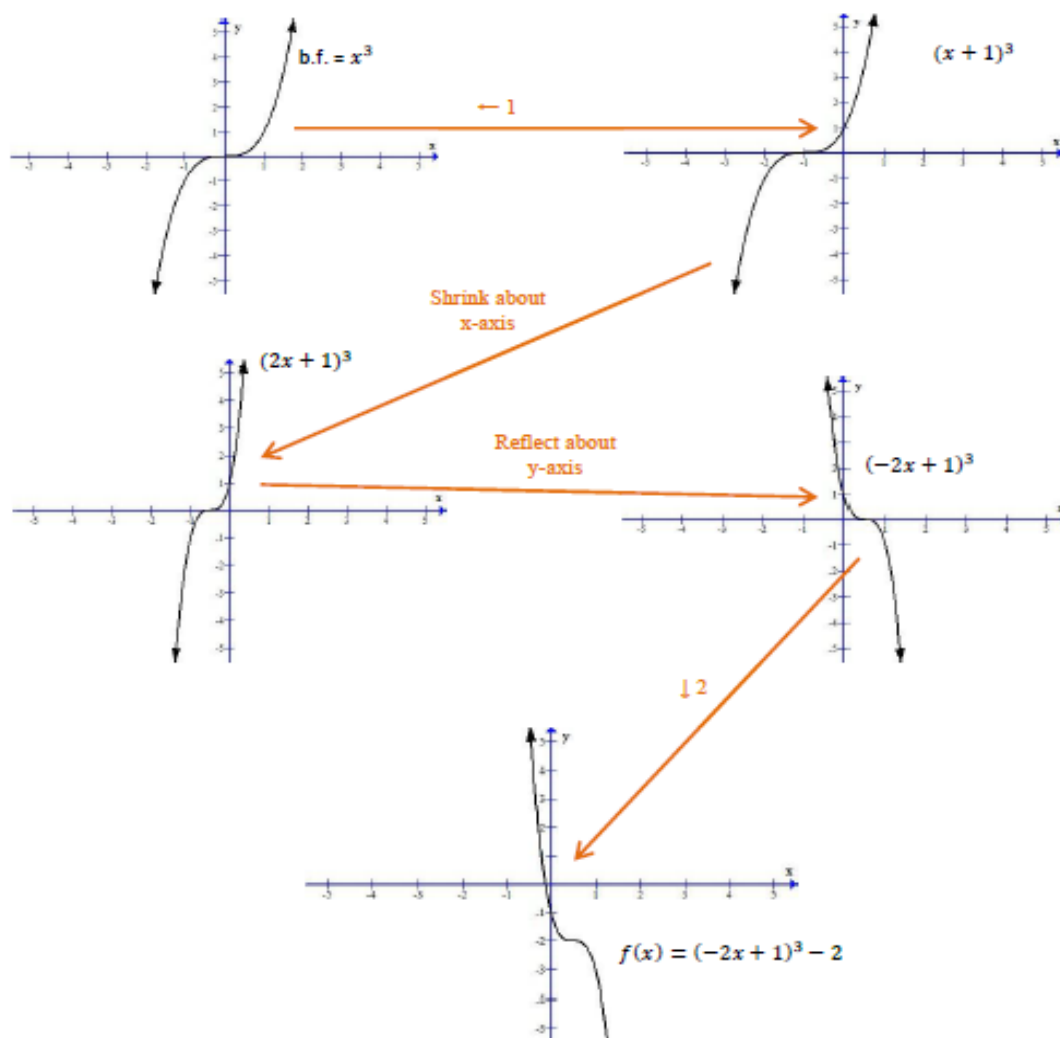
b.f. = \sqrt{x} , $\leftarrow 3$, stretch about y-axis ($c = 2$), reflect about x-axis, $\uparrow 1$



Domain = $[-3, \infty)$

Range = $(-\infty, 1]$

4. $f(x) = (-2x + 1)^3 - 2$
 b.f. = x^3 , $\leftarrow 1$, shrink about x-axis ($c = 2$), reflect about y-axis, $\downarrow 2$



$$\text{Domain} = (-\infty, \infty)$$

$$\text{Range} = (-\infty, \infty)$$

Thanks