

## 1.2 Basic Classes of Functions

### Slope Formula

The slope formula is used to find the slope between two points  $(x_1, y_1)$  and  $(x_2, y_2)$ :

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

- Positive slopes will increase as you move from left to right.
- Negative slopes will decrease as you move from left to right.
- A slope of zero is a horizontal line.
- An undefined or infinity slope is a vertical line.

EXAMPLE: Find the slope of a line passing through the following points. Indicate whether the line increases, decreases, is horizontal or vertical.

a.)  $(-1, 3)$  and  $(2, 4)$

b.)  $(4, -1)$  and  $(3, -1)$

c.)  $(3, -2)$  and  $(3, -5)$

**Slope-Intercept Formula**– this is the standard form of a line which allows you to easily identify the slope and y-intercept.

$$y = mx + b \quad \text{Here the slope is } m \text{ and the y-intercept is } (0, b).$$

**Linear Function**– this is the same as the slope-intercept form, except with function notation. In general, a linear function begins with  $f(x)$  and contains an  $x$  with a power of 0 or 1.

$$f(x) = mx + b$$

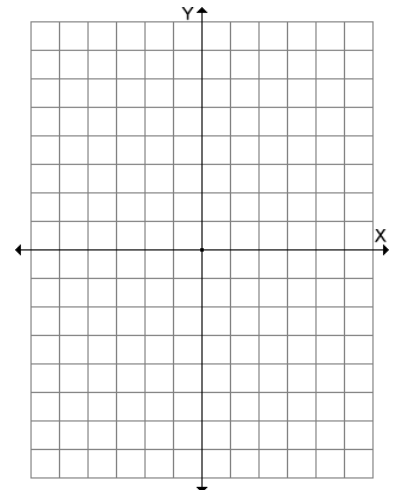
**Point-Slope Formula** – this is used when you want to find the equation of a line when you are given a slope and another point on the line. This other point does not need to be the y-intercept.

$$y - y_1 = m(x - x_1)$$

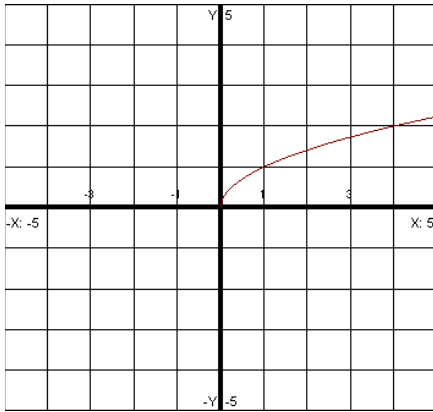
**EXAMPLE:** Use the information and given conditions to write an equation for each line in slope-intercept form as well as the point-slope form.

Passing through  $(-3, 6)$  and  $(3, -2)$

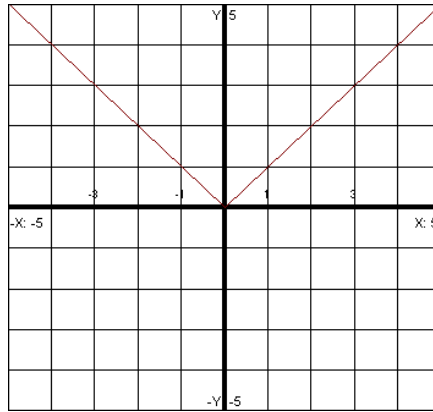
**EXAMPLE:** Write the following  $4x + 6y = -12$  in slope-intercept form and identify the slope and y-intercept. Use this information to graph the equation.



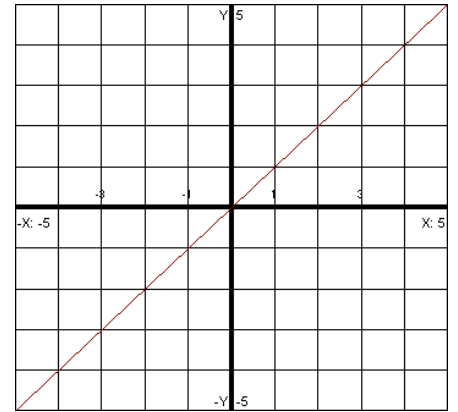
The following is a library of functions that you should know since sketches are sometimes necessary in Calculus.



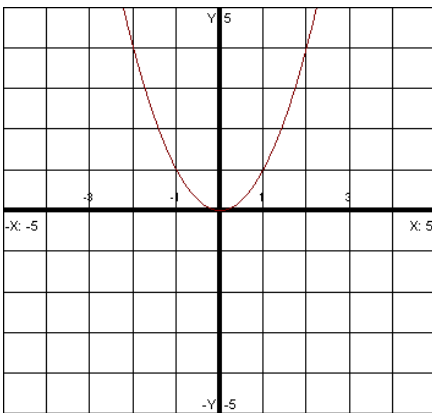
$y = \sqrt{x}$   
**Square Root Function**  
 Domain:  $[0, \infty)$   
 Range:  $[0, \infty)$   
 Increasing:  $(0, \infty)$   
 Decreasing: None



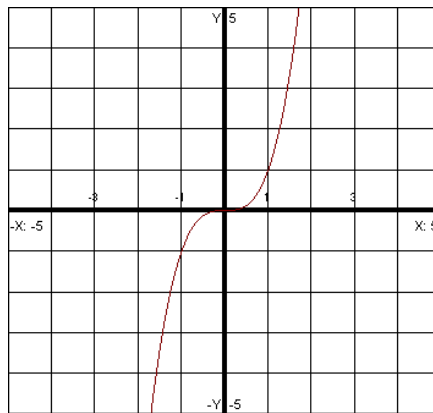
$y = |x|$   
**Absolute Value Function**  
 Domain:  $(-\infty, \infty)$   
 Range:  $[0, \infty)$   
 Increasing:  $(0, \infty)$   
 Decreasing:  $(-\infty, 0)$



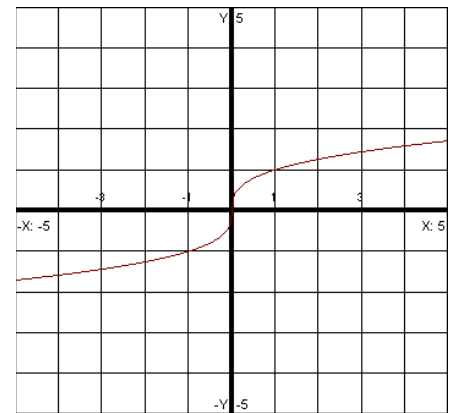
$y = x$   
**Identity Function**  
 Domain:  $(-\infty, \infty)$   
 Range:  $(-\infty, \infty)$   
 Increasing:  $(-\infty, \infty)$   
 Decreasing: None



$y = x^2$   
**Standard Quadratic Function**  
 Domain:  $(-\infty, \infty)$   
 Range:  $[0, \infty)$   
 Increasing:  $(0, \infty)$   
 Decreasing:  $(-\infty, 0)$



$y = x^3$   
**Standard Cube Function**  
 Domain:  $(-\infty, \infty)$   
 Range:  $(-\infty, \infty)$   
 Increasing:  $(-\infty, \infty)$   
 Decreasing: None



$y = \sqrt[3]{x}$   
**Cube Root Function**  
 Domain:  $(-\infty, \infty)$   
 Range:  $(-\infty, \infty)$   
 Increasing:  $(-\infty, \infty)$   
 Decreasing: None

## Transformations and Graph Sketches

Suppose  $y = f(x)$  is the original function (one we looked at in a previous section)

$y = f(x) + k$  moves  $f(x)$   $k$  units up

$y = f(x) - k$  moves  $f(x)$   $k$  units down

$y = f(x - h)$  moves  $f(x)$   $h$  units to the right

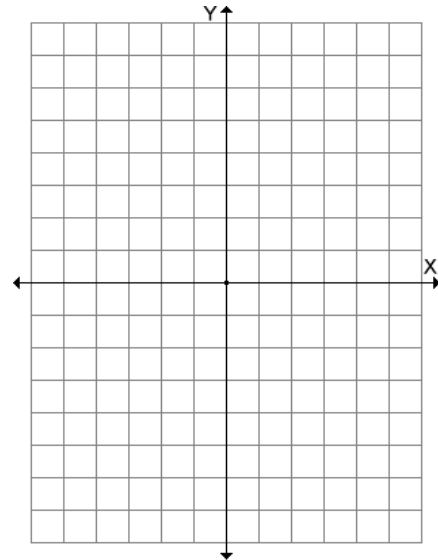
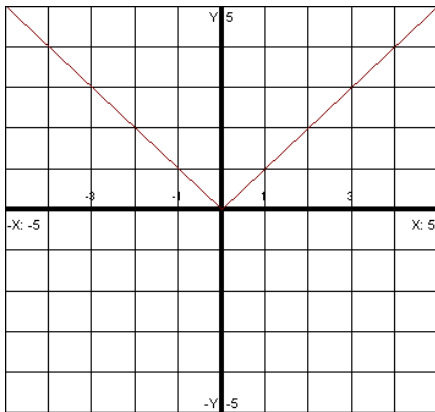
$y = f(x + h)$  moves  $f(x)$   $h$  units to the left

$y = -f(x)$  flips the graph over the horizontal axis

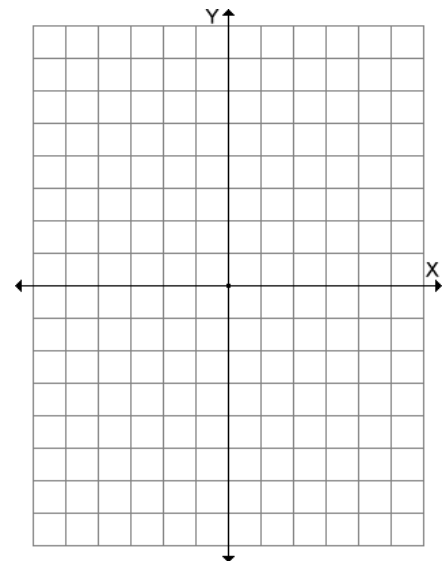
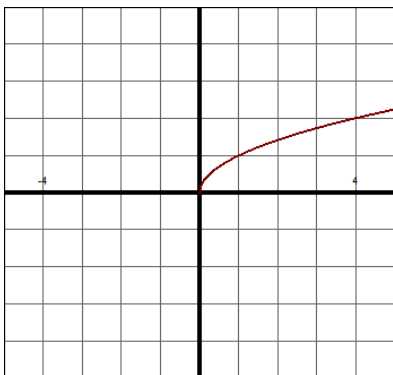
$y = f(-x)$  flips the graph over the vertical axis

$y = a \cdot f(x)$  If  $|a| > 1$  then there is a vertical stretch. If  $0 < |a| < 1$ , then there is a vertical compression.

EXAMPLE: Sketch  $y = -|x + 1| + 2$  by using transformations.



EXAMPLE: Sketch  $y = \sqrt{4 - x} + 2$  by using transformations.



## Piecewise Functions

These functions are made up of different pieces. Each piece is defined for certain values of  $x$ .

EXAMPLE: Use the function  $f(x) = \begin{cases} x+2 & \text{if } x < -3 \\ x-2 & \text{if } x \geq -3 \end{cases}$  to find  $f(-4)$ ,  $f(-3)$  and  $f\left(-\frac{3}{2}\right)$ . Then graph. and use this to determine the graph's range.

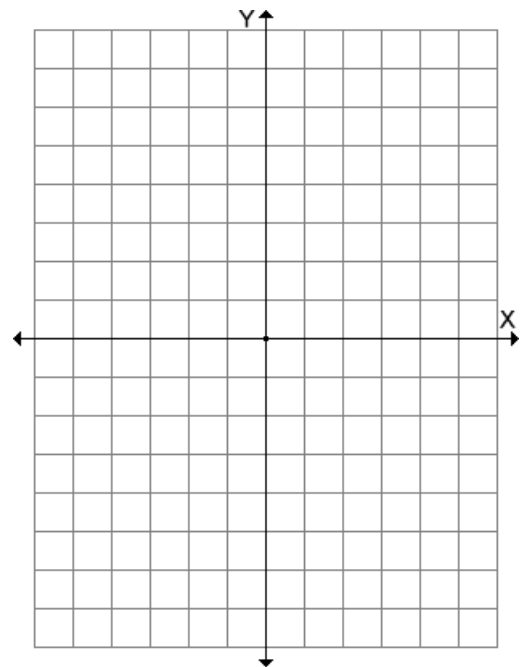
a.)  $f(-4)$

b.)  $f(-3)$

c.)  $f\left(-\frac{3}{2}\right)$  If you don't know if this fraction is less or more than  $-3$  then turn it into a decimal. This is  $-1.5$ .

x	$y = x + 2$	(x, y)
-5		
-4		
-3		

x	$y = x - 2$	(x, y)
-3		
-2		
-1		



EXAMPLE: Find the intercepts, vertex, axis of symmetry, domain, range, and the graph of  $y = x^2 - 6x + 5$ .

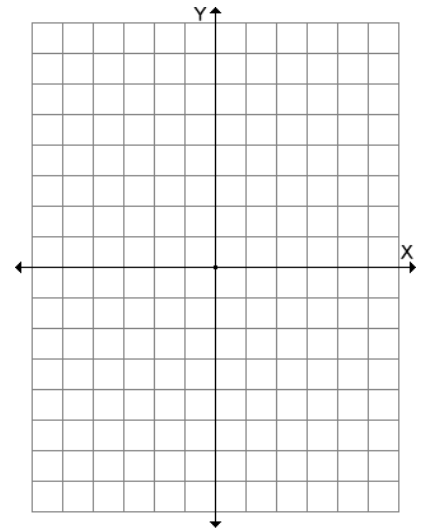
x-int: 0 for y

y-int: 0 for x

Vertex:

Axis of Symmetry:

Domain:



EXAMPLE: Suppose the height of an object shot straight up is given by  $h = 512t - 16t^2$  where  $h$  is measured in feet and  $t$  is in seconds. Find the maximum height and the time at which the object hits the ground.