

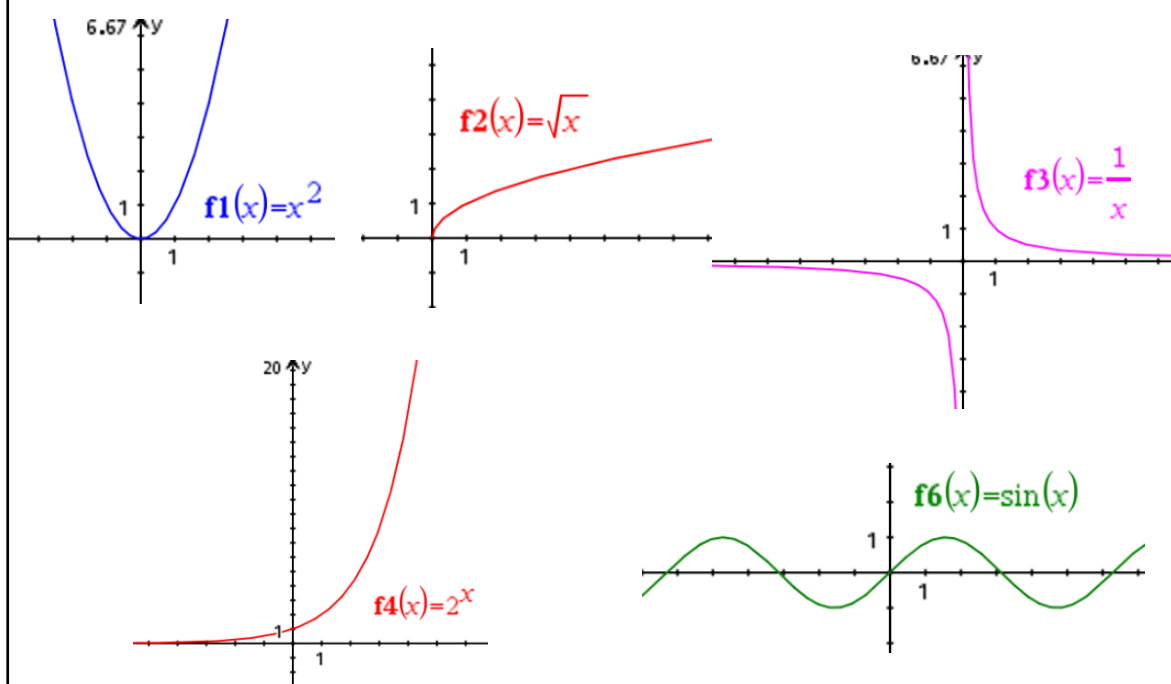
# Vertical Transformations

## "a" and "c"

Learning goal:

- explore vertical transformations of parent functions

What parent functions have we learned about?



You will be graphing a lot of graphs in the next part of the lesson.

Your window settings should be

$$-15 \leq x \leq 15$$

$$-15 \leq y \leq 15$$

The role of "a"

$$y = ax^2 + c$$

1. Use the TI-Nspire (OR Desmos) to graph each of the functions.
2. As a Note ... sketch and label on a single set of axis.

$$y = x^2$$

$$y = 2x^2$$

$$y = 5x^2$$

$$y = -2x^2$$

$$y = -7x^2$$

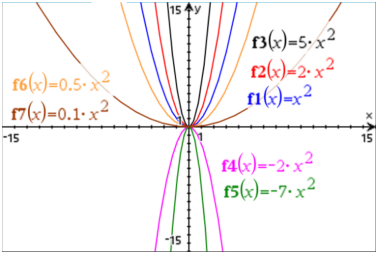
$$y = 0.5x^2$$

$$y = 0.1x^2$$

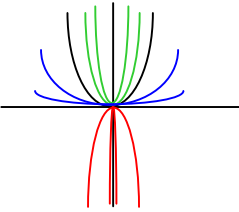
3. Describe the effect "a" has on the graph of  $y = x^2$   
*be very specific*

**The Answer**

1. This is what you should have seen on the Nspire  
(yes you should launched Nspire and have graphed them all)



2. As a Note ... sketch and label on a single set of axis.



*your sketch should look better than mine and I did not label the graphs you should have*

3. Describe the effect "a" has on the graph of  $y=x^2$   
*be very specific*

$a > 1$       *clearly describe what is happening to the graph for each interval of a.*  
 $0 < a < 1$   
 $a < 0$

The role of "a"

$$y = a\sqrt{x} + c$$

1. Use the TI-Nspire or Desmos to graph each of the functions.
2. As a Note ... sketch and label on a single set of axis.

$$y = \sqrt{x}$$

$$y = 2\sqrt{x}$$

$$y = 5\sqrt{x}$$

$$y = -2\sqrt{x}$$

$$y = -7\sqrt{x}$$

$$y = 0.5\sqrt{x}$$

$$y = 0.1\sqrt{x}$$

3. Describe the effect "a" has on the graph of  $y = \sqrt{x}$   
*be very specific*

## The Answer

You're on your own now ...

continue through the rest of lesson, you will be sketching graphs and determining the effect of "a" and "c" on all the parent functions.

### The role of "a"

$$y = \frac{a}{x} + c$$

1. Use the TI-Nspire or Desmos to graph each of the functions.
2. As a Note ... ..sketch and label on a single set of axis.

$$y = \frac{1}{x} \quad y = 5\frac{1}{x} \quad y = 0.5\frac{1}{x} \quad y = -\frac{1}{x}$$

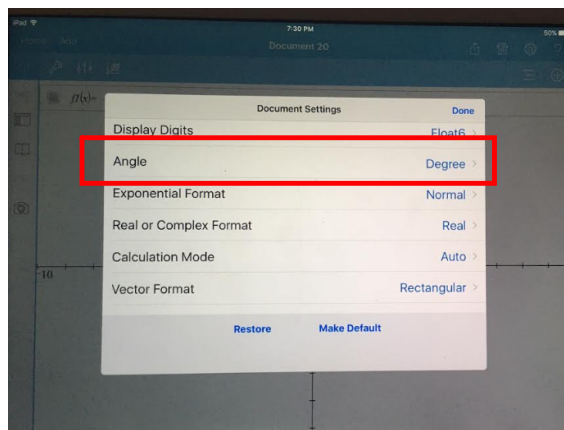
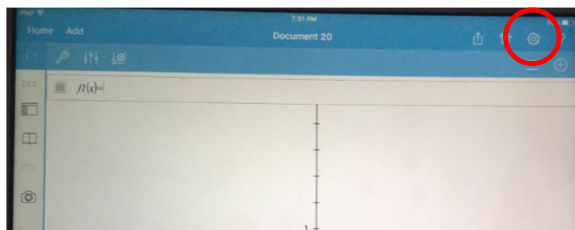
3. Does the change in "a" affect which **quadrant** the graph is in?
4. Describe the effect "a" has on the **shape** of the graph.
5. Does the change in "a" affect the location of the **asymptotes**?

To graph sinusoidal functions ...

- the app must be set degrees in **two** places
- the window size must be changed

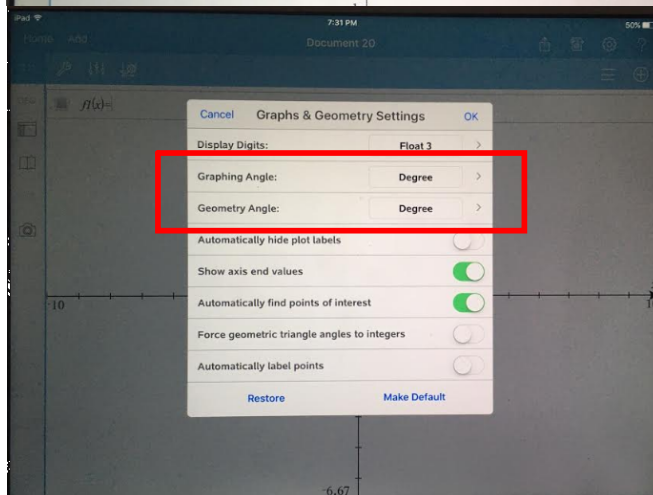
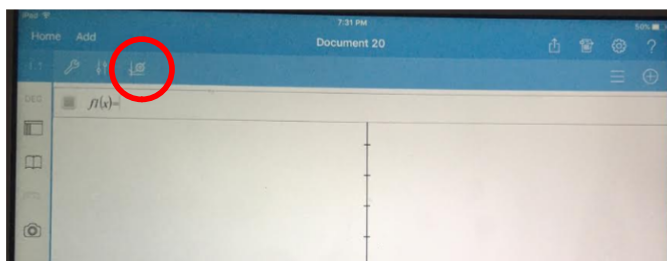
### #1 Document Settings

select this

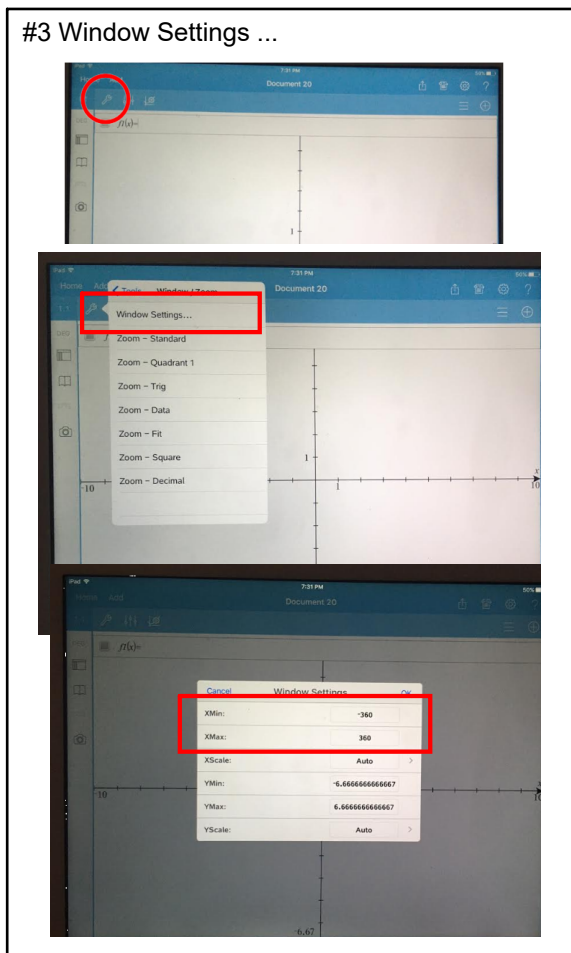


### #2 Graphs & Geometry Settings ...

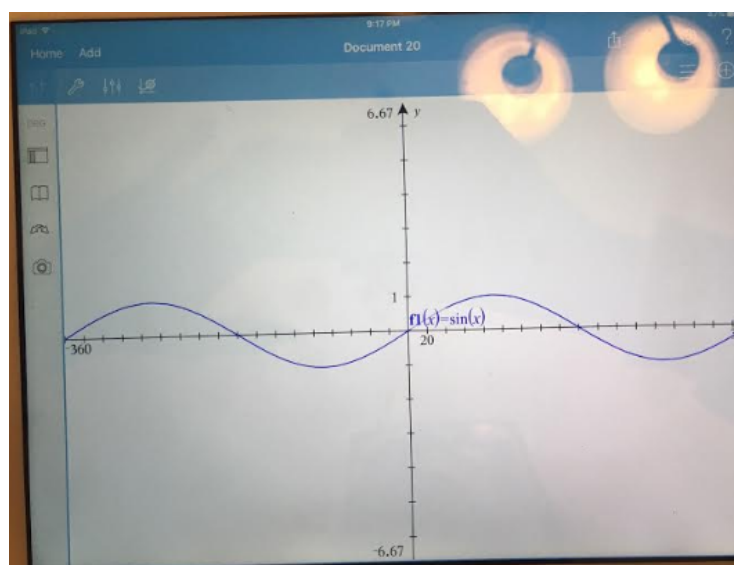
select this



## #3 Window Settings ...



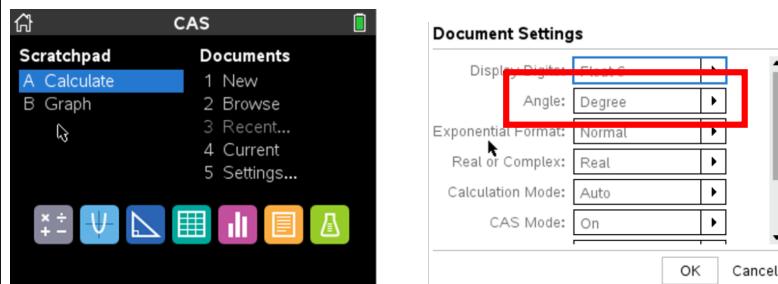
now try graphing  $f(x) = \sin x$   
it should look like this.



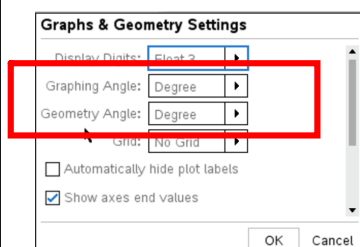
if it doesn't check all the settings.

If you have the Handheld **not** the iPad

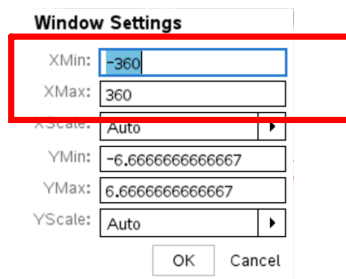
Document Settings on the Home Page



Within the Graphing app  
Menu - 9. Settings



Within the Graphing app  
Menu - 4. Window/Zoom -  
1. Window Settings



$$y = a \sin(x) + c$$

$$y = \sin x$$

$$y = 2 \sin x \quad y = 0.5 \sin x$$

$$y = 4 \sin x \quad y = -\sin x$$

1. Use the TI-Nspire or Desmos to graph each of the functions.
2. As a Note ... Sketch on the same axes.
3. Describe the effect "a" has on the graph of  $y = \sin x$   
*be very specific*

$$g(x) = ab^x + c$$

$$y = 2^x$$

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

$$y = 0.2(2^x)$$

$$y = -2^x$$

1. Sketch on the same axes.
2. Describe the effect "a" has on the graph of  $y=2^x$   
*be very specific*

The role of "c"

$$y = ax^2 + c$$

1. Use the TI-Nspire to graph each of the functions.
2. As a Note ... sketch and label on a single set of axis.

For "Predict" try to do a sketch without technology and then check using technology.

$$y = x^2$$

$$y = x^2 + 3$$

$$y = x^2 + 7$$

$$y = x^2 - 5$$

$$y = x^2 - 8$$

Predict

$$y = 2x^2 - 6$$

$$y = -3x^2 + 2$$

3. Describe the effect "c" has on the graph of  $y = x^2$



## The role of "c"

$$y = a\sqrt{x} + c$$

1. Use the TI-Nspire to graph each of the functions.
2. In your notes ...sketch and label on a single set of axis.

$$y = \sqrt{x}$$

$$y = \sqrt{x} + 3$$

$$y = \sqrt{x} + 7$$

$$y = \sqrt{x} - 5$$

$$y = \sqrt{x} - 8$$

Predict

$$y = 2\sqrt{x} - 6$$

$$y = -3\sqrt{x} + 2$$

3. Describe the effect "c" has on the graph of  $y = \sqrt{x}$

## The role of "c"

$$y = \frac{a}{x} + c$$

1. Use the TI-Nspire to graph each of the functions.
2. As a Note ... sketch and label on a single set of axis.

$$y = \frac{1}{x}$$

$$y = \frac{1}{x} + 4$$

$$y = \frac{1}{x} - 3$$

Predict

$$y = -\frac{4}{x} - 3$$

3. Does the change in "c" affect which **quadrant** the graph is in?
4. Describe the effect "c" has on the **shape** of the graph.
5. Does the change in "c" affect the location of the **asymptotes**?

$$y = a \sin(x) + c$$

$$y = \sin x$$

$$y = \sin x - 2$$

$$y = \sin x + 3$$

1. Use the TI-Nspire to graph each of the functions.
2. As a Note ... Sketch on the same axes.
3. Describe the effect "c" has on the graph of  $y = \sin x$   
*be very specific*

$$g(x) = ab^x + c$$

$$y = 2^x$$

$$y = 2^x + 6$$

$$y = 2^x - 7$$

$$y = 2^x + 10$$

Predict

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

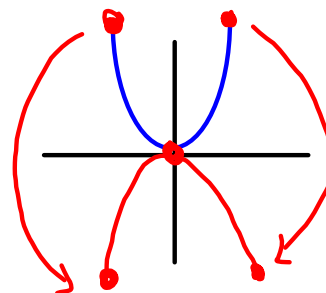
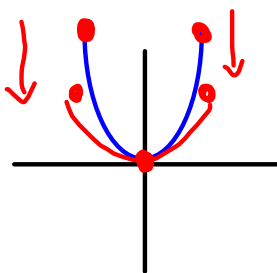
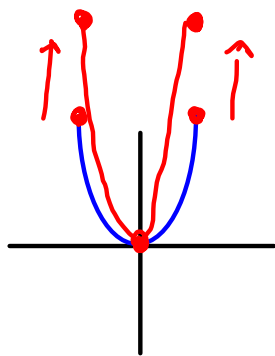
$$y = 0.5(2^x) + 3$$

1. Sketch on the same axes.
2. Describe the effect of "c" has on the graph of  $y = 2^x$   
*be very specific*

now listen to the video

### Summary

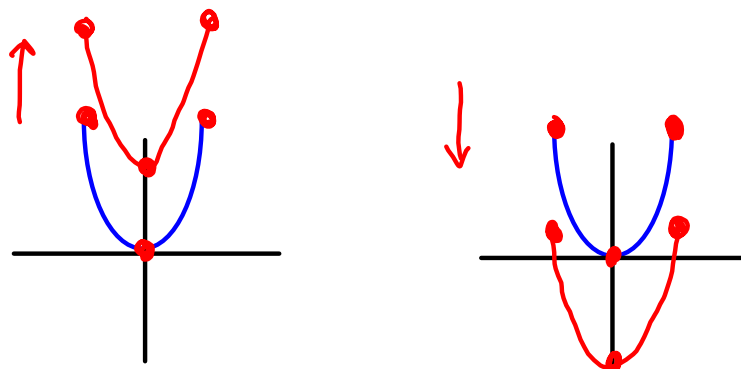
- $a = 1$       The shape doesn't change.  
 $a > 1$       Vertical Stretch (taller)  
 $0 < a < 1$       Vertical Compression (shorter)  
 $a < 0$       Vertical Reflection



$c = 0$       The graph doesn't move anywhere.

$c > 0$       Vertical Translation up

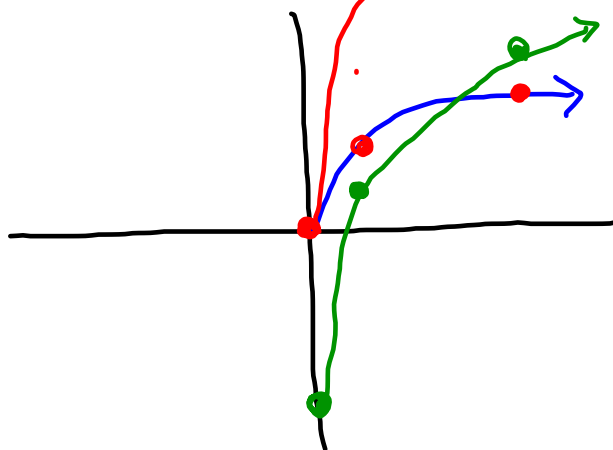
$c < 0$       Vertical Translation down



$$y = 3\sqrt{x} - 5$$

V. stretch by 3

V. Translation down 5



# HOMWORK

# HANDOUT

Cycle 2 – day 11 – Transformations – Homework

MCR3U

For the following functions

- Name the parent function
- Name all transformations
- Sketch (show any important points and asymptotes)

1.  $f(x) = 3x^2$        $y = \frac{2}{x}$        $g(x) = -2\sqrt{x}$        $r(x) = 0.5 \sin x$

2.  $y = 3^x - 6$        $k(x) = x^2 + 4$        $y = \sin x - 1$        $l(x) = \frac{1}{x} - 5$

3.  $m(x) = 2 \cdot 4^x - 3$        $y = -\sqrt{x} + 3$        $n(x) = \frac{3}{x} - 2$