**Section 3.4 Guided Notebook**

**Section 3.4 Transformations of Functions**

    ☐    Work through Section 3.4 TTK #1
    ☐    Work through Section 3.4 TTK #4
    ☐    Work through Objective 1
    ☐    Work through Objective 2
    ☐    Work through Objective 3
    ☐    Work through Objective 4
    ☐    Work through Objective 5
    ☐    Work through Objective 6
    ☐    Work through Objective 7

**Section 3.4 Transformations of Functions**

**3.4  Things To Know**

1. Determining the Domain of a Function Given the Equation (Section 3.1)
   You may want to work through the interactive video to remember how to find the domain of each of these functions.

a) $f(x) = 2x^2 - 5x$          b) $f(x) = \dfrac{x}{x^2 - x - 6}$

d) $f(x) = \sqrt[3]{5x - 9}$

4.  Sketching the Graphs of the Basic Functions
    You MUST have the graphs of the following functions memorized before starting Section 3.4.  Can you  easily sketch the graphs of these 8 functions? You can review these in Section 3.3.

    1.  The constant function  $f(x) = b$

    2.  The identity function  $f(x) = x$

    3.  The square function  $f(x) = x^2$

    4.  The cube function  $f(x) = x^3$

    5.  The absolute value function  $f(x) = |x|$

    6.  The square root function  $f(x) = \sqrt{x}$

    7.  The cube root function  $f(x) = \sqrt[3]{x}$

    8.  The reciprocal function  $f(x) = \dfrac{1}{x}$

<u>Section 3.4  Objective 1 Using Vertical Shifts to Graph Functions</u>
Work through the video that accompanies Example 1 and take notes here:
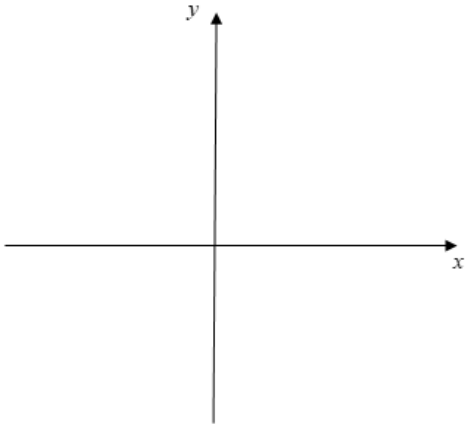Sketch the graphs of $f(x)=|x|$ and $g(x)=|x|+2$.

If $c > 0$, explain in your own words how to sketch the graph of $y = f(x)+c$ and $y = f(x)-c$. Click on the "**animate buttons**" on p. 3.4-6 and use the given graph of $y = f(x)$ below to sketch the graphs of $y = f(x)+c$ and $y = f(x)-c$.
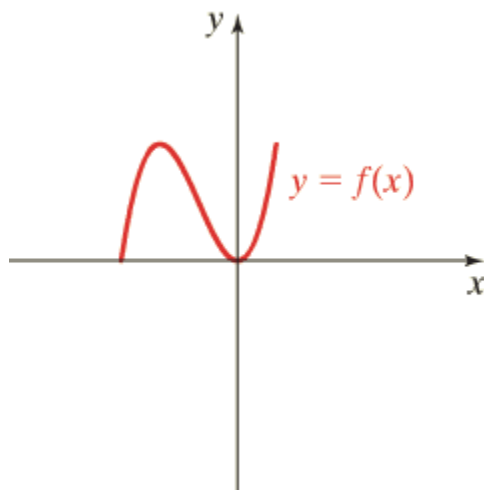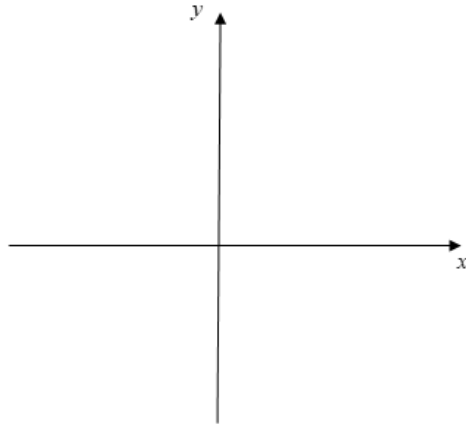
Section 3.4

Work through the **Guided Visualization** titled "Vertical Transformations of Functions" seen on page 3.4-7. Then sketch each of the following functions below:
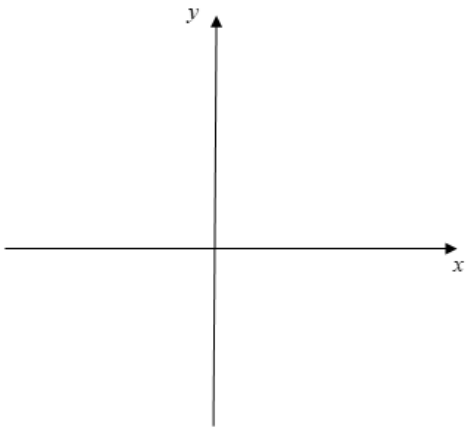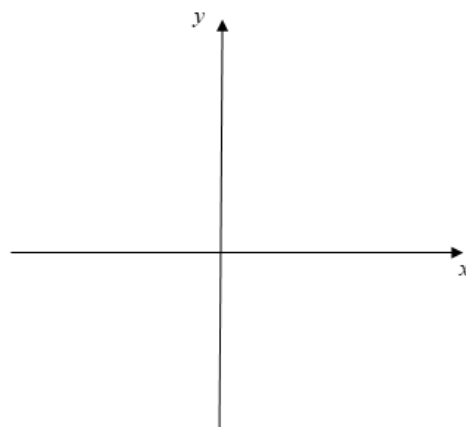
$f(x) = x^2 + 1$

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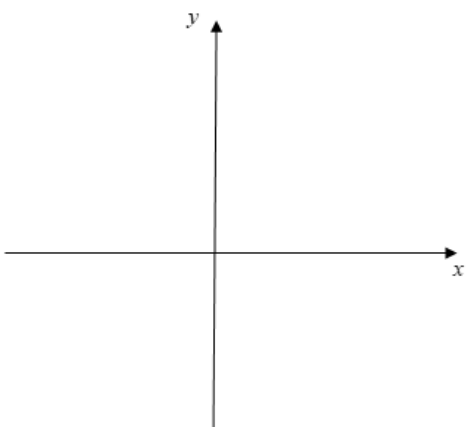
$f(x) = |x| - 3$

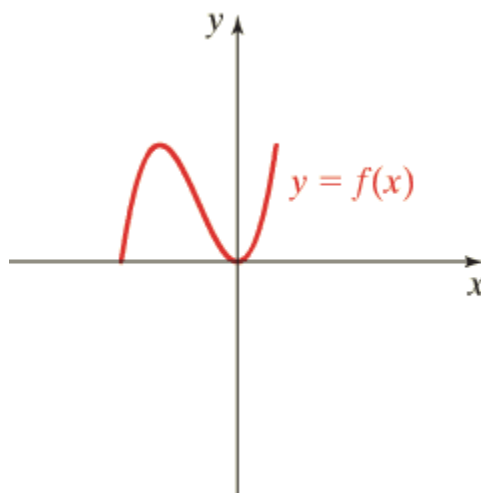$f(x) = \sqrt{x} + 4$

$f(x) = \dfrac{1}{x} - 3$

Section 3.4  Objective 2 Using Horizontal Shifts to Graph Functions
Work through the video that accompanies Objective 2 and take notes here:

If $c > 0$, explain in your own words how to sketch the graph of $y = f(x+c)$ and $y = f(x-c)$.
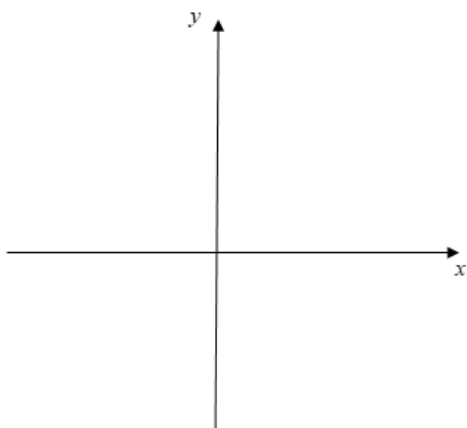
Click on the "**animate buttons**" on p. 3.4-9 and use the given graph of $y = f(x)$ below to sketch the graphs of $y = f(x+c)$ and $y = f(x-c)$.
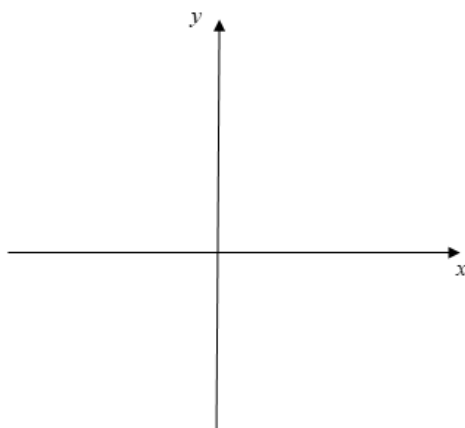
Section 3.4

Work through the **Guided Visualization** titled "Horizontal Transformations of Functions" seen on page 3.4-10. Then sketch each of the following functions below:
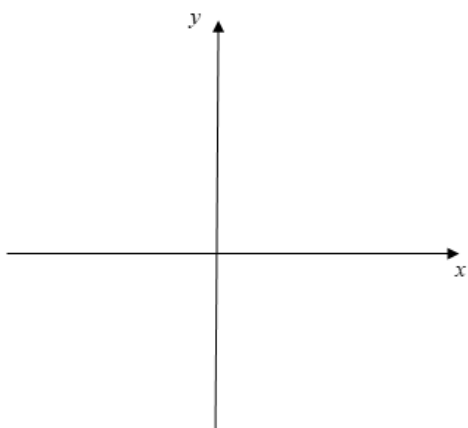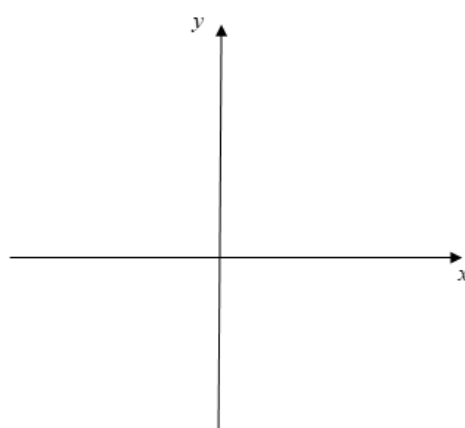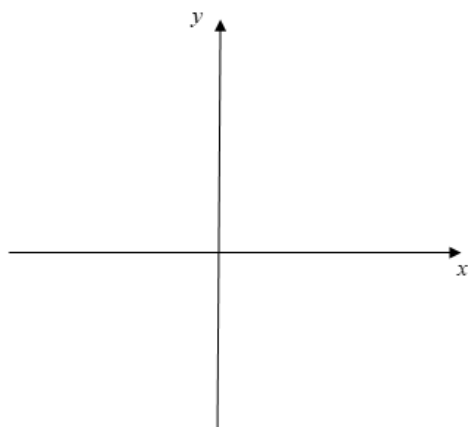
$f(x) = (x - 3)^2$

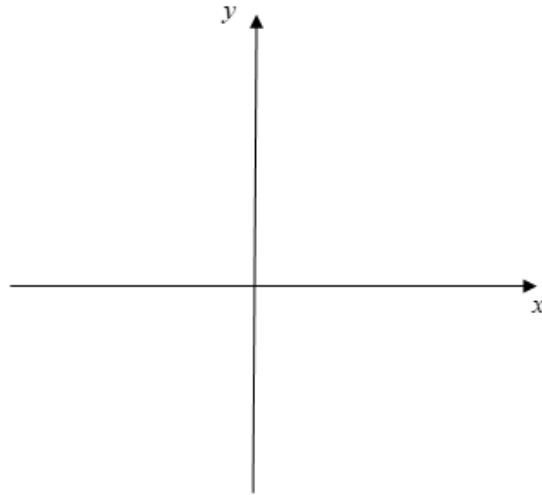$f(x) = (x + 4)^3$

$f(x) = |x + 2|$

$f(x) = \sqrt{x - 3}$

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

IT IS NOW TIME TO COMBINE A HORIZONTAL AND A VERTICAL SHIFT.

Work through the animation that accompanies Example 2 and take notes here:

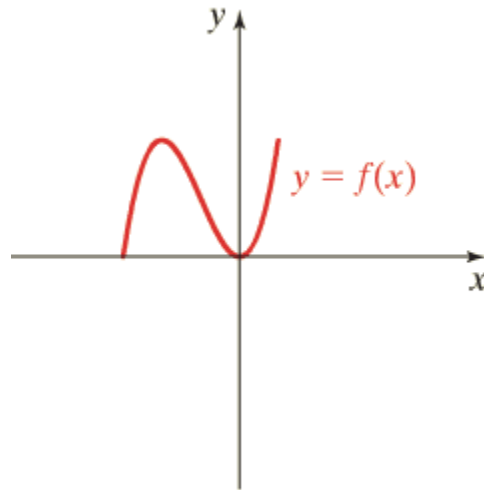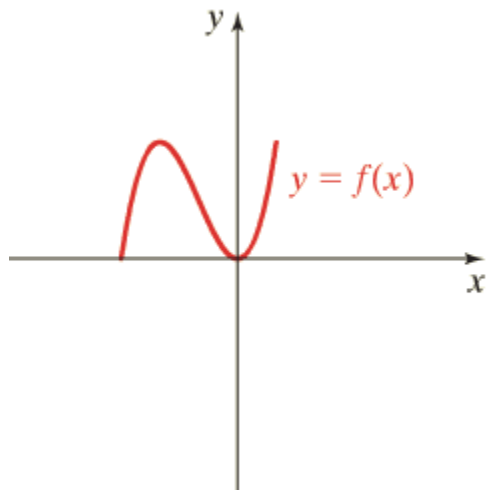Use the graph of $y = x^3$ to sketch the graph of $g(x) = (x-1)^3 + 2$.



Section 3.4  Objective 3 Using Reflections to Graph Functions
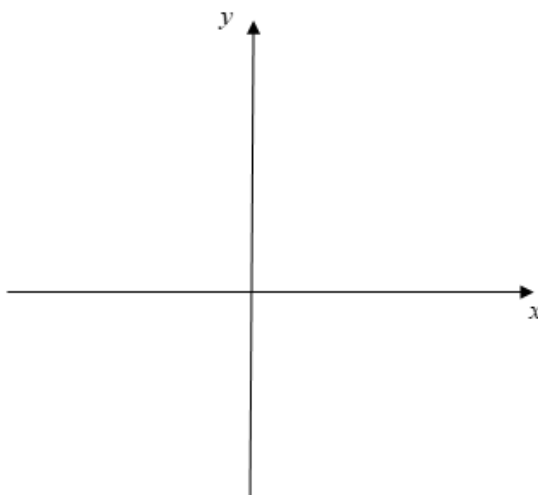Work through the video that accompanies Objective 3 and take notes here:

If $c > 0$, explain in your own words how to sketch the graph of $y = -f(x)$ and $y = f(-x)$.

Click on the "**animate buttons**" on p. 3.4-13 and p. 3.4-15 and use the given graphs of $y = f(x)$ below to sketch the graphs of $y = -f(x)$ and $y = f(-x)$.
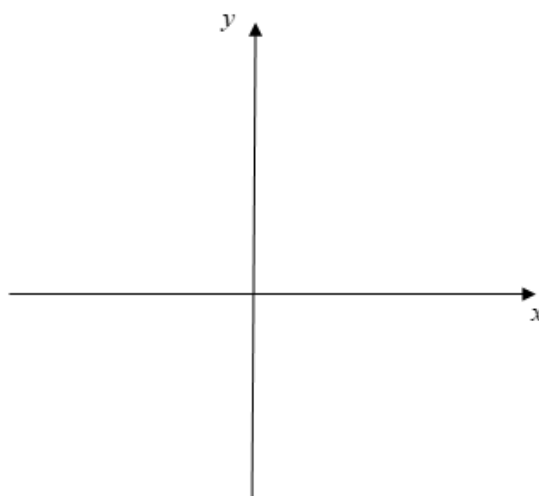


$y = f(x)$

$y = f(x)$

Work through Example 3 and take notes here:  Use the graph of the basic function $y = \sqrt[3]{x}$ to sketch each graph.

a) $y = -\sqrt[3]{x} - 2$



b) $y = \sqrt[3]{1 - x}$

Section 3.4  Objective 4 Using Vertical Stretches and Compressions to Graph Functions
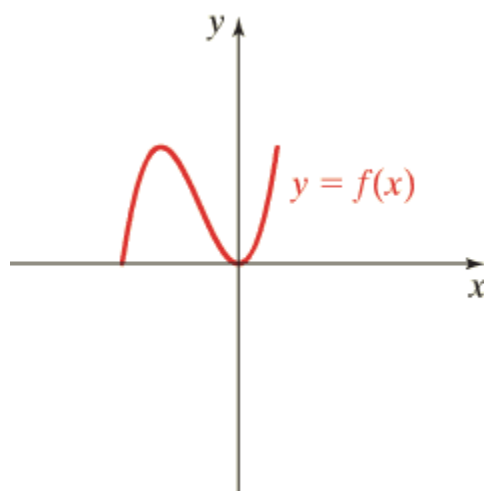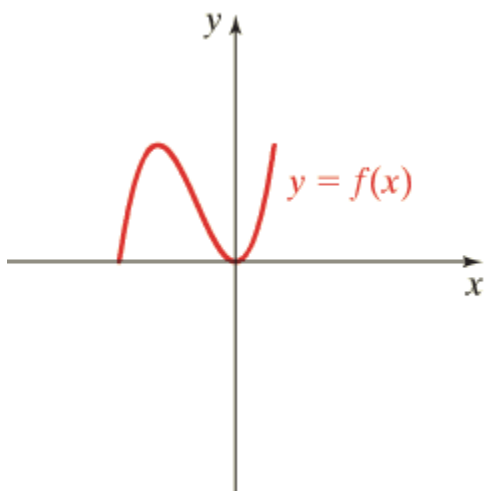Work through the video that accompanies Example 4 and take notes here:
Use the graph of $f(x) = x^2$ to sketch the graph of $g(x) = 2x^2$.

If $a > 1$, explain in your own words how to sketch the graph of $y = a f(x)$.

If $0 < a < 1$, explain in your own words how to sketch the graph of $y = a f(x)$.

Click on the "**animate buttons**" on p. 3.4-20 and use the given graph of $y = f(x)$ below to sketch the graphs of $y = a f(x)$ for $a > 1$ and $y = a f(x)$ for $0 < a < 1$.



Section 3.4  Objective 5 Using Horizontal Stretches and Compressions to Graph Functions
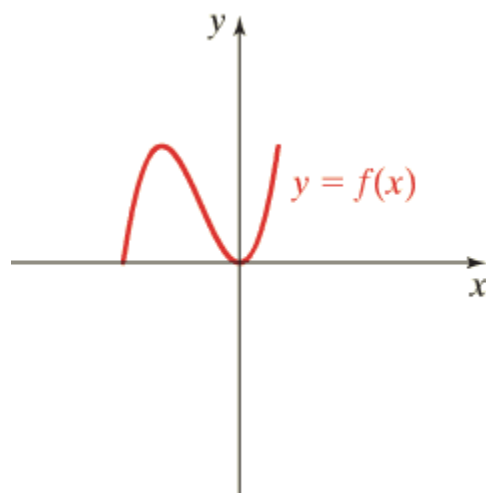Work through the video that accompanies Objective 5 and take notes here:

Copyright © 2019 Pearson Education, Inc.

Section 3.4

If $a > 1$, explain in your own words how to sketch the graph of $y = f(ax)$.

If $0 < a < 1$, explain in your own words how to sketch the graph of $y = f(ax)$.

Click on the "**animate buttons**" on p. 3.4-22 and use the given graph of $y = f(x)$ below to sketch the graphs of $y = f(ax)$ for $a > 1$ and $y = f(ax)$ for $0 < a < 1$.
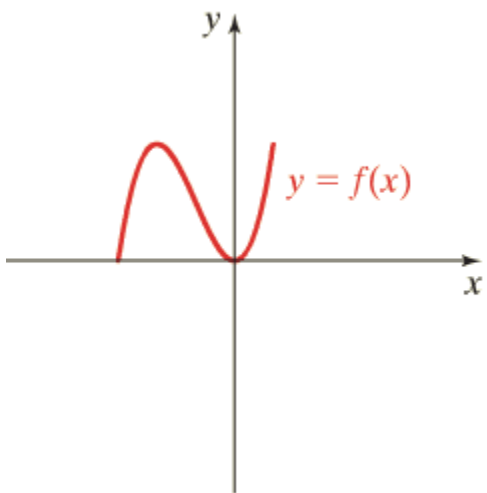
Work through the video that accompanies Example 5 and take notes here:

Use the graph of $f(x) = \sqrt{x}$ to sketch the graphs of $g(x) = \sqrt{4x}$ and $h(x) = \sqrt{\dfrac{1}{4}x}$ .

Section 3.4

Section 3.4 Objective 6 Using Combinations of Transformations to Graph Functions
You have learned 6 transformations in this section. You may encounter functions that combine many (if not all) of these transformations. Write down the "order of operations" of transformations as in Objective 6.
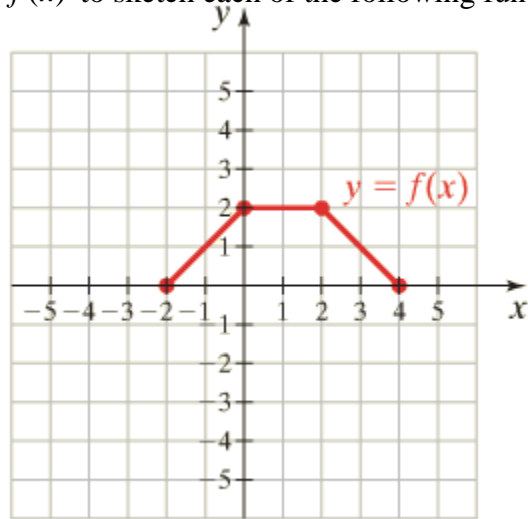
"Order of Operations" for Transformations

1.

2.

3.

4.

5.

6.

Work through the animation that accompanies Example 6 and take notes here:
Use transformations to sketch the graph of $y = -2(x+3)^2 - 1$.

Work through the interactive video that accompanies Example 7 and take notes here:
Use the graph of $y = f(x)$ to sketch each of the following functions.



a) $y = -f(2x)$

b) $y = 2f(x- 3)- 1$

c) $y = -\dfrac{1}{2}f(2 - x) + 3$

Section 3.4

Use the **Summary of Transformation Techniques** to complete the following statements:

Given a function $y = f(x)$ and a constant $c > 0$:

1. The graph of $y = f(x) + c$ is obtained by…

2. The graph of $y = f(x) - c$ is obtained by…

3. The graph of $y = f(x + c)$ is obtained by…

4. The graph of $y = f(x - c)$ is obtained by…

5. The graph of $y = -f(x)$ is obtained by…

6. The graph of $y = f(-x)$ is obtained by…

7. Suppose $a$ is a positive real number. The graph of $y = af(x)$ is obtained by…

8. Suppose $a$ is a positive real number. The graph of $y = f(ax)$ is obtained by…