

Sample student worksheet on translations and reflections

In this worksheet you will use an interactive web page to help you explore translations and reflections of graphs. You will do this by studying the effects of constants a , h and k on the graph of an equation like $y = a(x - h)^2 + k$. Using a PC connected to the Internet, point your web browser (Netscape or Internet Explorer) to

<http://www.jcu.edu/cspitzna/calculus/>

This will open a page titled *Interactive Calculus Activities*. From here, click on the link to *Translations and Reflections*. [**Note to PC owners:** If you are not using a PC in one of the labs, you will need to install a plug-in in order to use any of the *Interactive Calculus* web pages. Follow the link to information on how to get and install the plug-in.]

Read and follow directions carefully--especially the part about how to change the values of constants:

1. **Click on the box** with the dot in it, in front of the definition of the constant that you want to change. (This will highlight the entire expression.)
2. Press the **right arrow** cursor key. (This should move the cursor to the end of that line.)
3. Use the **Backspace** key to delete the current value, and then type a new value.

Notes:

- *Do not press Enter.* The mathematics and the graph will change automatically.
- To make further changes to any given constant, you do not need to repeat steps 1 and 2; simply use the backspace key and then supply a new value. The graph should be redrawn almost instantaneously.

Use the *Graphs of Quadratic Equations* web page to perform the following experiments, and to help you answer questions 1-8.

1. What are the initial values of a , h and k on the web page?

$a =$ _____ $h =$ _____ $k =$ _____

What is the corresponding (simplified) formula for y ? _____

2. To get $y = 0.2(x - 3)^2 + 8$, what values must a , h and k have?

$a =$ _____ $h =$ _____ $k =$ _____

3. Reload (or Refresh) the web page, to restore the original values of the constants. Then begin to try a dozen or so different values for a . (Leave h and k unchanged.) Observe the effects that these changes to a have on the graph, until you can answer the following questions with

confidence. In each case, describe the new graph relative to the graph of the original equation, $y = x^2$.

If $a > 1$, then the graph is _____

If $0 < a < 1$, then the graph is _____

If $a < 0$, then the graph is _____

4. Reload (or Refresh) the web page, to restore the original values of the constants. Then begin to try a dozen or so different values for h . (Leave a and k unchanged.) Observe the effects that these changes to h have on the graph, until you can answer the following questions with confidence. In each case, describe the new graph relative to the graph of the original equation, $y = x^2$.

If $h > 0$, then the graph is _____

If $h < 0$, then the graph is _____

5. Reload (or Refresh) the web page, to restore the original values of the constants. Then begin to try a dozen or so different values for k . (Leave a and h unchanged.) Observe the effects that these changes to k have on the graph, until you can answer the following questions with confidence. In each case, describe the new graph relative to the graph of the original equation, $y = x^2$.

If $k > 0$, then the graph is _____

If $k < 0$, then the graph is _____

6. Describe what you observe when you change a , h and k together. Do the changes you observed in (3), (4) and (5) still apply?

7. Consider the equation $y = -0.5(x - 3)^2 - 5$. What are the values of a , h and k ?

$$a = \underline{\hspace{2cm}} \quad h = \underline{\hspace{2cm}} \quad k = \underline{\hspace{2cm}}$$

Based on your observations above, and *without using the web page or your calculator*, describe in words how this graph differs from the graph of $y = x^2$.

Without using the web page or your calculator, sketch the graph of the equation. (Then check by using the web page.)

8. Consider the equation $y = 2(x + 1)^2 + 5$. What are the values of a , h and k ?

$$a = \underline{\hspace{2cm}} \quad h = \underline{\hspace{2cm}} \quad k = \underline{\hspace{2cm}}$$

Based on your observations above, and *without using the web page or your calculator*, describe in words how this graph differs from the graph of $y = x^2$.

Without using the web page or your calculator, sketch the graph of the equation. (Then check by using the web page.)

9. You are now ready to follow the link to *Graphing the Absolute Value Function*. As you did in the previous questions on this worksheet, explore the effects that changing the values of a , h and k has on the graph. Summarize your results below, using the graph of $y = |x|$ as a reference.

If $a > 1$, then the graph is _____

If $0 < a < 1$, then the graph is _____

If $a < 0$, then the graph is _____

If $h > 0$, then the graph is _____

If $h < 0$, then the graph is _____

If $k > 0$, then the graph is _____

If $k < 0$, then the graph is _____

10. Consider the equation $y = -3|x + 2| - 4$. What are the values of a , h and k ?

$a =$ _____ $h =$ _____ $k =$ _____

Based on your observations above, and *without using the web page or your calculator*, describe in words how this graph differs from the graph of $y = |x|$.

Without using the web page or your calculator, sketch the graph of the equation. (Then check by using the web page.)

11. You are now ready to follow the link to *Graphing the Square Root Function*. As you did in the previous questions on this worksheet, explore the effects that changing the values of a , h and k has on the graph. Summarize your results below, using the graph of $y = \sqrt{x}$ as a reference.

If $a > 1$, then the graph is _____

If $0 < a < 1$, then the graph is _____

If $a < 0$, then the graph is _____

If $h > 0$, then the graph is _____

If $h < 0$, then the graph is _____

If $k > 0$, then the graph is _____

If $k < 0$, then the graph is _____

12. Consider the equation $y = 3\sqrt{x-1} + 2$. What are the values of a , h and k ?

$a =$ _____ $h =$ _____ $k =$ _____

Based on your observations above, and *without using the web page or your calculator*, describe in words how this graph differs from the graph of $y = \sqrt{x}$.

Without using the web page or your calculator, sketch the graph of the equation. (Then check by using the web page.)

13. You are now ready to follow the link to *Graphing the Reciprocal Function*. As you did in the previous questions on this worksheet, explore the effects that changing the values of h and k has on the graph. Summarize your results below, using the graph of $y = \frac{1}{x}$ as a reference.

If $h > 0$, then the graph is _____

If $h < 0$, then the graph is _____

If $k > 0$, then the graph is _____

If $k < 0$, then the graph is _____

14. Consider the equation $y = \frac{1}{x+2} - 3$. What are the values of h and k ?

$h =$ _____ $k =$ _____

Based on your observations above, and *without using the web page or your calculator*, describe in words how this graph differs from the graph of $y = \frac{1}{x}$.

Without using the web page or your calculator, sketch the graph of the equation. (Then check by using the web page.)