

In each case,  $c$  represents a positive real number.

To Graph:	Draw the Graph of $f$ and:	Changes in the Equation of $y = f(x)$
Vertical shifts $y = f(x) + c$ $y = f(x) - c$	Raise the graph of $f$ by $c$ units. Lower the graph of $f$ by $c$ units.	$c$ is added to $f(x)$ . $c$ is subtracted from $f(x)$ .
Horizontal shifts $y = f(x + c)$ $y = f(x - c)$	Shift the graph of $f$ to the left $c$ units. Shift the graph of $f$ to the right $c$ units.	$x$ is replaced with $x + c$ . $x$ is replaced with $x - c$ .
Reflection about the $x$ -axis $y = -f(x)$	Reflect the graph of $f$ about the $x$ -axis.	$f(x)$ is multiplied by $-1$ .
Reflection about the $y$ -axis $y = f(-x)$	Reflect the graph of $f$ about the $y$ -axis.	$x$ is replaced with $-x$ .
Vertical stretching or shrinking $y = cf(x), c > 1$ $y = cf(x), 0 < c < 1$	Multiply each $y$ -coordinate of $y = f(x)$ by $c$ , vertically stretching the graph of $f$ . Multiply each $y$ -coordinate of $y = f(x)$ by $c$ , vertically shrinking the graph of $f$ .	$f(x)$ is multiplied by $c, c > 1$ . $f(x)$ is multiplied by $c, 0 < c < 1$ .
Horizontal stretching or shrinking $y = f(cx), c > 1$ $y = f(cx), 0 < c < 1$	Divide each $x$ -coordinate of $y = f(x)$ by $c$ , horizontally shrinking the graph of $f$ . Divide each $x$ -coordinate of $y = f(x)$ by $c$ , horizontally stretching the graph of $f$ .	$x$ is replaced with $cx, c > 1$ . $x$ is replaced with $cx, 0 < c < 1$ .

1. A project requires the transformation of the cubic function to the function  $h(x) = -(x - 2)^3 + 4$ . You are supervising Wells and Anderson and they have a dispute over the proper order of the transformation that you will have to write into a computer program.

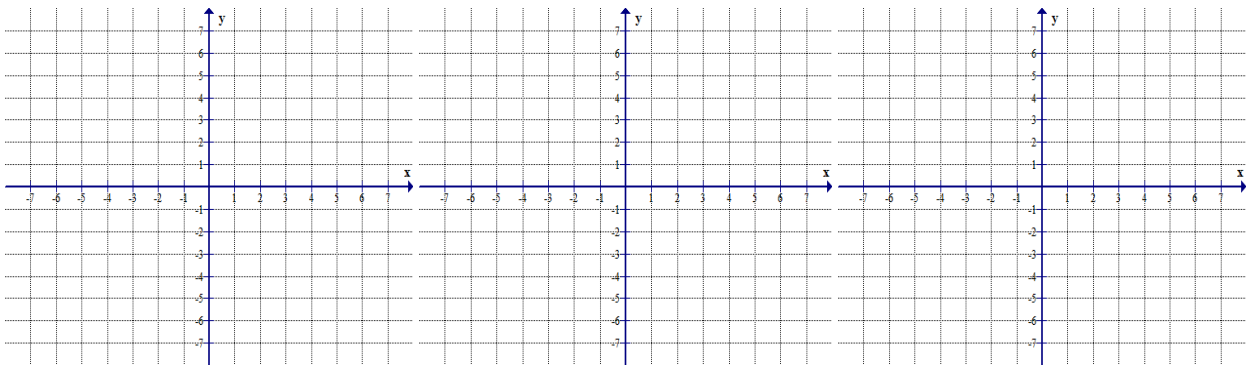
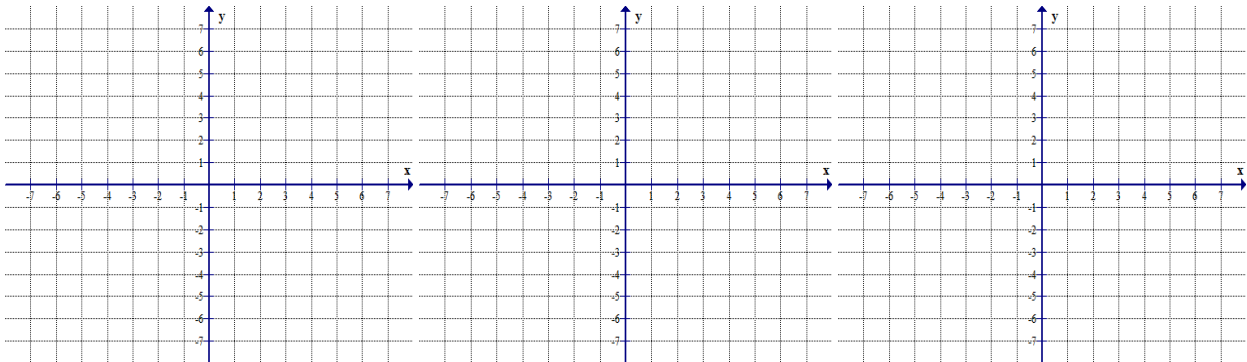
Wells says that the transformation should be:

- i. Shift right 2
- ii. Shift up 4
- iii. Reflect across the x axis

Anderson says:

- i. Shift right 2
- ii. Reflect across the x axis
- iii. Shift up 4

They are bickering. You need to settle this and use it as a teaching moment so they both know the correct transformation (and why it is correct) for future projects. Graph both set of transformations and determine which set results in the graph  $h(x) = -(x - 2)^3 + 4$ . Explain who is correct and why.




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