

Functions and Lines

Vertical and Horizontal Shifts:

Suppose $c > 0$. To obtain the graph of:

1. $y = f(x) + c$, shift the graph of $y = f(x)$ a distance of c units upward.
2. $y = f(x) - c$, shift the graph of $y = f(x)$ a distance of c units downward.
3. $y = f(x - c)$, shift the graph of $y = f(x)$ a distance of c units to the right.
4. $y = f(x + c)$, shift the graph of $y = f(x)$ a distance of c units to the left.

1. Graph the function $f(x) = x$.

Write the equation that is obtained from the graph of $f(x)$ with the following modifications, and then graph the resulting functions on the same graph with $f(x)$.

- Shift 3 units upward: $y = f(x) + 3 = x + 3$

- Shift 3 units downward: $y = f(x) - 3 = x - 3$

- Shift 3 units to the right: $y = f(x - 3) = x - 3$

- Shift 3 units to the left: $y = f(x + 3) = x + 3$

Vertical and Horizontal Stretching and Reflecting:

Suppose $c > 1$. To obtain the graph of:

- $y = c * f(x)$, stretch the graph of $y = f(x)$ vertically by a factor of c .
- $y = \frac{1}{c} * f(x)$, compress the graph of $y = f(x)$ vertically by a factor of c .
- $y = f(c * x)$, compress the graph of $y = f(x)$ horizontally by a factor of c .
- $y = f(\frac{x}{c})$, stretch the graph of $y = f(x)$ horizontally by a factor of c .
- $y = -f(x)$, reflect the graph of $y = f(x)$ about the x -axis.
- $y = f(-x)$, reflect the graph of $y = f(x)$ about the y -axis.

2. Graph the function $f(x) = x$.

Write the equation that is obtained from the graph of $f(x)$ with the following modifications, and then graph the resulting functions on the same graph with $f(x)$.

- Reflect about the x -axis: $y = -f(x) = -x$
- Reflect about the y -axis: $y = f(-x) = -x$
- Stretch vertically by a factor of 3: $y = 3f(x) = 3x$
- Compress vertically by a factor of 3: $y = \frac{1}{3}f(x) =$

3. Graph the function $g(x) = x^2$.

Graph the following functions on the same graph with $g(x)$.

- $y = x^2 + 3$

- $y = x^2 - 4$

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

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

- $y = |x^2 - 1|$

4. Graph the function $h(x) = \sqrt{x}$.

Graph the following functions on the same graph with $h(x)$.

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

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

- $y = -\sqrt{x}$

- $y = 2\sqrt{x}$

- $y = \sqrt{-x}$

5. Graph the function $k(x) = \cos x$.

Graph the following functions on the same graph with $k(x)$.

- $y = 2 \cos x$

- $y = \frac{1}{2} \cos x$

- $y = \cos \frac{x}{2}$

- $y = \cos 2x$

6. Graph the function $l(x) = \sin x$.

Graph the following functions on the same graph with $l(x)$.

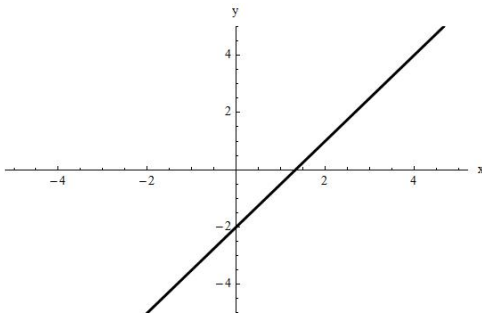
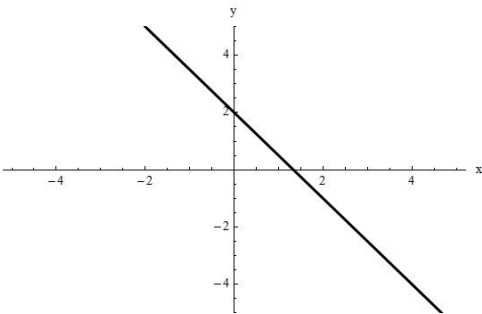
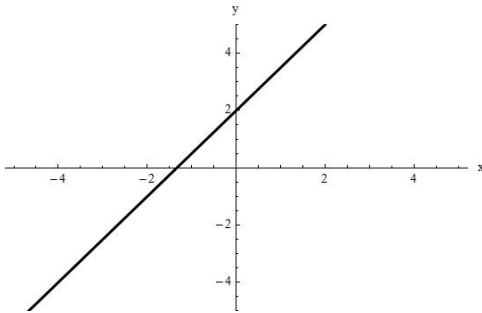
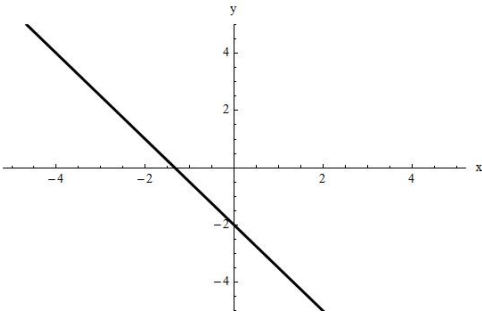
- $y = 2 \sin x$

- $y = \frac{1}{2} \sin x$

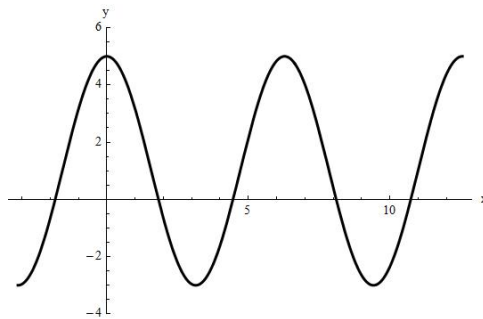
- $y = \sin \frac{x}{2}$

- $y = \sin 2x$

7. Which of the following is the graph of the function $2y - 3x = 4$?



8. What is an equation of the following graph?



- $y = 4 \sin x + 1$
- $y = 4 \cos x + 1$
- $y = 5 \sin x$
- $y = 5 \cos x$

9. Given $f(x) = \sin(x)$, and $g(x) = 1 - \sqrt{x}$, find the functions $f \circ g$, $g \circ f$, $f \circ f$, $g \circ g$, and state their domains.

10. Given $f(x) = 1 - 3x$, and $g(x) = 5x^2 + 3x + 2$, find the functions $f \circ g$, and $g \circ f$, and state their domains.

11. Given $f(x) = \sqrt{x-1}$, $g(x) = x^2 + 2$, and $h(x) = x + 3$, find the function $f \circ g \circ h$, and state its domain.