

# MA 109: September 29

Transformations: Shifts

Start of Class

Instructor Information

Name:

Email:

Office Hours:

Warm-up Questions

- remember:
  - vertical: outside
  - horizontal: inside

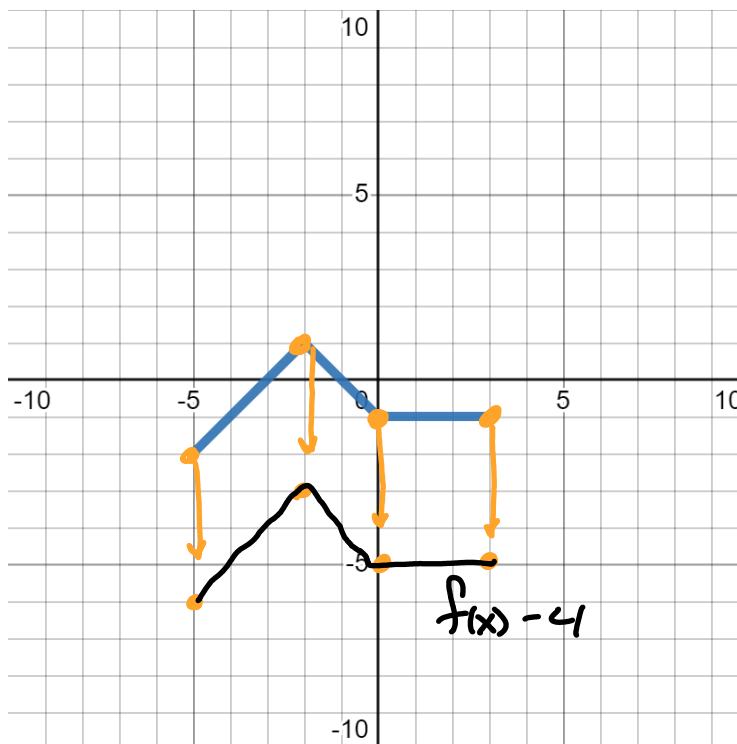
Notes

Example: Suppose  $f(x)$  is given in the graph to the right. Draw the graph of  $f(x)-4$ .



outside: vertical  
 subtract 4: shift  
 down by 4

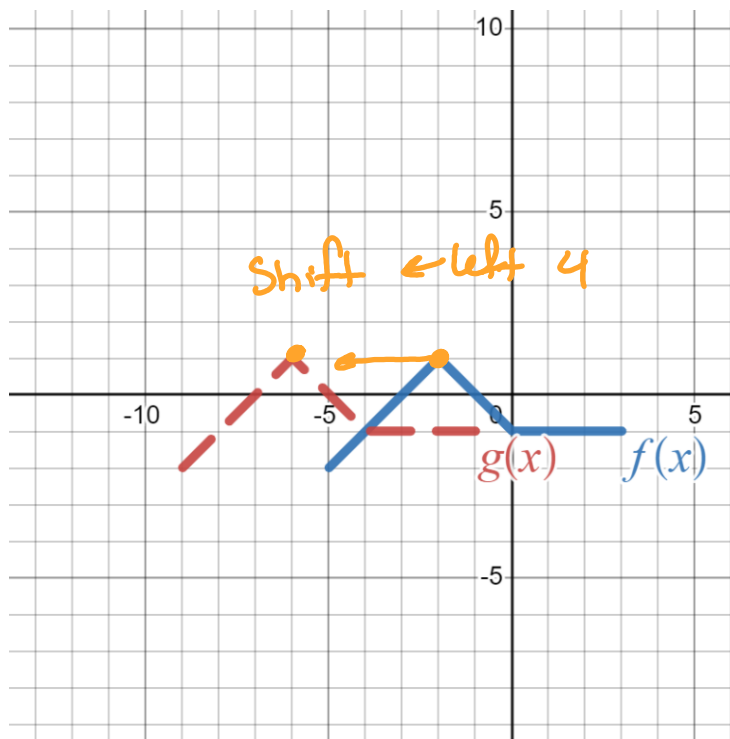
suggestion: move  
 each corner point, then  
 connect them



Example: Suppose  $f(x)$  and  $g(x)$  are given in the graph to the right.

If  $f(x)$  is our original function, write the formula for  $g(x)$  in terms of  $f(x)$ .

suggestion: pick one  
 point to track  
 how far moved



shift left (negative  
 horizontal direction)  
 by 4

so: add 4 inside (remember: horizontal  
 shifts are backwards)

$g(x) = f(x+4)$

**Example:** Suppose  $f(x) = x^2 + 8x - 3$ , and the graph of  $g(x)$  is the same as that of  $f(x)$ , but shifted left by 7. Write the formula for  $g(x)$ .

Shift left: negative horizontal direction

So: add 7 inside

$$g(x) = f(x+7) = (\underline{x+7})^2 + 8(\underline{x+7}) - 3$$

don't forget to plug into the formula for  $f(x)$

**Example:** Suppose  $f(x) = 3x^2 + 4$  and  $g(x) = 3x^2 - 1$ . What transformation took  $f(x)$  to  $g(x)$ ?

what changed?

5 less on changed one

$$g(x) = 3x^2 - 1 = (3x^2 + 4) - 5 = f(x) - 5$$

subtract 5  
outside

so:

vertical shift down

## End of Class

Write a summary of what you learned today:

What questions do you have about the material from today?

What do you need to do between now and the next class meeting?