

Function Shift Lab

Build and describe new functions from familiar ones.

HIGH SCHOOL • HSF-BF.B

CCSS.Math.Content.HSF-BF.B "Build new functions from existing functions"

NAME _____

DATE _____

TRANSFORM THE RULE

A new function can be made by changing the input or output of f . In $f(x-h)+k$, subtracting h inside shifts the graph right h , and adding k outside shifts it up k . Replacing $f(x)$ with $-f(x)$ reflects over the x -axis, while replacing x with $-x$ reflects over the y -axis.

WORKED EXAMPLE

Let $f(x)=11x+13$. Write $q(x)=f(x-12)-14$ in terms of x .

1. Substitute the rule for f : $q(x)=11(x-12)+13-14$.
2. Distribute: $q(x)=11x-132+13-14$.
3. Combine constants: $q(x)=11x-133$.

Answer: $q(x)=11x-133$

PRACTICE 6 problems

- 1** Let $f(x)=x^2$. Write $g(x)=f(x-3)+1$ in terms of x .

ANSWER _____

- 2** Let $f(x)=4x-5$. Write $g(x)=f(x)+2$ in terms of x .

ANSWER _____

- 3** Let $f(x)=|x|$. Describe the transformations that make $g(x)=f(x+2)-5$.

ANSWER _____

- 4** Let $f(x)=x^3$. Describe the transformation that makes $g(x)=-f(x)$.

ANSWER _____

- 5** Let $f(x)=1/x$. Write $g(x)=f(x)-4$ in terms of x .

ANSWER _____

- 6** Let $f(x)=x^2$. Describe the graph of $g(x)=f(-x)$.

ANSWER _____

APPLY IT Show your work

- 1** A gaming app gives a player $f(q)=2q+1$ coins after q quests. During a weekend event, the app adds 4 bonus coins to each player's usual total. Write the new function $g(q)$, then find $g(5)$.

WORK SPACE

ANSWER _____

- 2** An esports streaming overlay uses $f(t)=t^2$ to model a graphic's path. In a new layout, the path is shifted left 1 unit and up 6 units. Write $g(t)$, then find $g(2)$.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Let $f(x)=x^2$, $p(x)=f(x-2)+3$, and $q(x)=f(x+2)-3$. Find the point where the graphs of p and q intersect. Then describe how p and q are translated from f .

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Let $f(x)=x^2$. Write $g(x)=f(x-3)+1$ in terms of x .	$g(x)=(x-3)^2+1$
2	Let $f(x)=4x-5$. Write $g(x)=f(x)+2$ in terms of x .	$g(x)=4x-3$
3	Let $f(x)= x $. Describe the transformations that make $g(x)=f(x+2)-5$.	Shift left 2 units and down 5 units.
4	Let $f(x)=x^3$. Describe the transformation that makes $g(x)=-f(x)$.	Reflect the graph over the x-axis.
5	Let $f(x)=1/x$. Write $g(x)=f(x)-4$ in terms of x .	$g(x)=1/x-4$
6	Let $f(x)=x^2$. Describe the graph of $g(x)=f(-x)$.	It is a reflection over the y-axis. The graph is unchanged because $(-x)^2=x^2$.

PART 2 • APPLY IT

- $g(q)=2q+5$, and $g(5)=15$ coins.** Add 4 to the output: $g(q)=f(q)+4=2q+5$. Substitute $q=5$ to get 15.
- $g(t)=(t+1)^2+6$, and $g(2)=15$.** A left shift uses $t+1$, and an upward shift adds 6: $g(t)=f(t+1)+6$. Substitute $t=2$ to get 15.

CHALLENGE

The graphs intersect at $(3/4, 73/16)$. p is shifted right 2 units and up 3 units. q is shifted left 2 units and down 3 units.

Accept equivalent expanded or factored forms for function rules. For transformation descriptions, accept equivalent wording such as horizontal shift left or right and vertical shift up or down.