LESSON MAKER PRO

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

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.

WORK SPACE AND ANSWER

ANSWER KEY # Function Shift Lab

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

1. **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.
2. **$g(t)=(t+1)^2+6$, 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.