LESSON MAKER PRO

Function Shift Lab

Track horizontal and vertical changes on function graphs.

HIGH SCHOOL · MA.912.F.2.2

MA.912.F.2.2 "Identify the effect on the graph of a given function of two or more transformations defined by adding a real number to the x- or y- values or multiplying the x- or y- values by a real number."

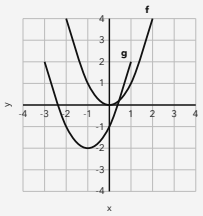
NAME _____ DATE _____

TRANSFORMATION RULES

In g(x) = a f(b(x - h)) + k, h moves the graph horizontally and k moves it vertically. A negative a reflects over the x-axis, a negative b reflects over the y-axis, and a factor inside f changes horizontal scale in the opposite way.

WORKED EXAMPLE

The grid shows f and g. Write g in terms of f, then state the translation.



1. The vertex of f is (0, 0). The vertex of g is (-1, -2).
2. Moving f left 1 gives f(x + 1).
3. Moving that result down 2 gives g(x) = f(x + 1) - 2.

Answer: g(x) = f(x + 1) - 2; shift left 1 unit and down 2 units.

PRACTICE 4 problems

1 Let p(x) = |x|. Describe every transformation from p to q, where q(x) = -3p(x - 4) + 5.

ANSWER _____

2 Let p(x) = x^3. Describe every transformation from p to q, where q(x) = p(-3x) - 4.

ANSWER _____

3 Write r in terms of f after a vertical stretch by 5, a shift left 6, and a shift down 8.

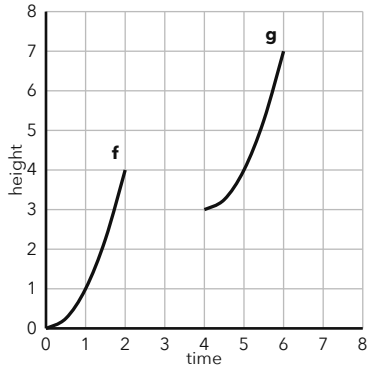
ANSWER _____

4 Write s in terms of f after a shift right 7, a reflection over the x-axis, a vertical shrink by 1/3, and a shift up 9.

ANSWER _____

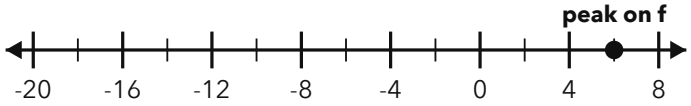
APPLY IT Show your work

1 In a game, the solid curve is a character's original jump path f. The curve labeled g is the redesigned path. Use the graph to write g in terms of f and describe the changes.



ANSWER _____

2 A music app models a sound peak with f. The dot marks the peak's x-location on f. An update uses g(x) = f(-x/3) - 7. Find the peak's new x-coordinate and state its vertical change.



ANSWER _____

CHALLENGE One step up

Point (5, -1) lies on f. For g(x) = -4f(2(x - 3)) + 6, find the corresponding point on g. Then name all transformations from f to g.

WORK SPACE AND ANSWER

ANSWER KEY

Function Shift Lab

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Let p(x) = |x|. Describe every transformation from p to q, where q(x) = -3p(x - 4) + 5.	**Reflect over the x-axis, vertically stretch by a factor of 3, shift right 4 units, and shift up 5 units.**
2	Let $p(x) = x^3$. Describe every transformation from p to q, where q(x) = p(-3x) - 4.	**Reflect over the y-axis, horizontally compress by a factor of 1/3, and shift down 4 units.**
3	Write r in terms of f after a vertical stretch by 5, a shift left 6, and a shift down 8.	**r(x) = 5f(x + 6) - 8**
4	Write s in terms of f after a shift right 7, a reflection over the x-axis, a vertical shrink by 1/3, and a shift up 9.	**s(x) = -(1/3)f(x - 7) + 9**

PART 2 · APPLY IT

1. **g(x) = f(x - 4) + 3; shift right 4 units and up 3 units.** Compare matching points, such as (0, 0) on f and (4, 3) on g. Every point moves right 4 and up 3.
2. **New x-coordinate: -18. Vertical change: 7 units down.** Set -x/3 equal to the original input, 6, so x = -18. The -7 outside the function moves the graph down 7 units.

CHALLENGE

Corresponding point: (11/2, 10). Reflect over the x-axis, vertically stretch by 4, horizontally compress by 1/2, shift right 3 units, and shift up 6 units.

Accept equivalent wording for reflections, stretches, compressions, and shifts. For the challenge, accept transformations in any order if the listed effects and point are correct.