LESSON MAKER PRO

Graph Shift Lab

Track how a change to a function changes its graph.

HIGH SCHOOL · PC.F.D.30

PC.F.D.30 "Identify the effect on the graph of replacing f(x) by f(x) + k, k · f(x), f(k · x), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Extend the analysis to include all trigonometric..."

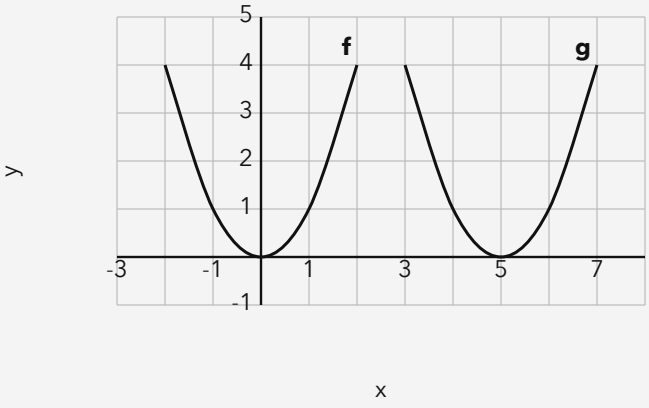
NAME _____ DATE _____

FOLLOW THE COORDINATES

Adding k to f(x) moves every point up k units. Multiplying f(x) by k multiplies every y-coordinate by k. For nonzero k, replacing x with kx divides every x-coordinate by k, while replacing x with x + k subtracts k from every x-coordinate. A negative multiplier reflects the graph across an axis.

WORKED EXAMPLE

The figure shows $f(x) = x^2$ and $g(x) = f(x + k)$. Find k and describe the shift.

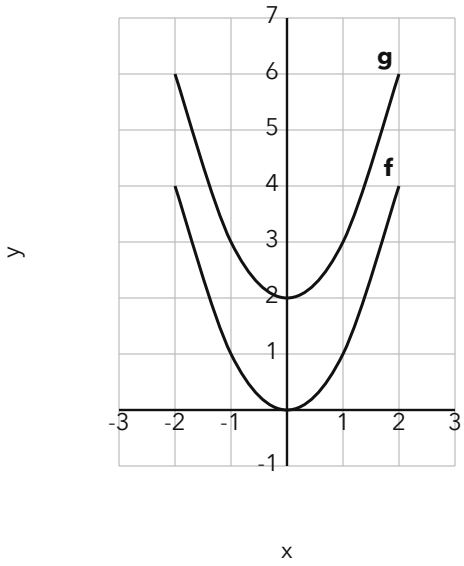


1. The vertex of f is at (0, 0).
2. The vertex of g is at (5, 0), so the graph moved right 5 units.
3. In f(x + k), x-coordinates change by -k. Solve -k = 5 to get k = -5.

Answer: k = -5; the graph shifts right 5 units.

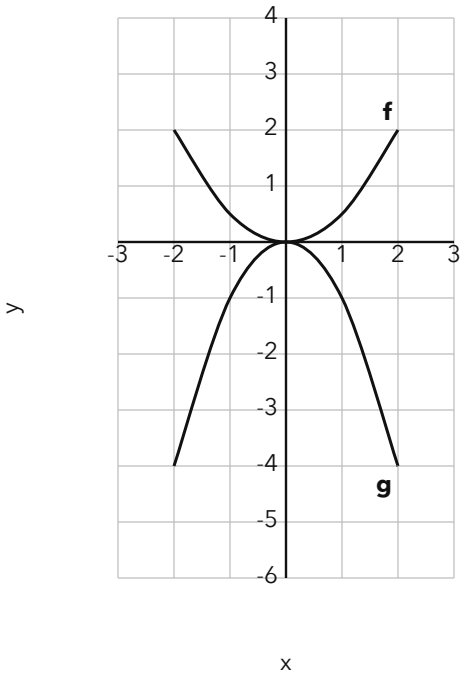
PRACTICE 6 problems

1 In the figure, g(x) = f(x) + k. Find k and describe the effect on the graph.



ANSWER _____

2 In the figure, g(x) = k f(x). Find k and describe the effect on the graph.



ANSWER _____

3 Let f(x) = sin x and g(x) = f(-2x). Describe the horizontal changes from f to g, and find the smallest positive period of g.

ANSWER _____

4 Let f(x) = 1/x and g(x) = f(x - 2). Describe the shift from f to g, and give the vertical asymptote of g.

ANSWER _____

5 Let f(x) = x + 1 when x < 0, and f(x) = 2x + 1 when x ≥ 0. For g(x) = f(x + 1), find the x-value where g switches rules and find g(0).

ANSWER _____

6 Let f(x) = cos x and g(x) = f(x) - 1. Give the midline and range of g.

ANSWER _____

APPLY IT Show your work

1 A DJ uses a repeating sound effect modeled by f(t) = sin t, where t is in seconds. A speed setting changes it to g(t) = f(2t). How does the graph change horizontally, and what is the new period?

WORK SPACE

ANSWER _____

2 Friends split a $120 concert ticket package equally. The cost per person is f(n) = 120/n dollars for n friends. A booking fee adds $6 per person, making g(n) = f(n) + 6. How does the graph change, and what does each person pay if 10 friends split the cost?

WORK SPACE

ANSWER _____

CHALLENGE One step up

Let f(x) = x + 2 when x < 0, and f(x) = 2 - x when x ≥ 0. Let g(x) = -f(x + 2) + 1. Describe the changes to the graph of f in order, find where g switches rules, and find g(-1).

WORK SPACE AND ANSWER

ANSWER KEY # Graph Shift Lab

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	In the figure, g(x) = f(x) + k. Find k and describe the effect on the graph.	**k = 2; the graph shifts up 2 units.**
2	In the figure, g(x) = k f(x). Find k and describe the effect on the graph.	**k = -2; the graph reflects across the x-axis and is stretched vertically by a factor of 2.**
3	Let f(x) = sin x and g(x) = f(-2x). Describe the horizontal changes from f to g, and find the smallest positive period of g.	**The graph reflects across the y-axis and is compressed horizontally by a factor of 1/2. The smallest positive period is pi.**
4	Let f(x) = 1/x and g(x) = f(x - 2). Describe the shift from f to g, and give the vertical asymptote of g.	**The graph shifts right 2 units. The vertical asymptote is x = 2.**
5	Let f(x) = x + 1 when x < 0, and f(x) = 2x + 1 when x ≥ 0. For g(x) = f(x + 1), find the x-value where g switches rules and find g(0).	**g switches rules at x = -1; g(0) = 3.**
6	Let f(x) = cos x and g(x) = f(x) - 1. Give the midline and range of g.	**Midline: y = -1. Range: -2 ≤ g(x) ≤ 0.**

PART 2 · APPLY IT

1. **The graph is compressed horizontally by a factor of 1/2. The new period is pi seconds.** The original period is 2pi seconds. Dividing each time coordinate by 2 gives a period of pi seconds.
2. **The graph shifts up 6 units. Each person pays $18.** The fee adds 6 to every cost, so the graph shifts up 6. At n = 10, g(10) = 120/10 + 6 = 18.

CHALLENGE

Shift left 2 units, reflect across the x-axis, then shift up 1 unit. The rule switches at x = -2, and g(-1) = 0.

Accept equivalent descriptions of a horizontal compression by a factor of 1/2. For the piecewise problems, the rule-switch value is included in the branch whose condition uses ≥.