Applications

Exercises 1–9 refer to the graph of a function $f(x)$. On copies of the graph, draw graphs of these functions.

1. $g(x) = f(x) + 2$

2. $h(x) = f(x) - 1$

3. $j(x) = 0.5\,f(x)$

4. $k(x) = 1.5\,f(x)$

5. $m(x) = -2\,f(x)$

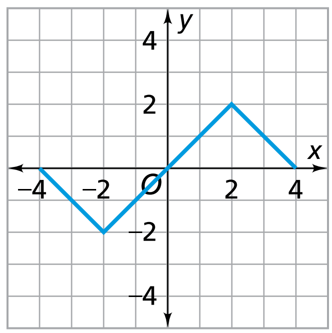
6. $n(x) = f(x - 1)$

7. $p(x) = f(x + 0.5)$

8. $q(x) = -2\,f(x) + 1$

9. $r(x) = f(x - 1) + 2$

Graph of $f(x)$



10. Match each function with its graph. Explain how you made each match. Give coordinates of the maximum or minimum point on each graph. Be prepared to explain how you can find that information from just the function rule.

a. $a(x) = x^2$

b. $b(x) = (x - 2)^2$

c. $c(x) = -(x - 2)^2 - 2$

d. $d(x) = (x + 2)^2 - 2$

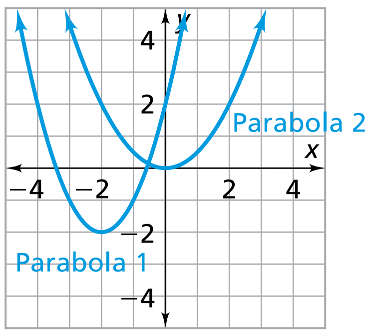
e. $e(x) = 0.5x^2$

f. $f(x) = 1.5x^2$

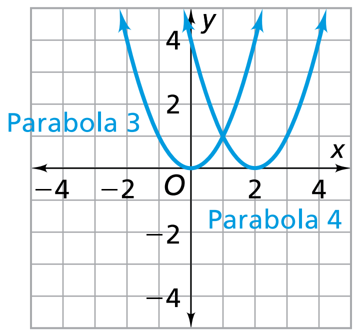
g. $g(x) = -(x - 3)^2$

h. $h(x) = -x^2 - 2$

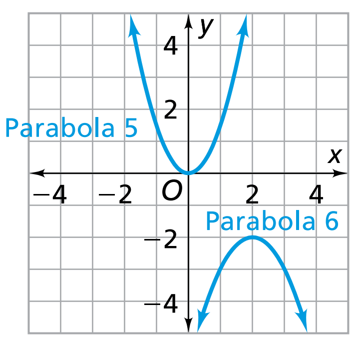
Parabolas 1 and 2



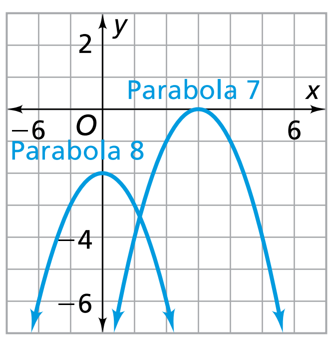
Parabolas 3 and 4



Parabolas 5 and 6



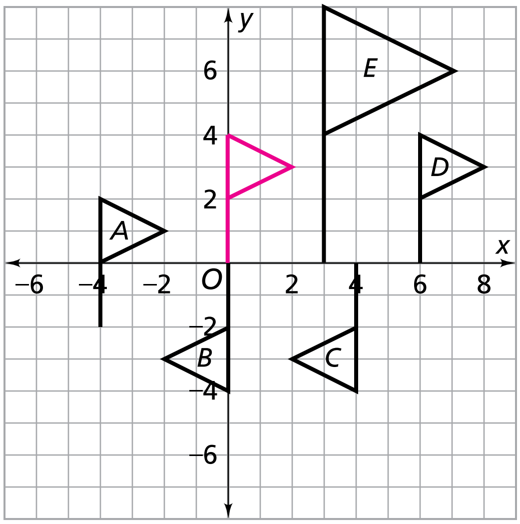
Parabolas 7 and 8



Connections

Exercises 11–15 refer to the following figure.

Five Transformations of a Flag



For each flag:

- **Give the coordinate rule $(x, y) \rightarrow (■, ■)$ for the transformation that maps the red flag to the given flag.**
- **Identify the kind of transformation(s) involved.**

11. Flag A

12. Flag B

13. Flag C

14. Flag D

15. Flag E

Extensions

16. The function $f(x) = x^2 - 4x - 5$ can also be expressed as $f(x) = (x - 5)(x + 1)$ and $f(x) = (x - 2)^2 - 9$.

a. Use algebraic reasoning to show that the three expressions are equivalent.

b. Find the y-intercept, x-intercept(s), line of symmetry, and maximum or minimum point on the graph of $f(x)$. Explain which algebraic expression makes each calculation easiest.

17. a. Suppose $g(x) = f(2x)$ when $f(x) = x^2 - 4x - 5$. Find the standard expression for $g(x)$.

Hint: Replace each occurrence of x in $x^2 - 4x - 5$ with $2x$. Simplify the result.

b. Sketch a graph that shows both $f(x)$ and $g(x) = f(2x)$ on the same axes.

c. Find the y-intercept, x-intercept(s), line of symmetry, and maximum or minimum point on the graph of $g(x)$.

d. How does replacement of x with $2x$ seem to change the graph of $f(x)$? The properties of $f(x)$?

18. a. Suppose $g(x) = f(0.5x)$ when $f(x) = x^2 - 4x - 5$. Find the standard expression for $g(x)$.

b. Sketch a graph that shows both $f(x)$ and $g(x) = f(0.5x)$ on the same axes.

c. Find the y-intercept, x-intercept(s), line of symmetry, and maximum or minimum point on the graph of $g(x)$.

d. How does replacement of x with $0.5x$ seem to change the graph of $f(x)$? The properties of $f(x)$?

19. Think about your work on Exercises 17–18. How do you think the graph of $g(x) = f(kx)$ is related to that of $f(x)$?

20. Test your conjecture in Exercise 19. Draw and compare graphs of these pairs of functions.

a. $f(x) = x^2$ and $f(3x) = (3x)^2$

b. $f(x) = x^2 - 1$ and $f(0.5x) = (0.5x)^2 - 1$

c. $f(x) = x^2 - 6x$ and $f(2x) = 4x^2 - 12x$