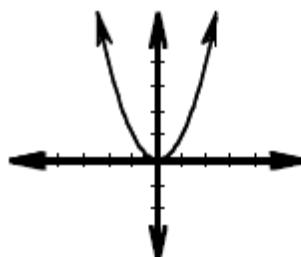


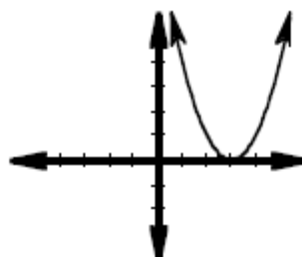
The simplest equation of one shape (e.g., line, parabola, absolute value) is called a parent equation. Changing a parent equation by addition or multiplication moves and changes the size and orientation of the parent graph but does not change the basic shape. These changes are called **transformations**. The first set of examples shows how the parent graph of a parabola can be moved on an  $xy$ -coordinate system. In later courses, you will learn how to make the parabola wider or narrower. Transformations of other functions are done in a similar manner.

**Examples**

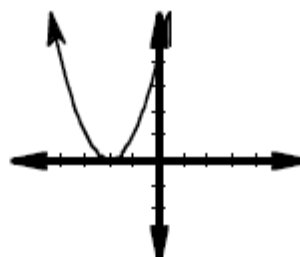
$f(x) = x^2$   
the parent graph



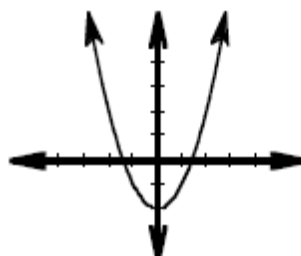
$f(x-3) = (x-3)^2$   
right 3 units



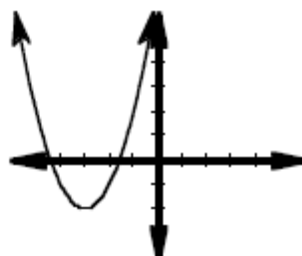
$f(x+2) = (x+2)^2$   
left 2 units



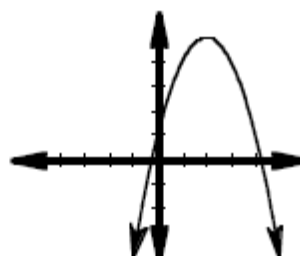
$f(x)-2 = x^2-2$   
down 2 units



$f(x+3)-2 = (x+3)^2-2$   
left 3 and down 2 units



$-f(x-2)+5 = -(x-2)^2+5$   
right 2 and up 5 units, and reflected across  $x$ -axis.

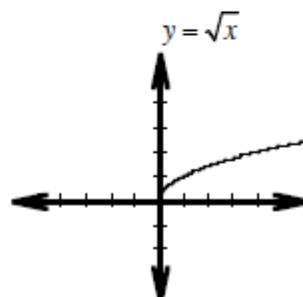
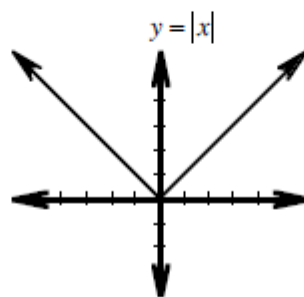


## Problems

Predict how each parabola is different from the parent graph. For each of these problems, the parent graph is  $f(x) = x^2$ .

1.  $f(x+5)$
2.  $f(x)+5$
3.  $-f(x)$
4.  $f(x)-4$
5.  $f(x)+5$
6.  $-f(x+2)$
7.  $f(x-5)-3$
8.  $-f(x+2)+1$
9.  $f(x-3)-5$

The parent graphs for absolute value and square root are shown at right. They are transformed exactly the same way as parabolas. Predict how the graph of each equation below is different from the parent graph.



10.  $f(x-4)$  where  $f(x) = |x|$
11.  $f(x)+5$  where  $f(x) = \sqrt{x}$
12.  $f(x)+3$  where  $f(x) = |x|$
13.  $f(x+2)$  where  $f(x) = \sqrt{x}$
14.  $-f(x)+5$  where  $f(x) = |x|$
15.  $-f(x)$  where  $f(x) = \sqrt{x}$
16.  $-f(x+3)$  where  $f(x) = \sqrt{x}$
17.  $-f(x-5)$  where  $f(x) = |x|$
18.  $-f(x-2)+5$  where  $f(x) = \sqrt{x}$
19.  $f(x)+3$  where  $f(x) = \sqrt{x}$
20.  $f(x-7)$  where  $f(x) = \sqrt{x}$
21.  $-f(x+3)+7$  where  $f(x) = |x|$

## Answers

1. left 5
2. up 5
3. Reflected across  $x$ -axis
4. down 4
5. up 5
6. left 2, flipped
7. right 5, down 3
8. left 2, up 1, reflected across  $x$ -axis
9. right 3, down 5
10. right 4
11. up 5
12. up 3
13. left 2
14. up 5, reflected across  $x$ -axis
15. reflected across  $x$ -axis
16. left 3, reflected across  $x$ -axis
17. right 5, reflected across  $x$ -axis
18. right 2, up 5, reflected across  $x$ -axis
19. up 3
20. right 7
21. left 3, up 7, reflected across  $x$ -axis