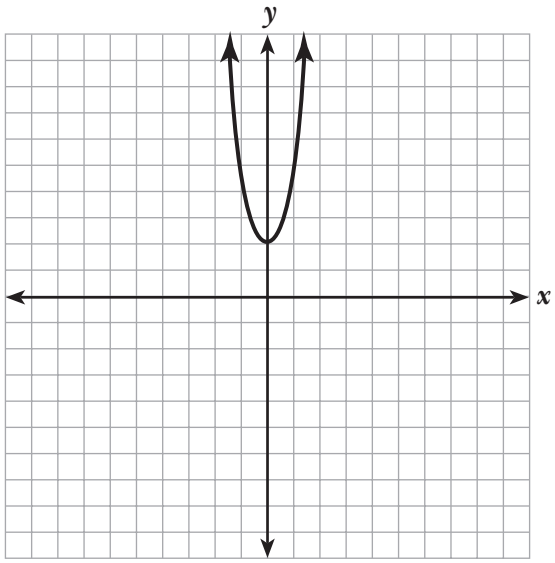
NAME

Module 14 Graphing Quadratic Relations
Lesson 2 Graphing Quadratic Relations by Analysis

independent practice

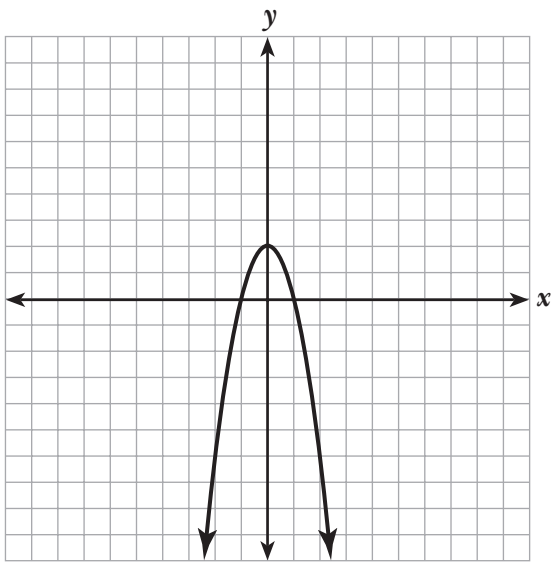
Choose the correct equation for each graph.

1.



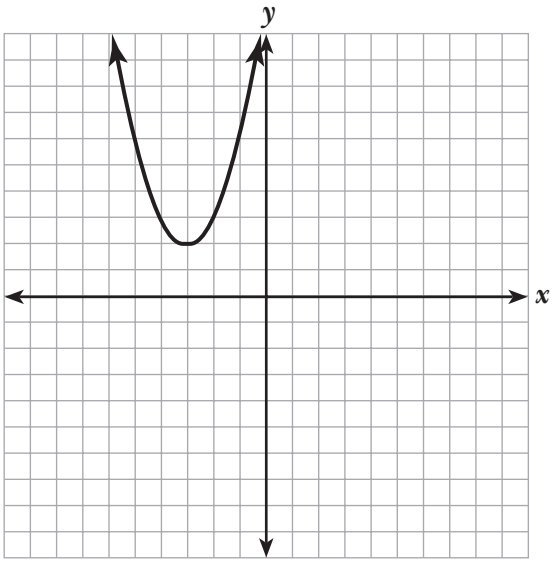
(a.) $y = 3x^2 + 2$
c. $y = -3x^2 + 2$
b. $y = 3x^2 - 2$
d. $y = -3x^2 - 2$

2.



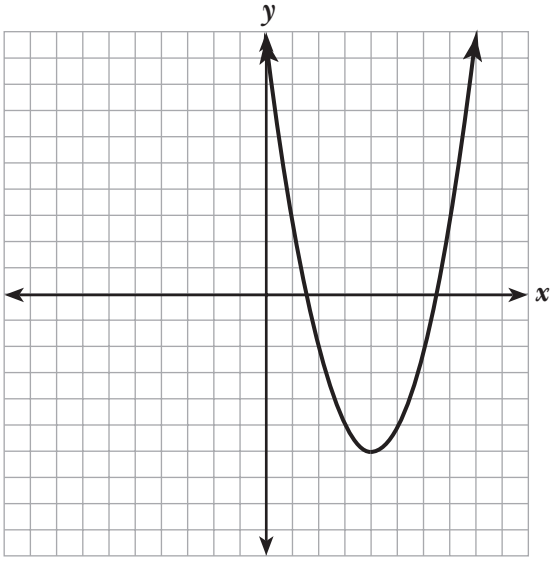
a. $y = x^2 + 3$
c. $y = -x^2 + 2$
b. $y = x^2 - 3$
(d.) $y = -2x^2 + 2$

3.



a. $y = (x - 3)^2 + 2$
c. $y = (x - 3)^2 - 2$
(b.) $y = (x + 3)^2 + 2$
d. $y = (x + 3)^2 - 2$

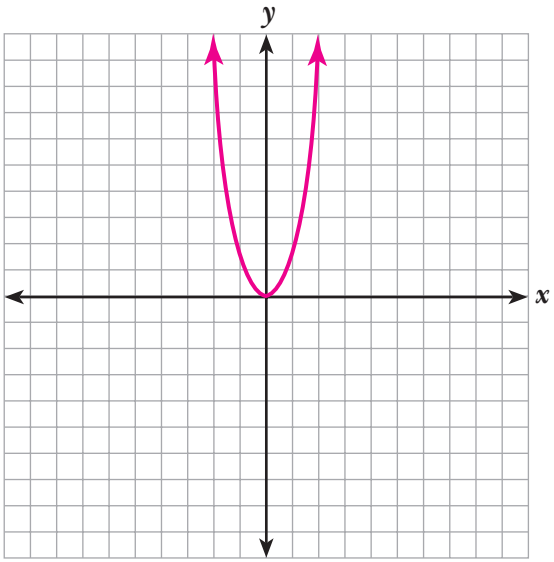
4.



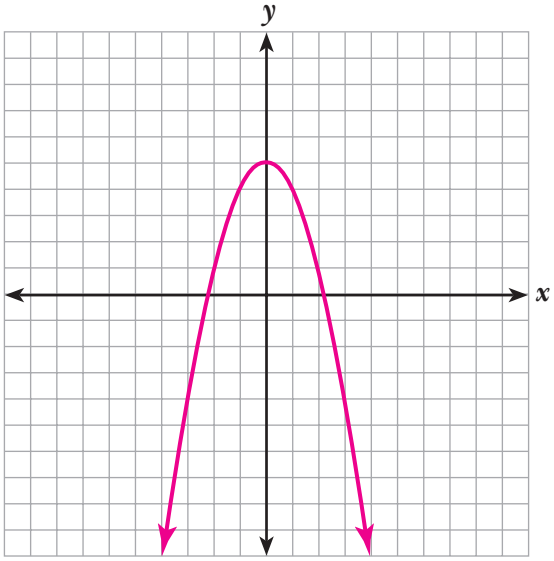
(a.) $y = x^2 - 8x + 10$
c. $y = x^2 + 8x - 5$
b. $y = -x^2 + 8x + 5$
d. $y = -x^2 + 8x - 5$

Graph.

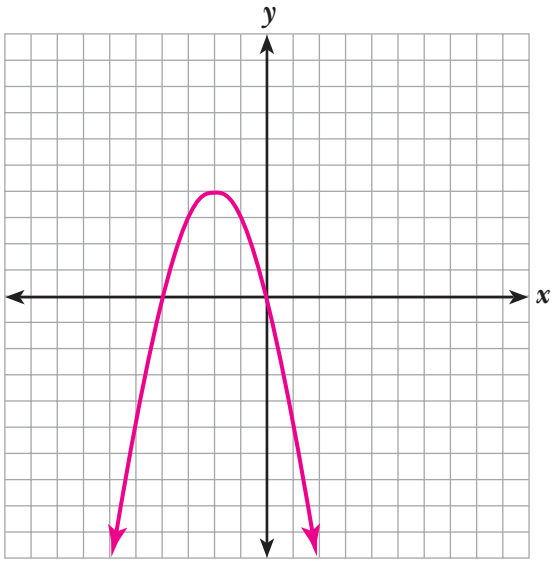
5. $y = 2x^2$



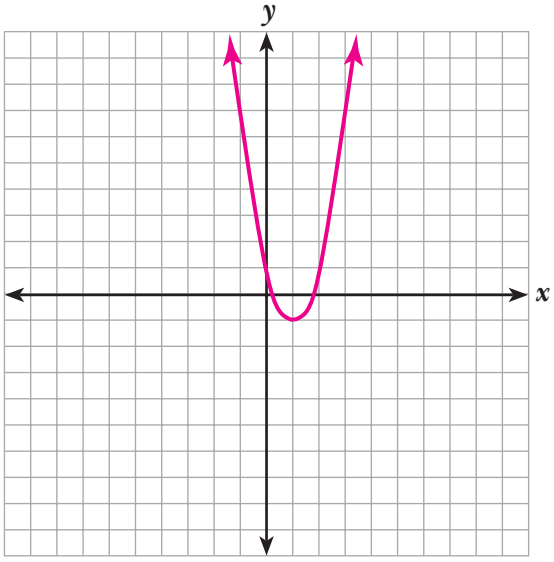
6. $y = -x^2 + 5$



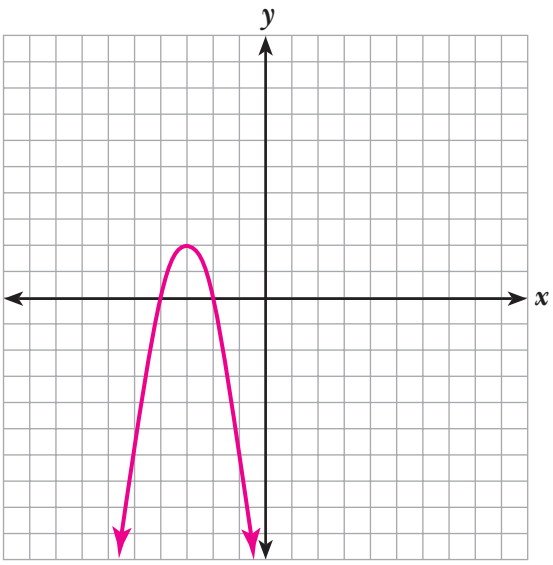
7. $y = -(x + 2)^2 + 4$



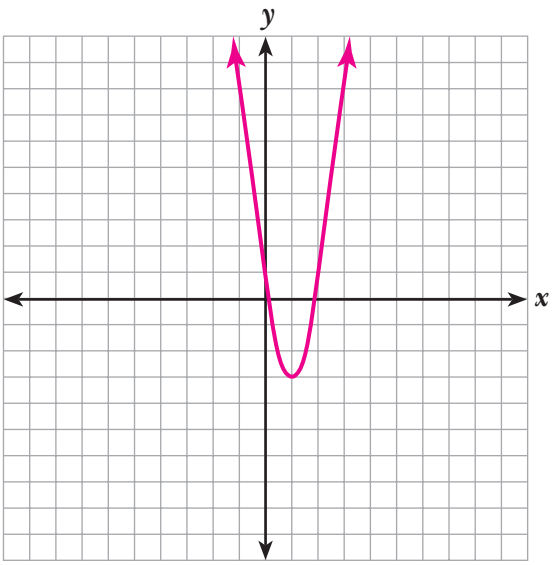
8. $y = 2(x - 1)^2 - 1$



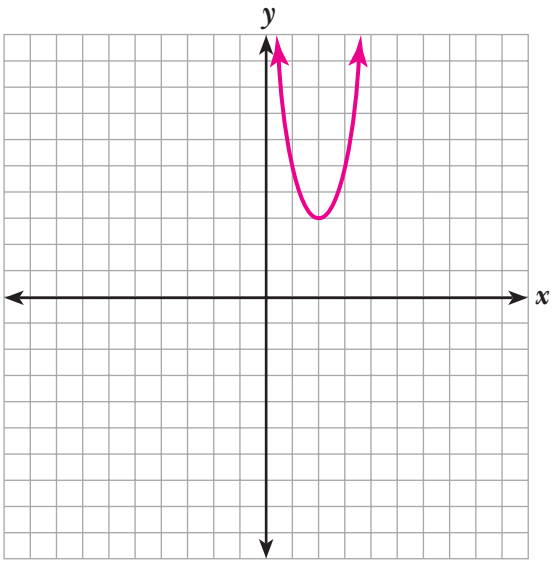
9. $y = -2(x + 3)^2 + 2$



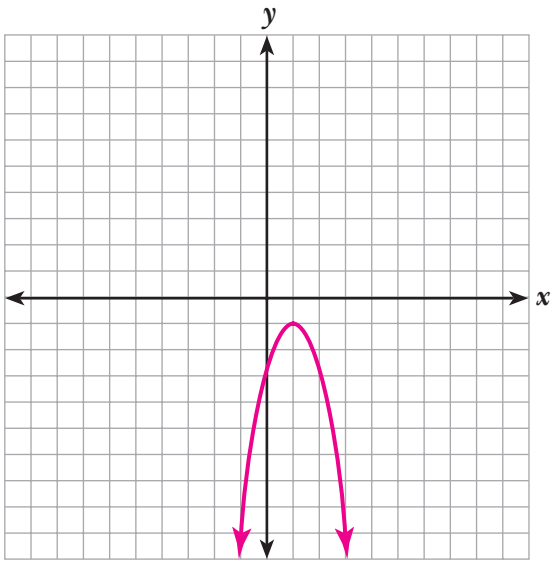
10. $y = 4(x - 1)^2 - 3$



11. $y = 2x^2 - 8x + 11$



12. $y = -2x^2 + 4x - 3$



Journal

1. In the equation $y = ax^2$, how does the value of a change the graph?
2. In the equation $y = x^2 + k$, how does the value of k change the graph?
3. In the equation $y = a(x - h)^2 + k$, how does the value of h change the graph?
4. Rodrigo says that the graph of $y = 4(x + 1)^2 + 3$ looks like Figure 1, and Marny says that it looks like Figure 2. Who is correct and why?

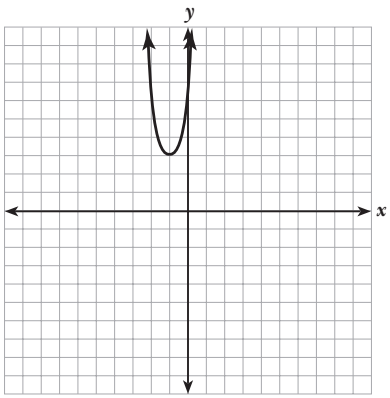


Figure 1

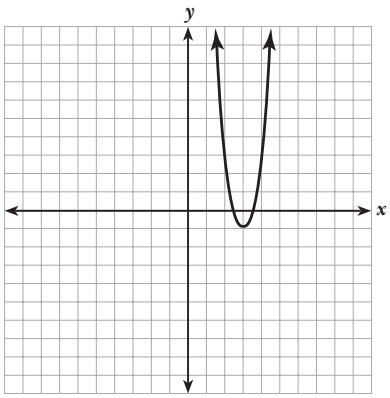


Figure 2

5. Explain how to identify the vertex of the graph of the equation $y = -x^2 + 4x + 3$.

Cumulative Review

Solve the equations by completing the square.

1. $2x^2 + 4x - 6 = 0$ **$x = 1; x = -3$**
2. $x^2 + 8x = 10$ **$x = -4 \pm \sqrt{26}$**
3. $3x^2 + 12x + 3 = 0$ **$x = -2 \pm \sqrt{3}$**
4. $-2x^2 + 4x + 8 = 0$ **$x = 1 \pm \sqrt{5}$**
5. $-3x^2 - 24x - 33 = 0$ **$x = -4 \pm \sqrt{5}$**
6. $2x^2 - 12x + 12 = 0$ **$x = 3 \pm \sqrt{3}$**

Calculator Problem

Graph the equation $y = -2x^2 + 4x - 1$ using a calculator. Find numerical estimates for the equation's vertex, axis of symmetry, and one point on the graph, which is not the vertex.

1. Press [Y=] and enter the function into $\mathbf{Y_1}=$. See Figure 1.

2. Press [GRAPH]. See Figure 2.

3. Since the graph of the equation opens down, the vertex of the graph is the point with the maximum *y* value. From the **CALC** menu, select **4:maximum. Left Bound?** will appear in the lower left hand corner of the screen. Use the arrow keys to move the cursor to the left of what appears to be the vertex; press [ENTER]. **Right Bound?** will appear in the lower left hand corner of the screen. Use the arrow keys to move the cursor to the right of what appears to be the vertex; press [ENTER]. **Guess?** will appear in the lower left hand corner of the screen; press [ENTER]. See Figure 3. The *x* and *y* values are in the lower left hand corner of the screen.

4. The axis of symmetry is $x = h$, where *h* is the *x*-coordinate of the vertex.

5. To find a point on the graph, press [TRACE]. Move the cursor with the arrow keys. The *x* and *y* values are in the lower left hand corner of the screen. See Figure 4.

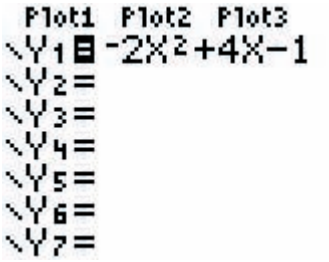


Figure 1

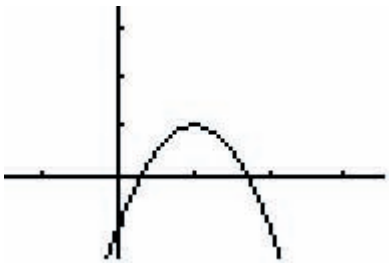


Figure 2

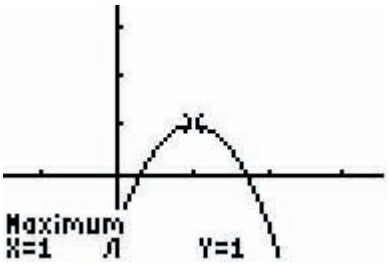


Figure 3

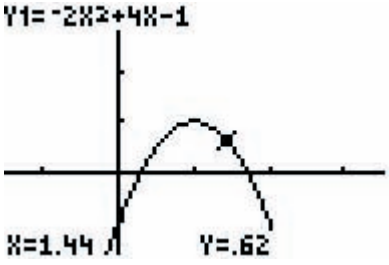


Figure 4

In the equations below, find numerical estimates for the equation's vertex, axis of symmetry, and one point on the graph, which is not the vertex.

1. $y = x^2 - 5x + 6$ **Possible answers:**

Vertex: (2.5, –0.25); Axis of symmetry:

$x = 2.5$; Non-vertex point: (4, 2)

2. $y = 2x^2 - 3$ **Possible answers:**

Vertex: (0, –3); Axis of symmetry: $x = 0$;

Non-vertex point: (1, –1)

3. $y = -\frac{3}{4}x^2 - x + 1$ **Possible answers:**

Vertex: (–0.67, 1.33); Axis of symmetry:

$x = 1.33$; Non-vertex point: (–2, 0)

4. $y = -4x^2 + 2x + 3$ **Possible answers:**

Vertex: (0.25, 3.25); Axis of symmetry:

$x = 0.25$; Non-vertex point: (1.5, –3)

Possible Journal Answers

1. If $a > 0$, the graph opens up. If $a < 0$, the graph opens down. If $a = 0$, the graph is $y = 0$. As $|a|$ increases, the graph of $y = ax^2$ narrows.

2. Every point on the graph is translated up or down by k units along the y-axis on the coordinate plane.

3. Every point on the graph is translated left or right by h units along the x-axis on the coordinate plane. If the value of h is positive, then every point on the graph shifts right. If the value of h is negative, then every point on the graph shifts left.

4. Rodrigo is correct. The equation $y = 4(x + 1)^2 + 3$ is in the general form $y = a(x - h)^2 + k$. In vertex form, the vertex is described as the point (h, k). In this example, h is –1 and k is 3. Rodriqo used the correct vertex: (–1, 3). His graph also correctly passes through points (–2, 7) and (0, 7).

5. Put the graph in vertex form. First, use the Subtraction Property of Equality to put the constant term on the left hand side of the equation and then, complete the square.

$y - 3 = -x^2 + 4x$

Multiply both sides of the equation by –1.

$-y + 3 = x^2 - 4x$

$\left(\frac{1}{2}\right)(-4) = -2$

$(-2)^2 = 4$

Add 4 to both sides of the equation.

$-y + 7 = x^2 - 4x + 4 = (x - 2)^2$

So $-y = (x - 2)^2 - 7$ and $y = -(x - 2)^2 + 7$.

The vertex is the point (2, 7), and the parabola opens down.