

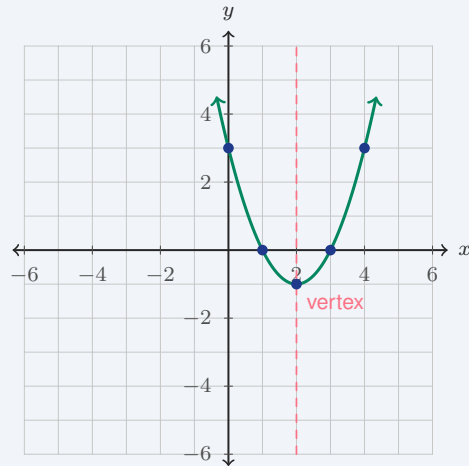
# Graphing Quadratic Functions

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 18

## Quick Review and Helpful Hints

A quadratic graph is a parabola, so graphing it means more than naming a formula. First find the vertex, then plot a few points on both sides of that vertex. Points on a parabola come in matching pairs across the axis of symmetry, so if  $(1, -3)$  is one unit to the left of the axis, the matching point one unit to the right has the same  $y$ -value. Use the graph to read the vertex, intercepts, maximum or minimum, and what the answer means in the situation.

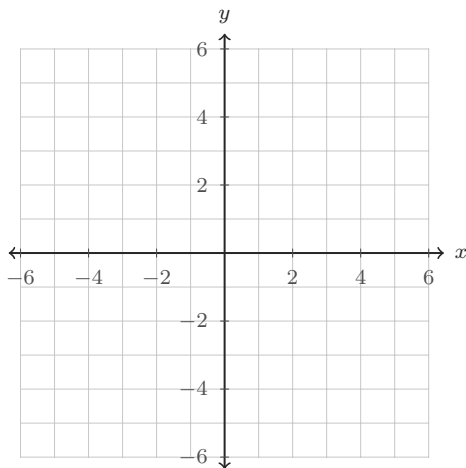
► **Example:** Graph  $y = (x - 2)^2 - 1$ . The vertex is  $(2, -1)$ . Plot the vertex, then choose matching  $x$ -values:  $x = 1$  and  $x = 3$  both give  $y = 0$ ;  $x = 0$  and  $x = 4$  both give  $y = 3$ . Connect the points with a smooth U-shape.



### Practice Problems

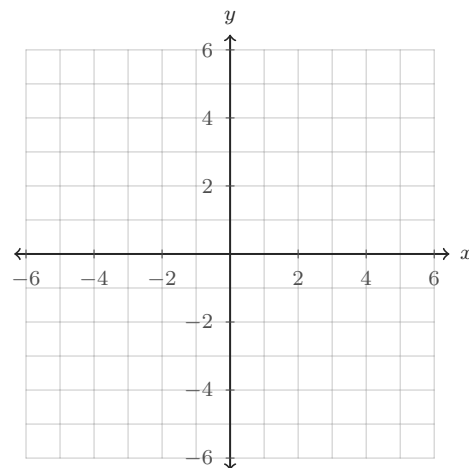
Graph each parabola or answer from the graph. Use the coordinate planes, not mental shortcuts.

1. Graph  $y = x^2 - 4$ . Then write the vertex.



Use  $x = -2, -1, 0, 1, 2$  to make a quick table.

2. Graph  $y = (x - 2)^2 - 1$ . Then write the axis of symmetry.



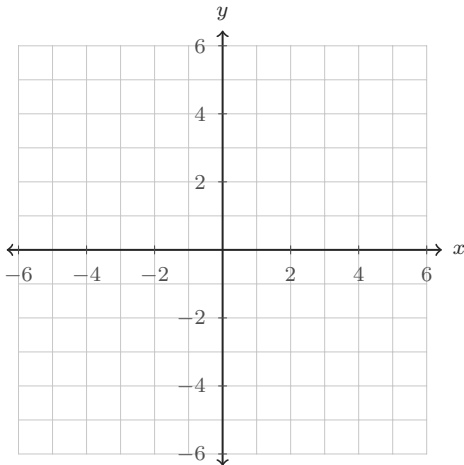
The vertex form already shows the center line.



**◆ Graph From the Equation**

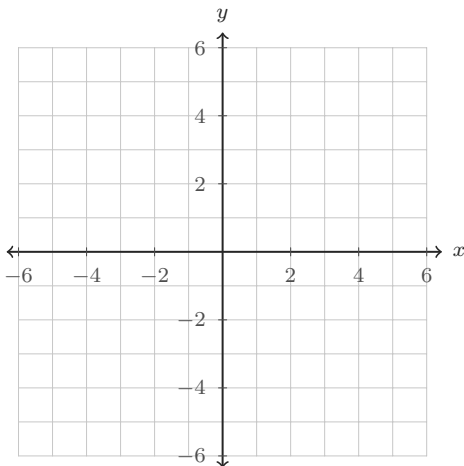
Plot the vertex first, add symmetric points, and sketch a smooth parabola.

**3.** Graph  $y = -(x + 1)^2 + 4$ . Is the vertex a maximum or a minimum?



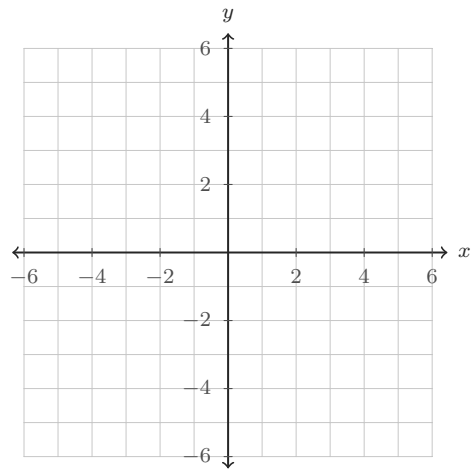
Because the coefficient is negative, the curve opens downward.

**4.** Graph  $y = 2x^2 - 2$ . Is it narrower or wider than  $y = x^2$ ?



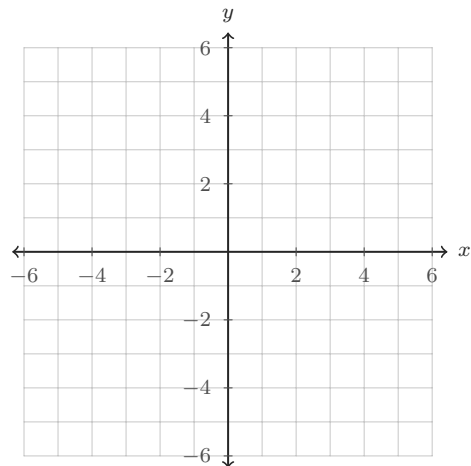
Compare the  $y$ -values when  $x = 1$  and  $x = 2$ .

**5.** Graph  $y = x^2 - 2x - 3$ . Then write the  $x$ -intercepts.



The intercepts are where the graph crosses the  $x$ -axis.

**6.** Graph  $y = -x^2 + 4x + 1$ . Then write the  $y$ -intercept and the maximum value.



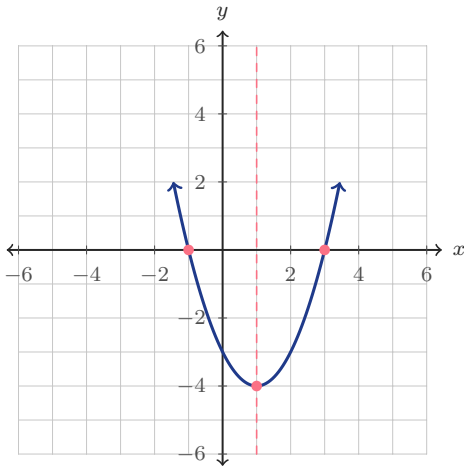
The  $y$ -intercept is where  $x = 0$ .



◆ Read the Graph

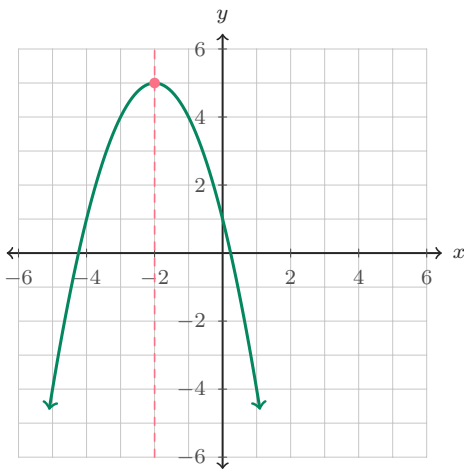
Use the printed graphs to identify key features.

7. Use the graph to find the  $x$ -intercepts.



Look for the points where the curve crosses  $y = 0$ .

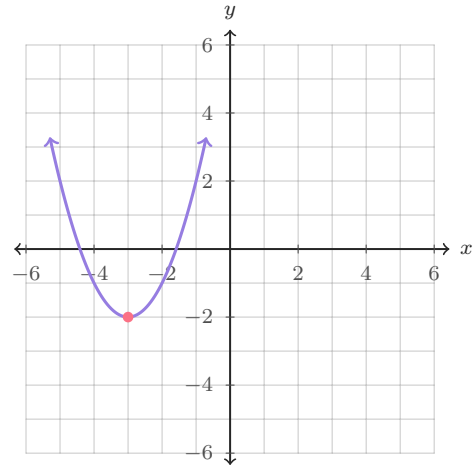
8. Use the graph to find the maximum value.



The maximum value is the highest  $y$ -value on the graph.

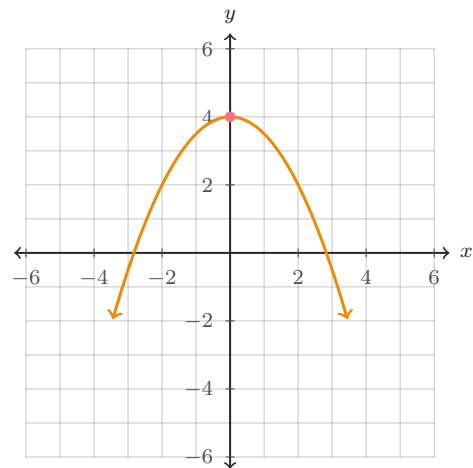
9. Which equation matches this graph?

- A.  $y = (x-3)^2 - 2$     B.  $y = (x+3)^2 - 2$     C.  $y = -(x+3)^2 - 2$



Use the vertex and the opening direction.

10. Use the graph to write the  $y$ -intercept.



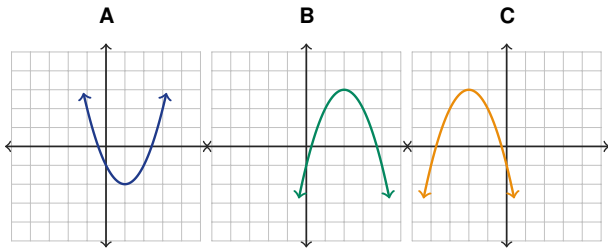
The  $y$ -intercept is the point on the vertical axis.



**◆ Choose, Plot, and Interpret**

These questions mix graph recognition, tables, and real contexts.

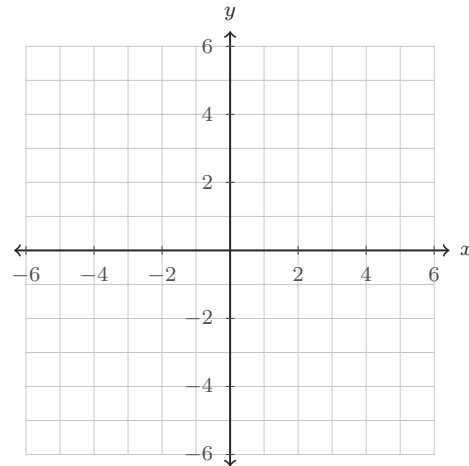
**11.** Circle the graph that opens down and has vertex (2, 3).



Check both clues: opens down and vertex at (2, 3).

**12.** Plot the table, sketch the parabola, and write the vertex.

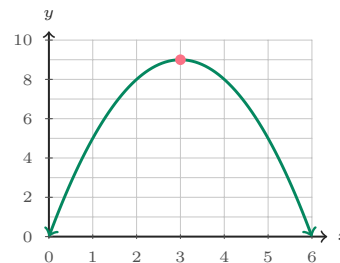
$x$	-2	-1	0	1	2
$y$	3	0	-1	0	3



The middle point in the table is often the vertex.

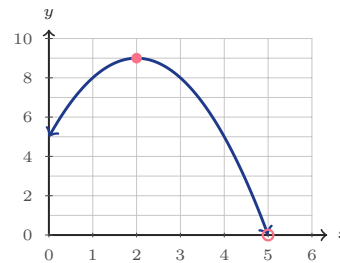
**13.** A garden arch is modeled by  $h = -(x - 3)^2 + 9$ , where  $x$  is feet from the left side and  $h$  is height in feet. What is the maximum height, and where does it happen?

Read the highest point of the arch.



**14.** A basketball is modeled by  $h = -t^2 + 4t + 5$ , where  $t$  is seconds and  $h$  is height in feet. Graph the path. When does the ball hit the ground?

The ground is the  $x$ -axis, where  $h = 0$ .

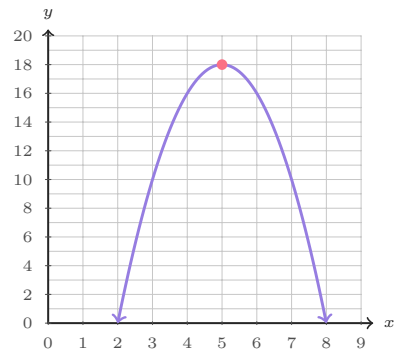


◆ Application Graphs

Each situation has a graph. Use the graph and the equation together.

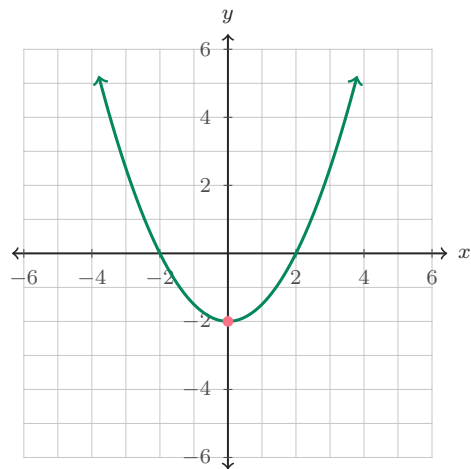
15. A school club models profit, in tens of dollars, by  $P = -2p^2 + 20p - 32$ , where  $p$  is the ticket price in dollars. Which ticket price gives the greatest profit?

The best price is the  $x$ -value at the top of the parabola.



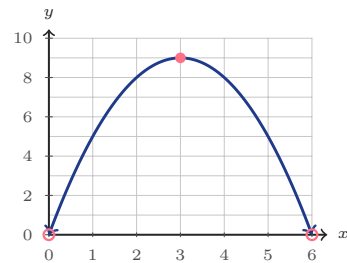
16. A satellite dish cross-section is modeled by  $y = 0.5x^2 - 2$ . What point is the lowest part of the dish?

The lowest point of an upward-opening parabola is its vertex.



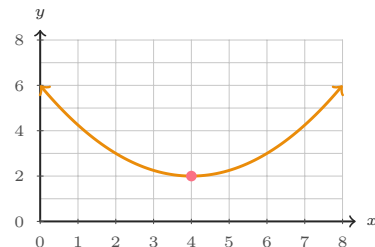
17. A fountain stream is modeled by  $h = -x^2 + 6x$ , where  $x$  is horizontal distance in feet. How far from the nozzle does the water land?

The water lands where the height returns to 0.



18. A bridge cable is modeled by  $h = 0.25(x - 4)^2 + 2$ , where  $h$  is height in feet. What is the lowest height, and how far from the left support is it?

For an upward-opening cable model, the vertex gives the lowest point.



**Answer Keys**

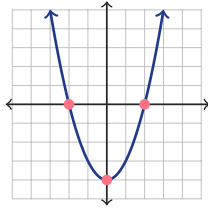
1.  $(0, -4)$
2.  $x = 2$
3. maximum at  $(-1, 4)$
4. narrower; vertex  $(0, -2)$
5.  $(-1, 0)$  and  $(3, 0)$
6.  $y$ -int  $(0, 1)$ ; max 5
7.  $(-1, 0)$  and  $(3, 0)$
8. 5
9. B
10.  $(0, 4)$
11. B
12.  $(0, -1)$
13. 9 ft at  $x = 3$  ft
14. 5 seconds
15. \$5
16.  $(0, -2)$
17. 6 ft
18. 2 ft at  $x = 4$  ft



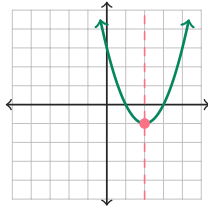
## Graph Answer Sketches

These sketches match the questions that ask students to graph, plot, or sketch a parabola.

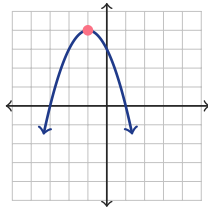
1.  $y = x^2 - 4$ ; vertex  $(0, -4)$



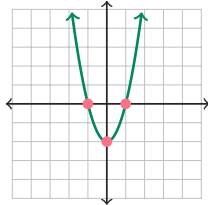
2.  $y = (x - 2)^2 - 1$ ; axis  $x = 2$



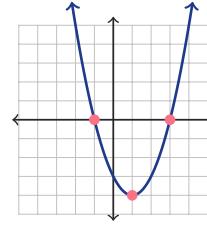
3.  $y = -(x + 1)^2 + 4$ ; maximum



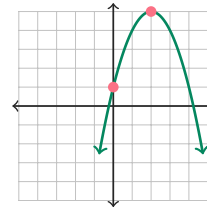
4.  $y = 2x^2 - 2$ ; narrower



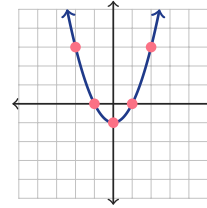
5.  $y = x^2 - 2x - 3$ ;  $x$ -ints  $(-1, 0)$ ,  $(3, 0)$



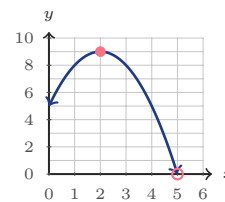
6.  $y = -x^2 + 4x + 1$ ;  $y$ -int  $(0, 1)$ , max 5



12. table graph; vertex  $(0, -1)$



14.  $h = -t^2 + 4t + 5$ ; ground at  $t = 5$



## Step-by-Step Explanations

1. Start with the equation  $y = x^2 - 4$ . When  $x = 0$ ,  $y = -4$ , so the vertex is  $(0, -4)$ . Plot matching pairs such as  $(-1, -3)$  and  $(1, -3)$ , then  $(-2, 0)$  and  $(2, 0)$ , and connect them with a smooth U-shape.

2. The equation is in vertex form,  $y = (x - 2)^2 - 1$ , so the vertex is  $(2, -1)$ . The vertical line through the vertex is the axis of symmetry, which means the graph balances on  $x = 2$ .

3. For  $y = -(x + 1)^2 + 4$ , the vertex is  $(-1, 4)$  because the expression is shifted left 1 and up 4. The negative sign makes the parabola open down, so the vertex is the highest point, a maximum.

4. The vertex of  $y = 2x^2 - 2$  is  $(0, -2)$ . The coefficient 2 makes the  $y$ -values grow twice as fast as in  $y = x^2$ , so the graph is narrower than the parent parabola.

5. For  $y = x^2 - 2x - 3$ , the graph crosses the  $x$ -axis where  $y = 0$ . Factoring gives  $x^2 - 2x - 3 = (x - 3)(x + 1)$ , so the crossings are  $x = 3$  and  $x = -1$ , written as  $(3, 0)$  and  $(-1, 0)$ .

6. The  $y$ -intercept happens when  $x = 0$ , and  $y = -0^2 + 4(0) + 1 = 1$ , so the point is  $(0, 1)$ . The vertex is halfway across the parabola at  $x = 2$ , and the graph shows the highest value is 5.

7. The  $x$ -intercepts are the places where the curve touches or crosses the horizontal axis. On this graph, those points are one unit left of 0 and three units right of 0, so they are  $(-1, 0)$  and  $(3, 0)$ .

8. A downward-opening parabola has its maximum at the vertex. The highest point on the graph is at  $(-2, 5)$ , so the maximum value is the  $y$ -value, 5.

9. The graphed parabola opens up and has vertex  $(-3, -2)$ . In vertex form,  $y = (x - h)^2 + k$ , that means  $h = -3$  and  $k = -2$ , so the matching equation is  $y = (x + 3)^2 - 2$ .

10. The  $y$ -intercept is where the graph meets the vertical axis. The marked point is on the  $y$ -axis at  $y = 4$ , so the intercept is  $(0, 4)$ .

11. Graph B is the only choice that opens downward and has its turning point at  $(2, 3)$ . Graph A opens upward, and Graph C opens downward but its vertex is on the left side of the plane.



12. Plot each table pair as a point:  $(-2, 3)$ ,  $(-1, 0)$ ,  $(0, -1)$ ,  $(1, 0)$ , and  $(2, 3)$ . The lowest and middle point is  $(0, -1)$ , so that is the vertex.

13. The garden arch graph reaches its highest point at the vertex. The top of the graph is at  $(3, 9)$ , so the arch is 9 feet high at a point 3 feet from the left side.

14. The ball is on the ground when its height is 0, which is the  $x$ -axis on this graph. The path crosses the axis at  $t = 5$ , so the ball hits the ground after 5 seconds.

15. The greatest profit is found at the highest point of the profit graph. The vertex occurs at ticket price  $p = 5$ , so the club should charge \$5 to get the modeled maximum profit.

16. This graph opens upward, so its lowest point is the vertex. The vertex is on the vertical axis at  $(0, -2)$ , which is the lowest part of the dish model.

17. The water lands when its height returns to 0. The graph starts at  $(0, 0)$  and crosses the ground again at  $(6, 0)$ , so the water lands 6 feet from the nozzle.

18. The cable graph opens upward, so its lowest point is the vertex. The marked vertex is  $(4, 2)$ , meaning the lowest height is 2 feet and it occurs 4 feet from the left support.



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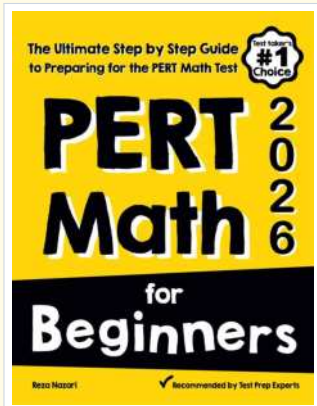
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