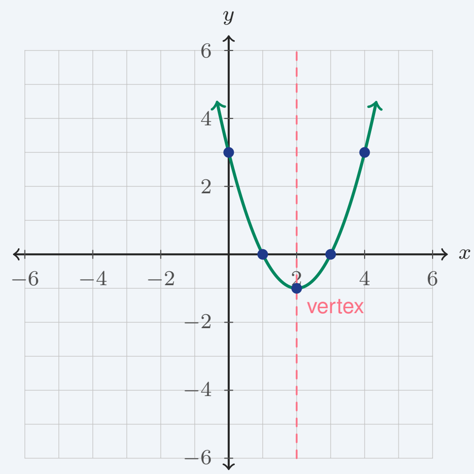
Graphing Quadratic Functions

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.

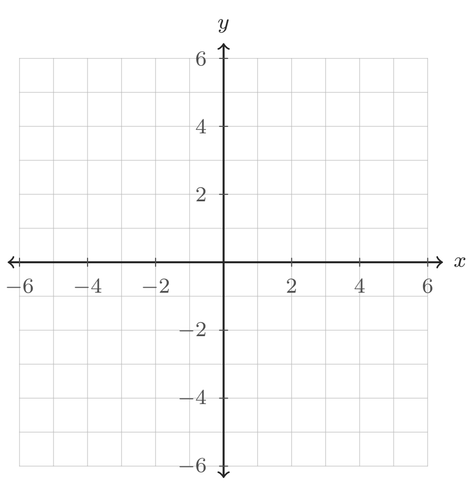
▷ **Example:** Graph $y = (x - 2)^2 - 1$. The vertex is $(2, -1)$. Plot the vertex, then choose matching x-values: $x = 1$ and $x = 3$ both give $y = 0$; $x = 0$ and $x = 4$ both give $y = 3$. Connect the points with a smooth U-shape.



Practice Problems

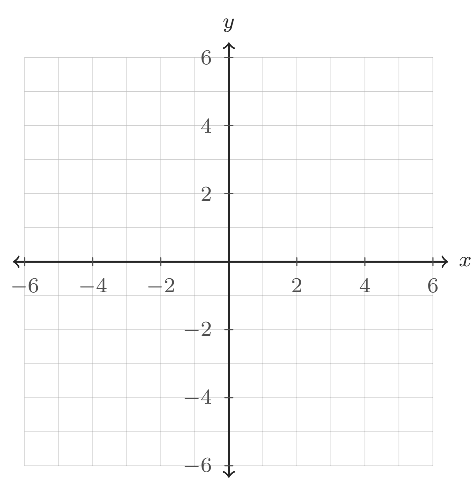
Graph each parabola or answer from the graph. Use the coordinate planes, not mental shortcuts.

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.

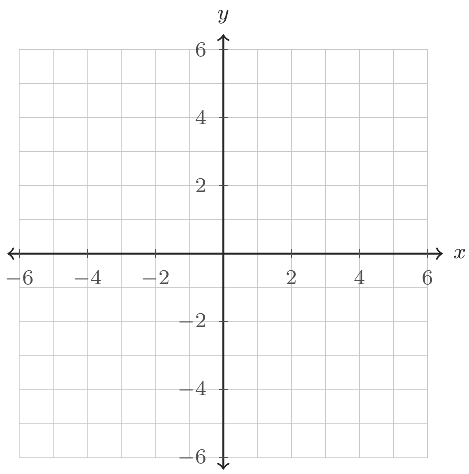


The vertex form already shows the center line.

Graph From the Equation

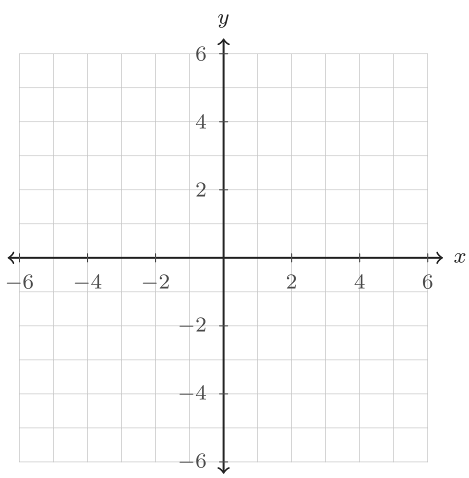
Plot the vertex first, add symmetric points, and sketch a smooth parabola.

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



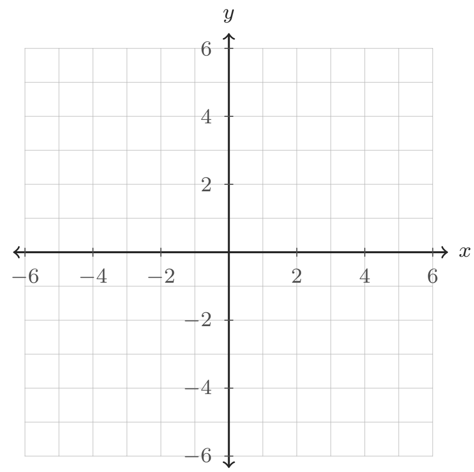
Because the coefficient is negative, the curve opens downward.

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



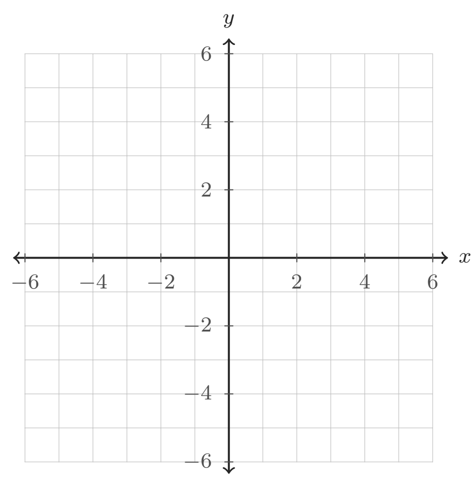
Compare the y-values when $x = 1$ and $x = 2$.

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.

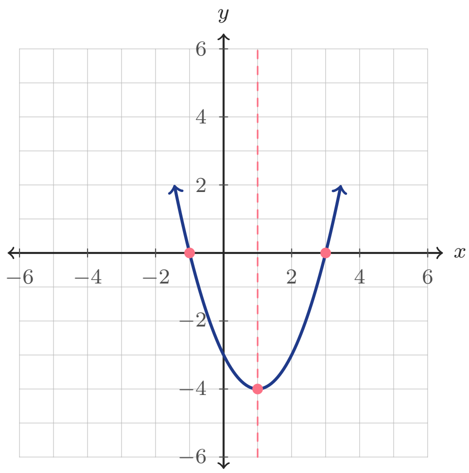


The y-intercept is where $x = 0$.

Read the Graph

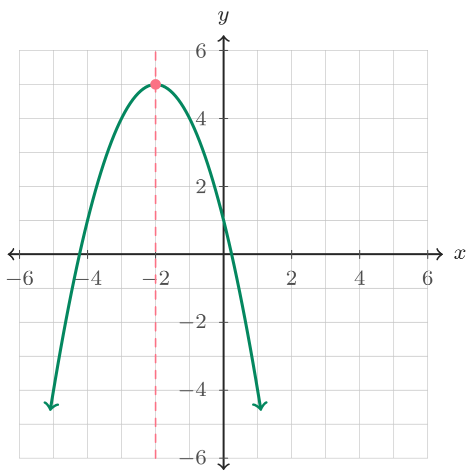
Use the printed graphs to identify key features.

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



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

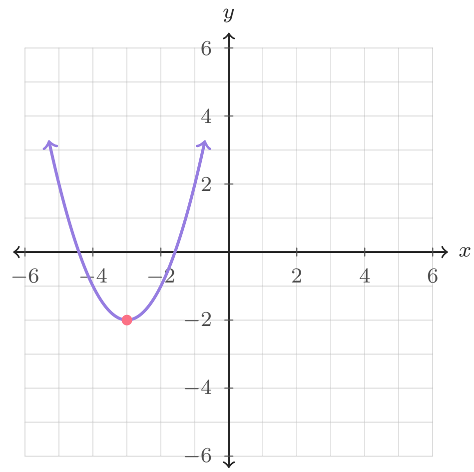
8. Use the graph to find the maximum value.



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

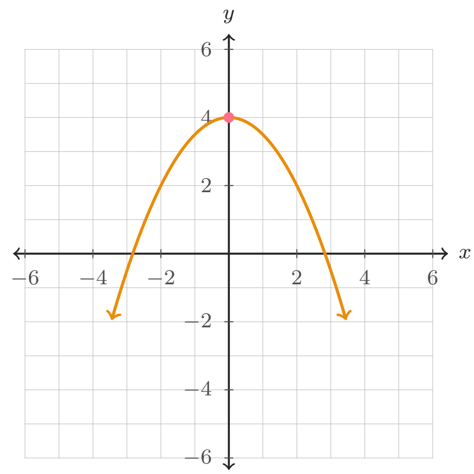
9. Which equation matches this graph?

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.

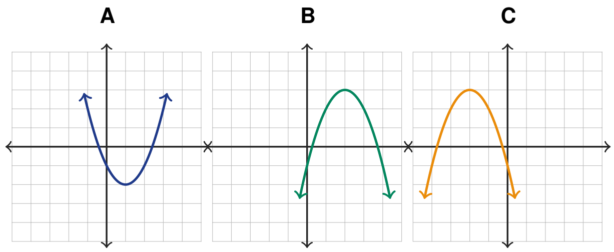


The y-intercept is the point on the vertical axis.

Choose, Plot, and Interpret

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

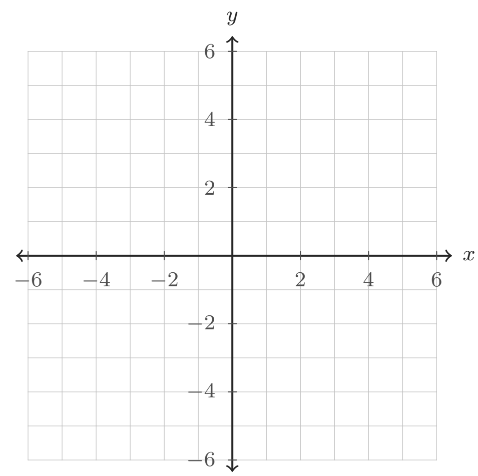
11. Circle the graph that opens down and has vertex $(2, 3)$.



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

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

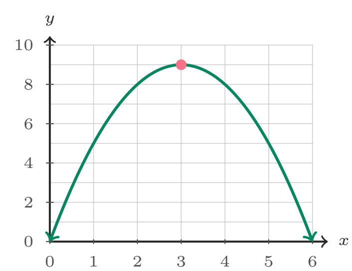
x	-2	-1	0	1	2
y	3	0	-1	0	3



The middle point in the table is often the vertex.

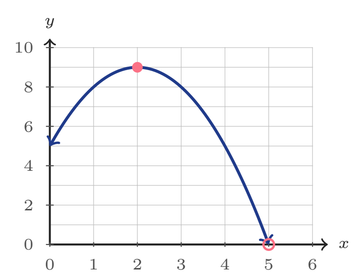
13. A garden arch is modeled by $h = -(x-3)^2 + 9$, where x is feet from the left side and h is height in feet. What is the maximum height, and where does it happen?

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 $h = 0$.

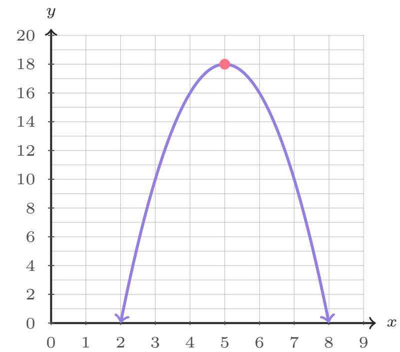


Application Graphs

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

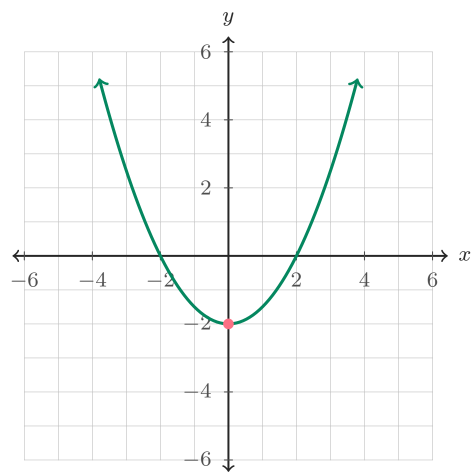
15. A school club models profit, in tens of dollars, by $P = -2p^2 + 20p - 32$, where p is the ticket price in dollars. Which ticket price gives the greatest profit?

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



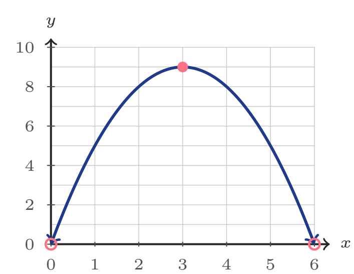
16. A satellite dish cross-section is modeled by $y = 0.5x^2 - 2$. What point is the lowest part of the dish?

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



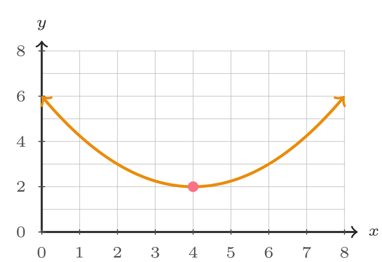
17. A fountain stream is modeled by $h = -x^2 + 6x$, where x is horizontal distance in feet. How far from the nozzle does the water land?

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.



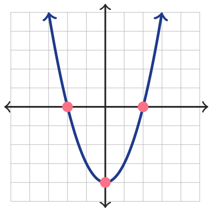
Answer Keys

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

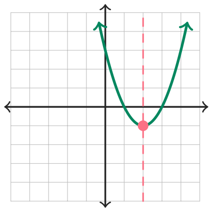
Graph Answer Sketches

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

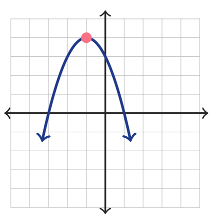
1. $y = x^2 - 4$; vertex $(0, -4)$



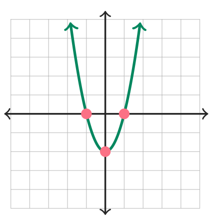
2. $y = (x-2)^2 - 1$; axis $x = 2$



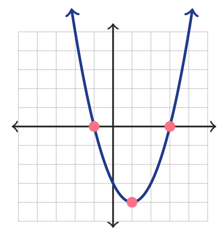
3. $y = -(x+1)^2 + 4$; maximum



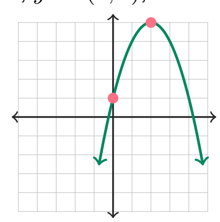
4. $y = 2x^2 - 2$; narrower



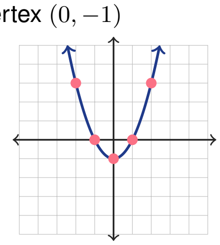
5. $y = x^2 - 2x - 3$; x-ints $(-1, 0), (3, 0)$



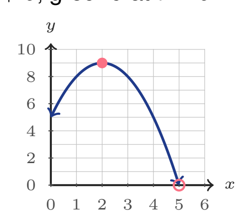
6. $y = -x^2 + 4x + 1$; y-int $(0, 1)$, max 5



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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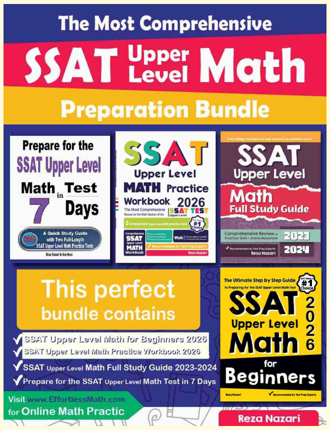

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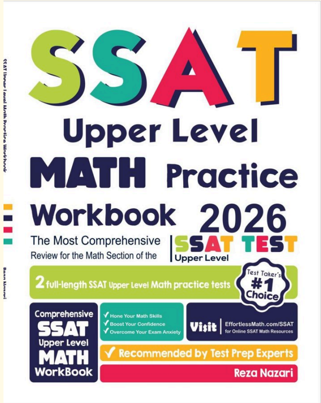

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