

# Graphing Quadratic Inequalities

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 34

## Q Quick Review

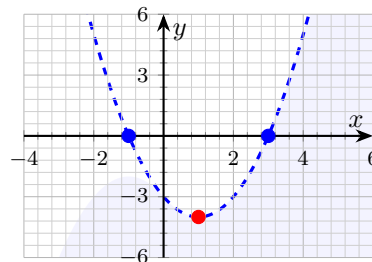
Graphing a quadratic inequality in two variables works just like graphing a linear one: **draw the boundary curve**, then **shade the correct region**. The boundary is the parabola you'd get by replacing the inequality symbol with =. Use a **solid** curve for  $\leq$  or  $\geq$  (boundary included) and a **dashed** curve for strict  $<$  or  $>$  (boundary excluded). For the shading: pick a test point not on the parabola —  $(0, 0)$  if the curve misses the origin — and plug into the inequality. If it makes the statement true, shade the side that contains the test point.

A handy shortcut once the inequality is written with  $y$  isolated:  $y > \text{stuff} \Rightarrow$  shade *above* the parabola,  $y < \text{stuff} \Rightarrow$  shade *below*. That works whether the parabola opens up or down — “above” and “below” refer to the curve, not to the  $x$ -axis. The vertex is always on the boundary, not in the interior of the shaded region. And changing the parabola’s direction (sign of  $a$ ) doesn’t change the shading rule — only the test point or the  $y$ -isolated form does.

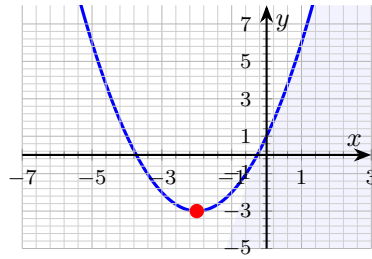
## PRACTICE

Identify boundary type, shading direction, or matching inequality.

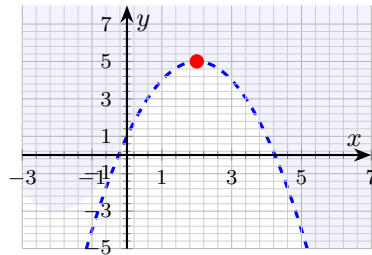
1. Boundary for  $y \leq x^2 + 1$ : solid or dashed? \_\_\_\_\_
2. Shading for  $y > x^2$ : above or below? \_\_\_\_\_
3. Is  $(0, 0)$  a solution of  $y \geq x^2 - 4$ ? \_\_\_\_\_
4. Dashed curve  $y = x^2 - 1$ , shaded below. Which inequality? \_\_\_\_\_
5. Find the vertex of the boundary for  $y \geq (x - 2)^2 - 3$ . \_\_\_\_\_
6. Test  $(0, 0)$  in  $y < -x^2 + 4$ . Is it in the region? \_\_\_\_\_
7. Find the vertex of the boundary for  $y \leq -x^2 + 2x + 3$ . \_\_\_\_\_
8. Describe the graph of  $y > -(x + 1)^2 + 4$  (boundary, vertex, shading). \_\_\_\_\_
9. Identify the inequality (dashed, shade below). \_\_\_\_\_



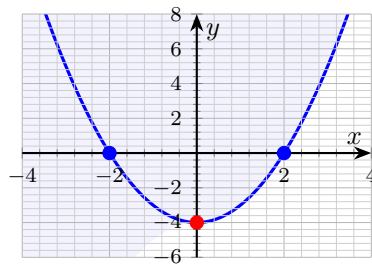
10. Identify the inequality (solid, shade below). \_\_\_\_\_



11. Identify the inequality (dashed, shade above). \_\_\_\_\_



12. Identify the inequality (solid, shade above). \_\_\_\_\_



13. Is  $(2, 0)$  in the solution region of  $y > x^2 - 4$ ? \_\_\_\_\_

14. Is  $(1, -5)$  in the solution region of  $y > x^2 - 4$ ? \_\_\_\_\_

15. Is  $(-3, 4)$  in the solution region of  $y > x^2 - 4$ ? \_\_\_\_\_

16. Direction of opening for boundary  $y \leq -2(x - 1)^2 + 3$ ? \_\_\_\_\_

17. Solid or dashed for  $y > x^2 + 2x$ ? \_\_\_\_\_

18. Solid or dashed for  $y \geq -x^2 + 5$ ? \_\_\_\_\_

19. Shading region for  $y < (x - 3)^2 + 1$ ? \_\_\_\_\_

20. Vertex of the boundary for  $y \leq 2(x + 1)^2 - 5$ ? \_\_\_\_\_



◆ **Word Problems**

- 21. A landscape architect's lawn must satisfy  $y \geq x^2 - 4$  (in meters), where  $x$  is the distance from a fence and  $y$  is the distance to the back property line. Is the point  $(3, 2)$  inside the allowed region? \_\_\_\_\_
- 22. A signal-strength region is described by  $y \leq -x^2 + 9$ , where  $x$  and  $y$  are in km. The vertex of the boundary parabola sits at the strongest point. Find the vertex and the boundary's  $x$ -intercepts. \_\_\_\_\_
- 23. Describe the graph of  $y \geq (x - 1)^2 - 4$ : boundary shape, solid or dashed, where to shade, and a test point that confirms the shading. \_\_\_\_\_
- 24. A factory's daily output must satisfy  $y > -(x - 3)^2 + 8$ , where  $x$  is hours of operation and  $y$  is widget count. Identify the boundary's vertex and the direction of opening. \_\_\_\_\_

**Additional Practice**

- 25. Solve  $x^2 - 5x + 6 = 0$ . \_\_\_\_\_
- 26. Solve  $x^2 = 49$ . \_\_\_\_\_
- 27. Find the vertex of  $y = (x - 3)^2 - 4$ . \_\_\_\_\_
- 28. Find the axis of symmetry of  $y = x^2 + 6x + 1$ . \_\_\_\_\_
- 29. Factor  $x^2 + 7x + 10$ . \_\_\_\_\_
- 30. Find the discriminant of  $x^2 - 4x + 8 = 0$ . \_\_\_\_\_
- 31. Solve  $2x^2 - 8 = 0$ . \_\_\_\_\_
- 32. Write roots  $-1$  and  $6$  as a quadratic. \_\_\_\_\_
- 33. Find the  $y$ -intercept of  $y = x^2 - 3x - 10$ . \_\_\_\_\_
- 34. Find zeros of  $y = (x - 4)(x + 2)$ . \_\_\_\_\_



## Answer Keys

- |   |  |
|---|--|
| 1. solid  | 13. no   |
| 2. above  | 14. no   |
| 3. yes  | 15. no   |
| 4. $y < x^2 - 1$                                      | 16. down   |
| 5. $(2, -3)$  | 17. dashed   |
| 6. yes  | 18. solid  |
| 7. $(1, 4)$   | 19. below the parabola                             |
| 8. dashed, opens down, vertex $(-1, 4)$ , shade above | 20. $(-1, -5)$                                     |
| 9. $y < (x - 1)^2 - 4$                                | 21. no   |
| 10. $y \leq (x + 2)^2 - 3$                            | 22. vertex $(0, 9)$ ; $x$ -int $(\pm 3, 0)$        |
| 11. $y > -(x - 2)^2 + 5$                              | 23. solid parabola, vertex $(1, -4)$ ; shade above |
| 12. $y \geq x^2 - 4$                                  | 24. vertex $(3, 8)$ , opens down                   |

## Additional Practice Answers

- |                      |                      |
|----------------------|----------------------|
| 25. $x = 2, 3$       | 30. $-16$            |
| 26. $x = -7, 7$      | 31. $x = -2, 2$      |
| 27. $(3, -4)$        | 32. $(x + 1)(x - 6)$ |
| 28. $x = -3$         | 33. $(0, -10)$       |
| 29. $(x + 5)(x + 2)$ | 34. $x = 4, -2$      |

**Additional Practice:** Answers for all numbered items, including the added practice, are shown in the grid above.

## Step-by-Step Explanations

- A non-strict symbol ( $\leq$  or  $\geq$ ) includes the boundary itself, so draw the parabola solid. Dashed is reserved for strict  $<$  or  $>$ .
- With  $y$  already isolated,  $y >$  stuff means shade above the curve. Confirm with a test point like  $(0, 1)$ : is  $1 > 0^2$ ? Yes, and  $(0, 1)$  sits above the parabola. ✓
- Substitute  $x = 0, y = 0$  into the inequality: is  $0 > 0^2 - 4 = -4$ ? Yes,  $0 > -4$  is true, so  $(0, 0)$  is in the region.
- Read the two clues: dashed boundary means a strict symbol, and shading below the curve means  $y <$ . Put them together:  $y < x^2 - 1$ .
- The boundary  $y = (x - 2)^2 - 3$  is in vertex form  $a(x - h)^2 + k$ . Read off  $h = 2$  (number subtracted inside) and  $k = -3$ , so the vertex is  $(2, -3)$ .
- Plug in  $x = 0, y = 0$ : is  $0 < -0^2 + 4 = 4$ ? Yes,  $0 < 4$  is true, so the origin lies in the solution region.
- Boundary is standard form with  $a = -1, b = 2$ . Vertex  $x = -\frac{b}{2a} = -\frac{2}{2(-1)} = 1$ . Plug back:  $y = -1 + 2 + 3 = 4$ , so the vertex is  $(1, 4)$ .
- Strict  $>$   $\Rightarrow$  dashed. Negative leading coefficient  $\Rightarrow$  opens down. Vertex  $(-1, 4)$ .  $y >$  stuff  $\Rightarrow$  shade above the curve.
- Vertex  $(1, -4)$ , opens up. Dashed  $\Rightarrow$  strict. Shaded below  $\Rightarrow y <$  form. So  $y < (x - 1)^2 - 4$ .
- Keep the rule visible: Vertex  $(-2, -3)$ , opens up. Solid  $\Rightarrow \leq$  or  $\geq$ . Shaded below  $\Rightarrow \leq$ . So  $y \leq (x + 2)^2 - 3$ . That gives a quick check on the answer.
- Vertex  $(2, 5)$ , opens down. Dashed  $\Rightarrow$  strict. Shaded above  $\Rightarrow y >$ . So  $y > -(x - 2)^2 + 5$ .
- Start with the key idea: Vertex  $(0, -4)$ , opens up. Solid  $\Rightarrow \leq$  or  $\geq$ . Shaded above  $\Rightarrow \geq$ . So  $y \geq x^2 - 4$ . That gives a quick check on the answer.
- Plug in  $x = 2, y = 0$ : is  $0 > 2^2 - 4 = 0$ ? No  $-0 > 0$  is false. The point sits exactly on the boundary, and a strict  $>$  excludes the boundary.
- Plug in  $x = 1, y = -5$ : is  $-5 > 1^2 - 4 = -3$ ? No, since  $-5 < -3$ . The point sits below the parabola, but the inequality wants the region above.
- Plug in  $x = -3, y = 4$ : is  $4 > (-3)^2 - 4 = 5$ ? No,  $4 < 5$ . At  $x = -3$  the boundary is at height 5, and the point sits below it.
- The opening direction is set by the sign of the leading coefficient. Here it's  $-2 < 0$ , so the parabola opens downward.
- The symbol is a strict  $>$ , so the boundary is not part of the solution — draw it dashed.
- The  $\geq$  is non-strict, so the boundary points satisfy the inequality and the curve is drawn solid.
- One steady path is:  $y <$  stuff  $\Rightarrow$  below the curve. (The parabola's vertex is  $(3, 1)$ , but that doesn't change the rule.) That gives a quick check on the answer.
- Vertex form  $a(x - h)^2 + k$ . Since  $(x + 1) = (x - (-1))$ , we get  $h = -1$ , and  $k = -5$ . Vertex  $(-1, -5)$  — the 2 only sets the steepness.
- Plug into the inequality:  $y = 2$  and  $x^2 - 4 = 9 - 4 = 5$ . Is  $2 \geq 5$ ? No. So  $(3, 2)$  is *not* in the allowed region — it sits below the boundary parabola at that  $x$ -value.
- Boundary  $y = -x^2 + 9$ . Vertex:  $h = 0$  (the  $x$ -term is missing),  $k = 9$ .  $x$ -intercepts:  $0 = -x^2 + 9 \Rightarrow x^2 = 9 \Rightarrow x = \pm 3$ .
- One steady path is:  $\geq \Rightarrow$  solid boundary. Vertex  $(1, -4)$ , opens up.  $y \geq$  stuff  $\Rightarrow$  shade above the curve. Test  $(0, 0)$ :  $0 \geq (0 - 1)^2 - 4 = -3$ . True. The origin is above the parabola, so the shading is on the side containing it. That gives a quick check on the answer.
- Vertex form gives  $h = 3, k = 8$ . The leading  $-1$  means the boundary parabola opens downward. The strict  $>$  makes the boundary dashed, and  $y >$  shades above the curve.



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