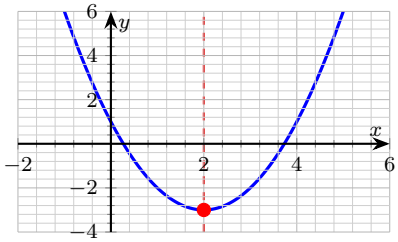
Axis of Symmetry of Quadratic Functions

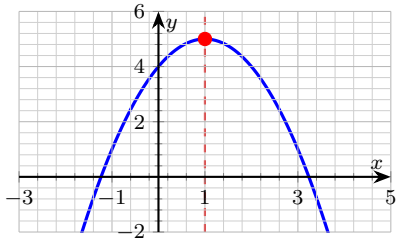
Name: _____	Date: _____	Score: _____ / 31

Quick Review

The **axis of symmetry** of a parabola is the vertical line that splits it into two mirror halves. It always passes through the vertex, so it's written as $x = h$ — a vertical line, never $y = k$. Two reliable ways to find it: from standard form $f(x) = ax^2 + bx + c$, use $x = -\frac{b}{2a}$; from vertex form $f(x) = a(x - h)^2 + k$, just read h off. The trap with vertex form is the sign: $(x + 5)^2 = (x - (-5))^2$, so the axis is $x = -5$, not $x = 5$. There's a third route that's handy when you only have a graph or a pair of points: two points on a parabola with the same y-value are reflections of each other across the axis. Their x-coordinates average to h. That's why if a parabola has x-intercepts at -6 and 2, the axis sits at $x = \frac{-6 + 2}{2} = -2$. Same trick reflects an arbitrary point across the axis — count the distance from one side, then go the same distance to the other side, keeping the y-value.

Below: the dashed line $x = h$ is the axis.

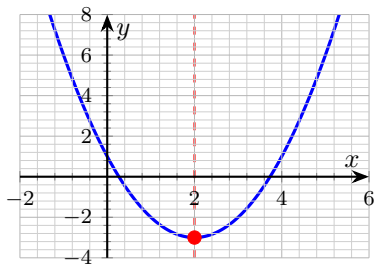




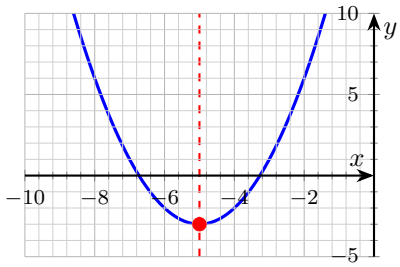
PRACTICE

Find the axis of symmetry or related quantity.

1. Find the axis of symmetry of $f(x) = x^2 - 4x + 1$. _____



2. Find the axis of symmetry of $f(x) = (x + 5)^2 - 3$. _____



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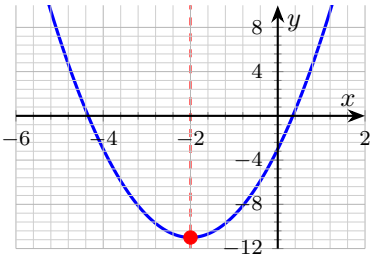
3. Find the axis of symmetry of $f(x) = 2x^2 + 8x - 3$. _____

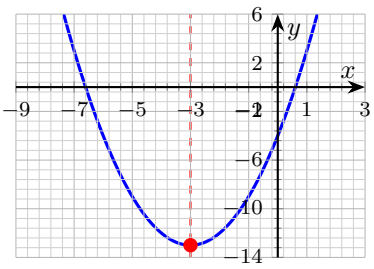


4. Vertex $(3, 7)$; find the axis. _____

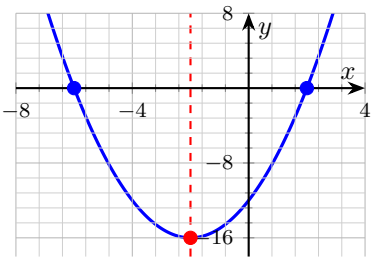
5. Passes through $(1, 5)$ and $(7, 5)$; find the axis. _____

6. Axis $x = -1$; parabola through $(3, 8)$. Find the reflected point. _____

7. Find the axis of symmetry of $f(x) = x^2 + 6x - 4$. _____



8. From the intercepts at $(-6, 0)$ and $(2, 0)$, find the axis of symmetry. _____



9. $f(x) = 2x^2 + kx + 5$ has axis $x = 3$. Find k. _____

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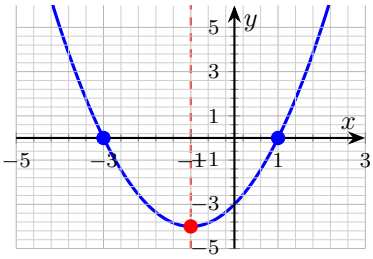
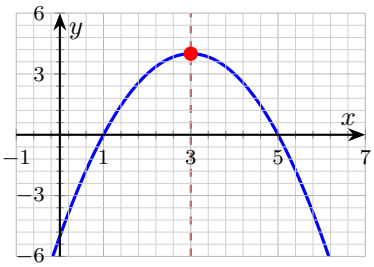
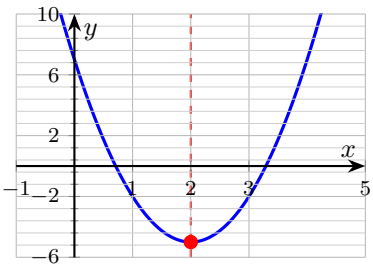
10. Find the axis of symmetry of $f(x) = x^2 + 2x - 3$. _____



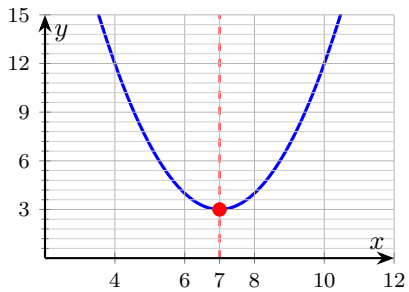
11. Find the axis of symmetry of $f(x) = -x^2 + 6x - 5$. _____



12. Find the axis of symmetry of $f(x) = 3x^2 - 12x + 7$. _____



13. Find the axis of symmetry of $f(x) = (x - 7)^2 + 3$. _____



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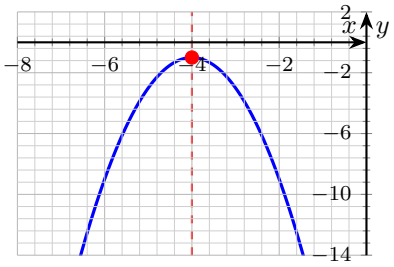
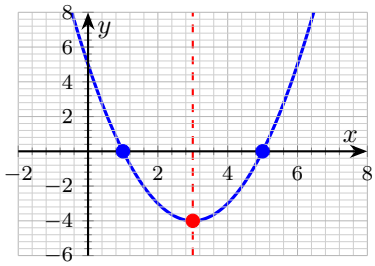
14. Find the axis of symmetry of $f(x) = -2(x+4)^2 - 1$ from its vertex form. _____

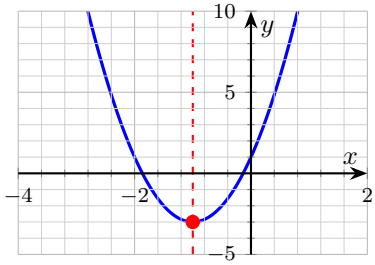


15. Parabola through $(-2, 5)$ and $(8, 5)$. _____

16. From x-intercepts $(1, 0)$ and $(5, 0)$, find the axis. _____



17. Find the axis of symmetry of $f(x) = 4x^2 + 8x + 1$. _____



18. Axis $x = 4$; parabola through $(7, 2)$. Find the reflected point. _____

19. $f(x) = x^2 + kx + 9$ has axis $x = -2$. Find k. _____

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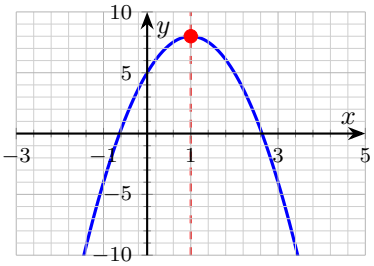
20. Find the axis of symmetry of $f(x) = -3(x-1)^2 + 8$. _____



Word Problems

21. A diver's height above water follows $h(t) = -16t^2 + 24t + 10$, where t is seconds. When does the diver reach maximum height? (That's the t-value on the axis of symmetry.) ____

22. A football is kicked, and its height (in feet) at horizontal distance x feet is given by $h(x) = -0.05x^2 + 2x$. The ball lands when $h = 0$. Find the axis of symmetry (which is where the ball reaches peak height). ____

23. A parabolic suspension cable is symmetric about its lowest point. The cable's height (in meters) above the deck is $y = 0.01x^2 - 0.6x + 15$, where x is horizontal distance in meters. Find the axis of symmetry. ____

24. A parabola has x-intercepts at -3 and 11. The axis of symmetry is also the x-value where the vertex sits. Find the axis, then find a point on the parabola that is the mirror image of $(0, -33)$. ____

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 $2x^2 - 8 = 0$. _____

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Answer Keys

1. $\boxed{x = 2}$
2. $\boxed{x = -5}$
3. $\boxed{x = -2}$
4. $\boxed{x = 3}$
5. $\boxed{x = 4}$
6. $\boxed{(-5, 8)}$
7. $\boxed{x = -3}$
8. $\boxed{x = -2}$
9. $\boxed{k = -12}$
10. $\boxed{x = -1}$
11. $\boxed{x = 3}$
12. $\boxed{x = 2}$
13. $\boxed{x = 7}$
14. $\boxed{x = -4}$
15. $\boxed{x = 3}$
16. $\boxed{x = 3}$
17. $\boxed{x = -1}$
18. $\boxed{(1, 2)}$
19. $\boxed{k = 4}$
20. $\boxed{x = 1}$
21. $\boxed{t = 0.75 \text{ seconds}}$
22. $\boxed{x = 20 \text{ feet}}$
23. $\boxed{x = 30 \text{ m}}$
24. $\boxed{x = 4;\ \text{mirror point } (8, -33)}$

Additional Practice Answers

25. $\boxed{x = 2,\ 3}$
26. $\boxed{x = -7,\ 7}$
27. $\boxed{(3, -4)}$
28. $\boxed{x = -3}$
29. $\boxed{(x + 5)(x + 2)}$
30. $\boxed{-16}$
31. $\boxed{x = -2,\ 2}$

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

Step-by-Step Explanations

1. A careful way to see it: $x = -\dfrac{-4}{2(1)} = 2$. The axis is the vertical line $x = 2$. (Sign matters: $-b$ with $b = -4$ is $+4$.) That gives a quick check on the answer.

2. Vertex form: $(x + 5)^2 = (x - (-5))^2$, so $h = -5$ and the axis is $x = -5$. The tempting wrong move is $x = 5$ from the sign inside the parentheses.

3. Use $x = -\dfrac{b}{2a}$ with $a = 2, b = 8$: $-\dfrac{8}{2(2)} = -\dfrac{8}{4} = -2$. Don't forget the $2a$ in the bottom includes the leading 2, not just b.

4. Axis is always $x = h$, the x-coordinate of the vertex. The 7 is the height of the vertex — a horizontal piece of data, not the axis.

5. Two points with the same y-value are mirrored across the axis. Average the x's: $\dfrac{1 + 7}{2} = 4$.

6. Keep the rule visible: $(3, 8)$ sits $3 - (-1) = 4$ units to the right of the axis. Mirror it: 4 units to the left of -1 is -5. Same y-value: $(-5, 8)$. That gives a quick check on the answer.

7. With $a = 1, b = 6$, the axis is $x = -\dfrac{b}{2a} = -\dfrac{6}{2} = -3$. That vertical line passes through the vertex, as the graph shows.

8. Start with the key idea: x-intercepts share $y = 0$, so they're symmetric across the axis. Average: $\dfrac{-6 + 2}{2} = -2$. That gives a quick check on the answer.

9. A careful way to see it: $-\dfrac{k}{2(2)} = 3 \Rightarrow -\dfrac{k}{4} = 3 \Rightarrow k = -12$. Verify: $-\dfrac{-12}{4} = 3$. ✓ This is the part to check before moving on, because it keeps the answer tied to the original question.

10. With $a = 1, b = 2$, the axis is $x = -\dfrac{2}{2(1)} = -1$. The graph confirms it: the dashed line cuts the parabola through its vertex at $x = -1$.

11. Here $a = -1, b = 6$, so $x = -\dfrac{6}{2(-1)} = -\dfrac{6}{-2} = 3$. Watch the signs — the $-b$ on top and the negative a underneath give two minus signs that cancel to a positive.

12. With $a = 3, b = -12$: $x = -\dfrac{-12}{2(3)} = \dfrac{12}{6} = 2$. The $-b$ turns -12 into $+12$ before you divide by $2a = 6$.

13. In vertex form $a(x - h)^2 + k$, the axis is $x = h$. Since $(x - 7)$ gives $h = 7$, the axis is $x = 7$ — no formula needed.

14. Keep the rule visible: $(x + 4)$ means $h = -4$. Axis: $x = -4$. The -2 flips the parabola but doesn't move the axis. That gives a quick check on the answer.

15. Two points sharing a y-value are mirror images across the axis, so h is their x-midpoint: $\dfrac{-2 + 8}{2} = \dfrac{6}{2} = 3$. Axis: $x = 3$.

16. The two x-intercepts both have $y = 0$, so they reflect across the axis. The axis sits at their midpoint: $\dfrac{1 + 5}{2} = 3$.

17. With $a = 4, b = 8$: $x = -\dfrac{8}{2(4)} = -\dfrac{8}{8} = -1$. The bigger leading coefficient narrows the parabola but the axis formula is unchanged.

18. Keep the rule visible: $(7, 2)$ is 3 units right of $x = 4$. Mirror: 3 units left of 4 is 1. Reflected point: $(1, 2)$. That gives a quick check on the answer.

19. The axis is $-\dfrac{b}{2a} = -\dfrac{k}{2(1)} = -\dfrac{k}{2}$. Set it equal to -2: $-\dfrac{k}{2} = -2$, so $k = 4$. Quick check: $-\dfrac{4}{2} = -2$. ✓

20. Vertex form. $h = 1$, so the axis is $x = 1$. The -3 stretches and flips the parabola but doesn't move the axis.

21. Vertex axis: $t = -\dfrac{24}{2(-16)} = -\dfrac{24}{-32} = 0.75$ seconds. Two negatives in the formula cancel; the result is a positive time.

22. Keep the rule visible: $x = -\dfrac{2}{2(-0.05)} = -\dfrac{2}{-0.1} = 20$ feet. The ball peaks halfway through the flight — you can also confirm by finding the landing point: $h = 0$ gives $x = 0$ or $x = 40$, and the midpoint is 20. That gives a quick check on the answer.

23. One steady path is: $x = -\dfrac{-0.6}{2(0.01)} = \dfrac{0.6}{0.02} = 30$ meters. That's the horizontal position of the lowest point of the cable. That gives a quick check on the answer.

24. Axis: $\dfrac{-3 + 11}{2} = 4$. The point $(0, -33)$ sits 4 units left of the axis $x = 4$. Its mirror sits 4 units right: at $x = 8$. Same y-value, so the mirror point is $(8, -33)$.

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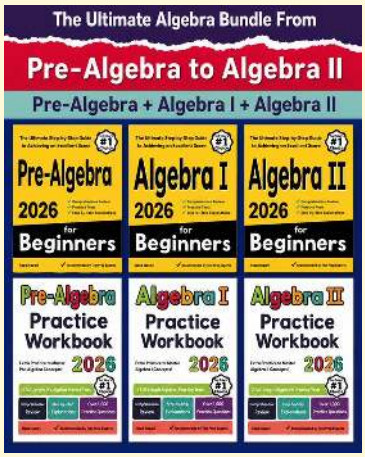

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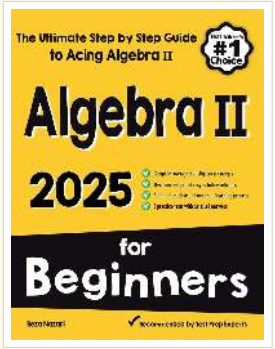

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