Solving Quadratic Equations by Using Square Roots

Name: ________	Date: ________	Score: ______ / 36

Quick Review

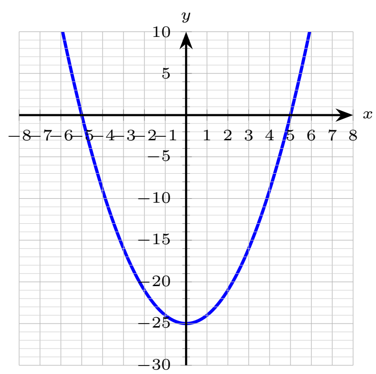
The square-root method works whenever you can wrestle a **single squared expression equal to a constant**: anything that looks like $(\text{stuff})^2 = k$. The recipe is the same every time. (1) Isolate the square — move constants, divide out coefficients — so the equation reads $(\text{stuff})^2 = k$. (2) Take *both* square roots: stuff $= \pm\sqrt{k}$. (3) Solve the two linear equations that fall out. The $\pm$ is the move students drop most often, and it's where half the missed solutions live.

If $k > 0$, you get two real solutions. If $k = 0$, the equation collapses to one repeated root. If $k < 0$ and you're staying in the reals, there's no solution — a real number squared can't be negative. Over the complex numbers, $\sqrt{-k} = i\sqrt{k}$, so $x^2 = -9$ gives $x = \pm 3i$. One more trap: when the equation has a coefficient like $2x^2 = 50$, divide by the coefficient *before* taking square roots — not after. Square rooting $2x^2$ doesn't give $x\sqrt{2}$ cleanly the way the next step would.

PRACTICE

Solve each equation by isolating the square and taking roots.

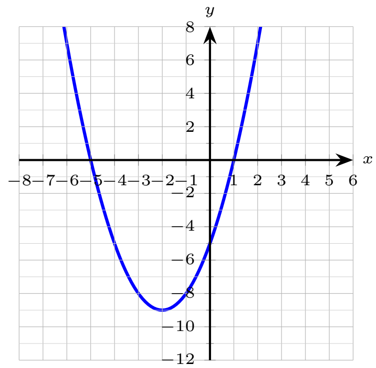
1. The graph of $y = x^2 - 25$ is shown. Read its x-intercepts, then solve $x^2 = 25$. ________



2. $(x - 3)^2 = 16$ ________

3. $2x^2 = 50$ ________

4. The parabola $y = (x+2)^2 - 9$ is graphed below. Use the graph to locate its roots, then solve $(x+2)^2 - 9 = 0$ by square roots. ________



5. Solve $x^2 + 4 = 0$ over the complex numbers. ________

6. $3(x-1)^2 = 27$ ________

7. $4(x+5)^2 - 12 = 0$ ________

8. $3(2x-5)^2 - 14 = 49$ ________

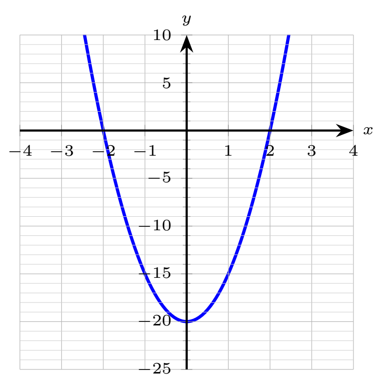
9. $(t-6)^2 = 0.25$ ________

10. $2(x+4)^2 + 18 = 0$ ________

11. $x^2 = 12$ ________

12. $(x-1)^2 = 8$ ________

13. The graph of $y = 5x^2 - 20$ is shown. Read where it crosses the x-axis, then solve $5x^2 - 20 = 0$. ________



14. $(2x+1)^2 = 49$ ________

15. $(x-5)^2 - 7 = 0$ ________

16. $\dfrac{(x+2)^2}{4} = 9$ ________

17. $9x^2 = 1$ ________

18. Solve $(x-7)^2 = -4$ over the complex numbers. ________

19. $3x^2 + 5 = 17$ ________

20. $-2(x+1)^2 + 8 = 0$ ________

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Word Problems

21. A square plot has area 169 ft^2. What is the length of each side? ____

22. A free-falling object's distance fallen (in feet) after t seconds is $d = 16t^2$ (ignoring air). How long until the object has fallen 144 feet? ____

23. A sensor's error model is $(t-6)^2 = 0.25$. Find the two times where the error is exactly that amount. ____

24. A square photo is mounted in a frame that adds 2 inches all around. The framed picture has area 144 in^2. What is the side length of the photo itself? ____

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 $y = (x-4)(x+2)$. ______

35. Solve $x^2 - 9 < 0$. ______

36. Solve $x^2 - 4x \geq 0$. ______

Answer Keys

1. $\boxed{x = \pm 5}$
2. $\boxed{x = 7,\ -1}$
3. $\boxed{x = \pm 5}$
4. $\boxed{x = 1,\ -5}$
5. $\boxed{x = \pm 2i}$
6. $\boxed{x = 4,\ -2}$
7. $\boxed{x = -5 \pm \sqrt{3}}$
8. $\boxed{x = \frac{5 \pm \sqrt{21}}{2}}$
9. $\boxed{t = 5.5,\ 6.5}$
10. no real solution
11. $\boxed{x = \pm 2\sqrt{3}}$
12. $\boxed{x = 1 \pm 2\sqrt{2}}$
13. $\boxed{x = \pm 2}$
14. $\boxed{x = 3,\ -4}$
15. $\boxed{x = 5 \pm \sqrt{7}}$
16. $\boxed{x = 4,\ -8}$
17. $\boxed{x = \pm \frac{1}{3}}$
18. $\boxed{x = 7 \pm 2i}$
19. $\boxed{x = \pm 2}$
20. $\boxed{x = 1,\ -3}$
21. 13 feet
22. $t = 3$ seconds
23. $t = 5.5$ and $t = 6.5$
24. 8 inches

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. $\boxed{x = -2,\ 2}$
32. $\boxed{(x + 1)(x - 6)}$
33. $\boxed{(0, -10)}$
34. $\boxed{x = 4,\ -2}$
35. $\boxed{-3 < x < 3}$
36. $x \le 0$ or $x \ge 4$

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

Step-by-Step Explanations

1. The parabola crosses the x-axis where $y = 0$, i.e. $x^2 - 25 = 0$. Square roots both sides: $x = \pm\sqrt{25} = \pm 5$. The $\pm$ matters — both signs square to 25, matching the two crossings on the graph.

2. The left side is already a perfect square, so take both roots: $x - 3 = \pm\sqrt{16} = \pm 4$. The $\pm$ is the easy step to drop. Add 3: $x = 3 + 4 = 7$ or $x = 3 - 4 = -1$.

3. Divide by 2 first: $x^2 = 25$. Then $x = \pm 5$. (Don't square root $2x^2$ as $x\sqrt{2}$ — clear the coefficient first.)

4. Roots are where the curve meets the x-axis. Isolate: $(x + 2)^2 = 9$. Then $x + 2 = \pm 3$, so $x = 1$ or $x = -5$ — exactly the two crossings you read off the graph.

5. A careful way to see it: $x^2 = -4$, no real solution. Over the complex numbers, $\sqrt{-4} = 2i$, so $x = \pm 2i$. That gives a quick check on the answer.

6. Isolate the square first by dividing by 3: $(x - 1)^2 = 9$. Take both roots: $x - 1 = \pm 3$. Add 1: $x = 4$ or $x = -2$.

7. One steady path is: Add 12, divide by 4: $(x + 5)^2 = 3$. So $x + 5 = \pm\sqrt{3}$ and $x = -5 \pm \sqrt{3}$. That gives a quick check on the answer.

8. Add 14: $3(2x - 5)^2 = 63$. Divide by 3: $(2x - 5)^2 = 21$. Square roots: $2x - 5 = \pm\sqrt{21}$. Then $2x = 5 \pm \sqrt{21}$ and $x = \frac{5 \pm \sqrt{21}}{2}$. Don't forget the final division by 2.

9. Take both roots: $t - 6 = \pm\sqrt{0.25} = \pm 0.5$. Add 6: $t = 6.5$ or $t = 5.5$ — each is half a unit from 6.

10. Isolate the square: subtract 18 and divide by 2 to get $(x + 4)^2 = -9$. A real number squared is never negative, so there is no real solution.

11. Take both roots: $x = \pm\sqrt{12}$. Simplify the radical by pulling out the perfect square: $\sqrt{12} = \sqrt{4 \cdot 3} = 2\sqrt{3}$. So $x = \pm 2\sqrt{3}$.

12. Start with the key idea: Square roots: $x - 1 = \pm\sqrt{8}$, and $\sqrt{8} = \sqrt{4 \cdot 2} = 2\sqrt{2}$. Add 1: $x = 1 \pm 2\sqrt{2}$. That gives a quick check on the answer.

13. Crossings occur where $y = 0$. Add 20: $5x^2 = 20$. Divide: $x^2 = 4$. Roots: ± 2, matching the two x-intercepts on the graph.

14. Take both roots: $2x + 1 = \pm 7$. Solve each branch: $2x = 6 \Rightarrow x = 3$, or $2x = -8 \Rightarrow x = -4$. Don't forget the final division by 2.

15. Move the 7 over to isolate the square: $(x - 5)^2 = 7$. Square roots: $x - 5 = \pm\sqrt{7}$ (doesn't simplify — 7 has no square factor). Add 5: $x = 5 \pm \sqrt{7}$.

16. Clear the denominator by multiplying both sides by 4: $(x + 2)^2 = 36$. Square roots: $x + 2 = \pm 6$, so $x = 4$ or $x = -8$.

17. A careful way to see it: Divide by 9 to isolate x^2: $x^2 = \frac{1}{9}$. Take both roots: $x = \pm\sqrt{\frac{1}{9}} = \pm\frac{1}{3}$. That gives a quick check on the answer.

18. Keep the rule visible: $x - 7 = \pm 2i$, so $x = 7 \pm 2i$. (Over the reals: no solution.) This is the part to check before moving on, because it keeps the answer tied to the original question.

19. One steady path is: Subtract 5: $3x^2 = 12$. Divide by 3: $x^2 = 4$. Roots: ± 2. That gives a quick check on the answer.

20. Subtract 8: $-2(x + 1)^2 = -8$. Divide by -2 (and the signs flip both sides): $(x + 1)^2 = 4$. Then $x + 1 = \pm 2$, so $x = 1$ or $x = -3$.

21. Side s satisfies $s^2 = 169$. Square roots: $s = \pm 13$. A length can't be negative, so $s = 13$ feet.

22. Keep the rule visible: $16t^2 = 144$, so $t^2 = 9$ and $t = \pm 3$. Reject the negative time: $t = 3$ seconds. That gives a quick check on the answer.

23. One steady path is: $t - 6 = \pm 0.5$. So $t = 5.5$ or $t = 6.5$. Both are 0.5 seconds away from $t = 6$. That gives a quick check on the answer.

24. Let photo side be s. The framed picture is $s + 4$ on each side, with area $(s + 4)^2 = 144$. Square roots: $s + 4 = \pm 12$. Positive: $s + 4 = 12$, so $s = 8$ inches. Check: framed side 12, area 144. ✓

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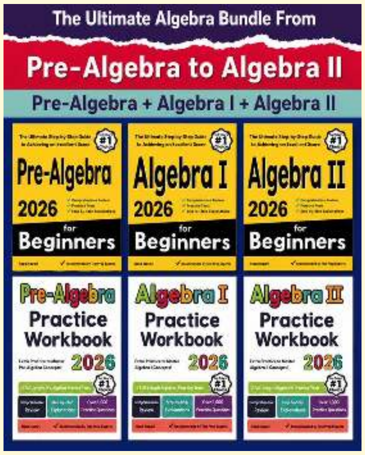

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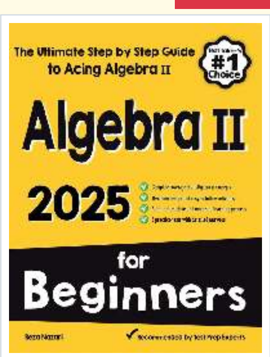

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