Solving a Quadratic Equation by Graphing

Name: ________________	Date: ____________	Score: ______ / 28

Quick Review

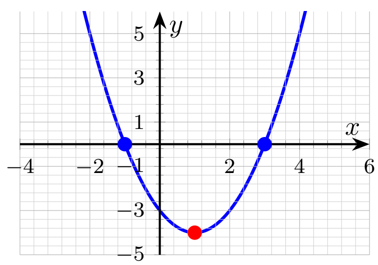
To solve $f(x) = 0$ graphically, look for the x**-intercepts** of the parabola $y = f(x)$. Those are exactly the points where the output is zero — so their x-coordinates are the solutions. Three cases sum it up. **Two intercepts**: the parabola crosses the x-axis twice, giving two distinct real roots (discriminant $\Delta > 0$). **One intercept**: the vertex sits exactly on the x-axis and the parabola is tangent there — one repeated root, also called a double root ($\Delta = 0$). **No intercepts**: the parabola sits entirely above or entirely below the x-axis. The equation has no real roots, only a complex-conjugate pair ($\Delta < 0$).

Two clarifications worth flagging. The y-intercept is the value at $x = 0$ and is generally *not* a solution. And the vertex is on the x-axis only in the double-root case — in every other case it's above or below. Always double-check a graphical reading by plugging the supposed root back into the equation.

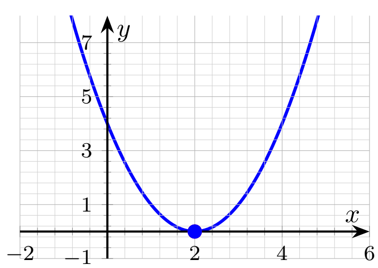
PRACTICE

Use the graph or equation to find all real solutions.

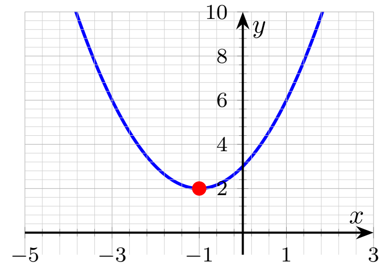
1. $y = x^2 - 4$ ________
2. Intercepts $(-3, 0)$ and $(5, 0)$; what are the solutions? ________
3. $y = x^2 - 6x + 8$ ________
4. For $y = x^2 - 2x - 3$ (parabola crosses below the x-axis), find the roots. ________



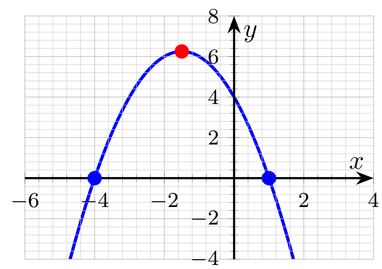
5. For $y = (x - 2)^2$ (graph tangent to the x-axis), find the root(s). ________



6. For $y = (x+1)^2 + 2$ (parabola sits above the x-axis), find any real roots. ________



7. y = -(x+4)(x-1) ________



8. $y = x^2 + 2x - 8$ ________

9. Vertex $(1, -9)$; one intercept at $(4, 0)$. Find both solutions. ________

10. Find the discriminant of $x^2 + x + 1$ and the number of real solutions. ________

11. $y = x^2 + 4x + 4$ ________

12. $y = -x^2 + 4x - 3$ ________

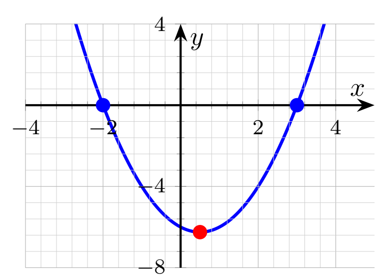
13. $y = 2x^2 - 8$ ________

14. How many x-intercepts does $y = x^2 - 2x + 5$ have? ________

15. How many x-intercepts does $y = 4x^2 - 12x + 9$ have? ________

16. $y = x^2 - x - 6$ ________

17. Solve from the graph: find both roots. ________



18. $y = (x+3)(x-5)$ ________

19. Find the smaller solution of $x^2 + 2x - 8 = 0$. ________

20. $y = x^2 + 9$ ________

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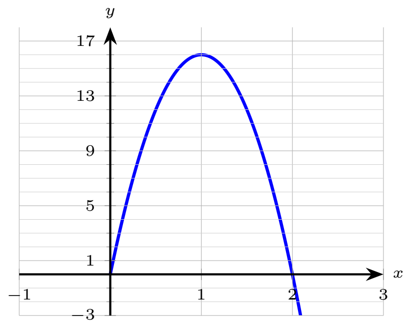
♦ Word Problems

21. A projectile's height is $h(t) = -16t^2 + 32t$ feet, where t is seconds. From the graph of h below, find when the projectile is back on the ground. ____



22. A small bridge's profile is the parabola $y = -0.1(x-10)^2 + 10$, where x and y are in meters. The bridge touches the ground where $y = 0$. Find both ground-contact points. ____

23. A baker's profit (in dollars) is $P(n) = -n^2 + 30n - 200$, where n is the number of loaves sold. Find the break-even points $(P(n) = 0)$. ____

24. A parabolic dish satisfies $y = x^2 - 4$ (in meters). Where does the dish meet the ground $(y = 0)$, and how wide is the dish at ground level? ____

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 $y = x^2 + 6x + 1$. ________

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Answer Keys

1. $x = \pm 2$	**13.** $x = \pm 2$
2. $x = -3,\ 5$	**14.** 0
3. $x = 2,\ 4$	**15.** 1 (double)
4. $x = -1,\ 3$	**16.** $x = -2,\ 3$
5. $x = 2$ (double root)	**17.** $x = -2,\ 3$
6. no real solutions	**18.** $x = -3,\ 5$
7. $x = -4,\ 1$	**19.** $x = -4$
8. $x = -4,\ 2$	**20.** no real solutions
9. $x = -2,\ 4$	**21.** $t = 2$ seconds
10. $\Delta = -3,$ none	**22.** $x = 0$ and $x = 20$
11. $x = -2$ (double root)	**23.** $n = 10$ and $n = 20$
12. $x = 1,\ 3$	**24.** $x = \pm 2;$ width 4 m

Additional Practice Answers

25. $x = 2,\ 3$	**27.** $(3, -4)$
26. $x = -7,\ 7$	**28.** $x = -3$

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

Step-by-Step Explanations

1. Solving graphically means finding where $y = 0$. Set $x^2 - 4 = 0$, so $x^2 = 4$ and $x = \pm 2$. Keep both signs — the parabola crosses the x-axis at -2 and 2.

2. An x-intercept is a point where $y = 0$, which is exactly what $f(x) = 0$ asks for. So read the x-coordinates straight off: $x = -3$ and $x = 5$.

3. Set $y = 0$ and factor: two numbers multiplying to 8 and adding to -6 are -2 and -4, so $(x-2)(x-4) = 0$. The roots $x = 2$ and $x = 4$ are the x-intercepts $(2, 0)$ and $(4, 0)$.

4. The roots are where the curve meets the x-axis: read off -1 and 3. Confirm by factoring: $(x-3)(x+1) = 0$ gives $x = 3$ or $x = -1$. The dip below the axis between the roots is just where $y < 0$.

5. Set $(x-2)^2 = 0$, which forces $x - 2 = 0$, so $x = 2$ — and it counts twice. The vertex sits right on the x-axis, so the graph is tangent there: one intercept, one repeated root.

6. The vertex is at $(-1, 2)$, above the x-axis, and the parabola opens up — so it never reaches $y = 0$. Expanding to $x^2 + 2x + 3$, the discriminant is $4 - 12 = -8 < 0$, confirming complex roots only and no real solutions.

7. It's already factored, so use the zero-product property: each factor equal to 0 gives a root. $x + 4 = 0 \Rightarrow x = -4$ and $x - 1 = 0 \Rightarrow x = 1$. The leading -1 flips the parabola down but doesn't change where it crosses.

8. Two numbers multiplying to -8 and adding to 2 are 4 and -2, so $(x+4)(x-2) = 0$. The roots are $x = -4$ and $x = 2$; the smaller is -4.

9. The axis of symmetry runs through the vertex at $x = 1$. The known intercept $(4, 0)$ is $4 - 1 = 3$ units right of the axis, so its mirror sits 3 units left at $x = 1 - 3 = -2$. Both intercepts: $x = -2$ and $x = 4$.

10. With $a = b = c = 1$, $\Delta = b^2 - 4ac = 1 - 4 = -3$. A negative discriminant means no real roots — the parabola floats entirely above the x-axis and never crosses it.

11. This is a perfect-square trinomial: $(x+2)^2 = 0$, so $x = -2$ counts twice. The vertex lands on the x-axis at $x = -2$, where the graph is tangent.

12. Multiply by -1 to factor: $x^2 - 4x + 3 = (x-1)(x-3) = 0$, so $x = 1$ or $x = 3$. The original parabola opens down with intercepts at 1 and 3.

13. Set $y = 0$: $2x^2 - 8 = 0$. Divide by 2 first to clear the coefficient, giving $x^2 = 4$, so $x = \pm 2$. Both signs square to 4.

14. The discriminant decides this: $\Delta = b^2 - 4ac = 4 - 20 = -16$. Negative means no real roots, so the parabola never touches the x-axis — zero intercepts.

15. Discriminant: $\Delta = (-12)^2 - 4(4)(9) = 144 - 144 = 0$. A zero discriminant means one repeated root, so the parabola is tangent to the x-axis at a single point.

16. Two numbers multiplying to -6 and adding to -1 are -3 and 2, so $(x-3)(x+2) = 0$, giving $x = 3$ or $x = -2$.

17. Read where the curve cuts the x-axis: $x = -2$ and $x = 3$. Those crossings are exactly the points where $y = 0$, so they are the solutions.

18. Set each factor to zero (zero-product property): $x + 3 = 0 \Rightarrow x = -3$ and $x - 5 = 0 \Rightarrow x = 5$. The signs flip from factor to root.

19. Numbers multiplying to -8 and adding to 2 are 4 and -2: $(x+4)(x-2) = 0$. Roots are -4 and 2, and the smaller is -4.

20. Set $y = 0$: $x^2 = -9$. No real number squares to a negative, so there are no real solutions. (Over the complex numbers the roots are $\pm 3i$, but the question asks for real ones.)

21. Set $h = 0$: $-16t(t-2) = 0$, so $t = 0$ (launch) or $t = 2$ (landing). The two x-intercepts of the parabola $y = h(t)$ are at 0 and 2. The projectile lands at $t = 2$ seconds.

22. Set $y = 0$: $0.1(x-10)^2 = 10$, so $(x-10)^2 = 100$ and $x - 10 = \pm 10$. That gives $x = 0$ and $x = 20$. The bridge spans 20 meters.

23. Multiply by -1: $n^2 - 30n + 200 = 0$. Factor: $(n-10)(n-20) = 0$, so $n = 10$ or $n = 20$. The baker breaks even at 10 or 20 loaves; between those, the profit is positive.

24. Start with the key idea: $x^2 = 4 \Rightarrow x = \pm 2$. The dish meets the ground at $x = -2$ and $x = 2$. The distance between those points is 4 meters. That gives a quick check on the answer.

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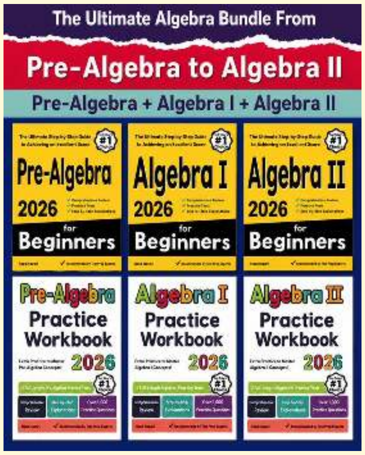

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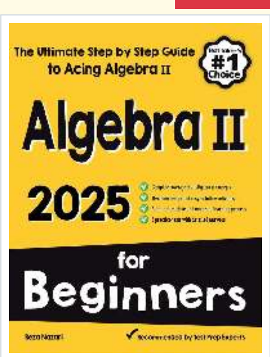

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