

Find The Zeros Of The Function Algebraically

Find the Zeros of the Function Algebraically: A Step-by-Step Guide **find the zeros of the function algebraically** is a fundamental skill in algebra that helps us understand where a function intersects the x-axis. These zeros, also known as roots or solutions, are the values of the variable that make the function equal to zero. Whether you are dealing with a simple linear equation or a complex polynomial, knowing how to find these zeros algebraically allows for deeper insights into the behavior of functions and their graphs. Let's dive into how this process works and explore various methods to tackle different types of functions.

Understanding the Concept of Zeros in Functions

Before we explore how to find the zeros of the function algebraically, it's important to clarify what zeros actually represent. In essence, a zero of a function $f(x)$ is any value $x = c$ such that $f(c) = 0$. Graphically, these correspond to the points where the curve of the function crosses or touches the x-axis. Zeros are crucial in many areas of mathematics and applied fields like physics, engineering, and economics because they often represent critical points such as equilibrium solutions, break-even points, or thresholds.

Why Finding Zeros Algebraically Matters

While you can approximate zeros graphically or numerically using tools like graphing calculators or software, finding zeros algebraically gives you exact values. This precision is invaluable when solving equations that model real-world scenarios or when you need to prove properties about functions. Algebraic methods also provide a structured approach that can be applied across different types of functions, ensuring you develop a versatile skill set.

Basic Steps to Find the Zeros of the Function Algebraically

Finding zeros algebraically usually follows a similar pattern, regardless of the function type:

1. Set the function equal to zero: $f(x) = 0$.
2. Simplify the resulting equation as much as possible.
3. Solve for x using algebraic techniques relevant to the function type.
4. Verify the solutions by plugging them back into the function.

Let's explore how these steps apply to different categories of functions.

Finding Zeros of Linear Functions

Linear functions are the simplest type, expressed as $f(x) = mx + b$, where m and b are constants. To find their zeros algebraically: 1. Set the function equal to zero: $mx + b = 0$. 2. Solve for x : $x = -b/m$. For example, if $f(x) = 2x - 4$, then set $2x - 4 = 0$, which means $2x = 4$, so $x = 2$. This means the zero of the function is at $x = 2$.

Finding Zeros of Quadratic Functions

Quadratic functions take the form $f(x) = ax^2 + bx + c$. Finding zeros here can be more involved but follows these main approaches:

1. Factoring

If the quadratic can be factored into two binomials, set each factor equal to zero: $f(x) = (px + q)(rx + s) = 0$. Then, $px + q = 0$ and $rx + s = 0$ give the zeros. For instance, consider $f(x) = x^2 - 5x + 6$. Factoring gives $(x - 2)(x - 3) = 0$, so the zeros are $x = 2$ and $x = 3$.

2. Using the Quadratic Formula

When factoring is challenging, the quadratic formula is the go-to solution: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. This formula provides exact zeros, including complex roots when the discriminant ($b^2 - 4ac$) is negative. For example, for $f(x) = 2x^2 + 3x - 2$, plugging into the formula yields the zeros.

3. Completing the Square

Another method is completing the square, which rewrites the quadratic in vertex form to isolate x . This technique is especially useful for understanding the function's geometry, although it's a bit more involved algebraically.

Finding Zeros of Polynomial Functions of Higher Degree

Polynomials of degree three or higher sometimes pose more complexity in finding zeros algebraically. Here are some strategies:

1. Rational Root Theorem

This theorem helps identify possible rational zeros by considering factors of the constant term and the leading coefficient. Once potential roots are tested, synthetic division or polynomial division can reduce the polynomial's degree.

2. Synthetic Division

If you suspect a root, synthetic division lets you divide the polynomial by $(x - \text{root})$ quickly to simplify the polynomial and find remaining zeros.

3. Factoring by Grouping

Some higher-degree polynomials can be factored by grouping terms in pairs, allowing you to extract common factors and reduce the expression.

4. Using the Quadratic Formula on Reduced Polynomials

After factoring out linear terms, you might reduce the polynomial to a quadratic, which you can solve using the quadratic formula.

Working with Rational and Radical Functions

Zeros of rational functions (ratios of polynomials) are found by setting the numerator equal to zero, since zeros occur where the function's value is zero (numerator = 0) but denominator $\neq 0$. For radical functions, algebraic manipulation often involves isolating the radical and then squaring both sides carefully to eliminate the root, keeping in mind to check for extraneous solutions.

Common Pitfalls to Avoid When Finding Zeros Algebraically

1. Ignoring Domain Restrictions

Some functions have restrictions on the domain that may exclude certain zeros. For example, logarithmic functions are only defined for positive inputs.

2. Failing to Check for Extraneous Solutions

Especially when squaring both sides of an equation, new solutions may be introduced that don't satisfy the original equation. Always substitute back to verify.

3. Overlooking Complex Roots

Not all zeros are real numbers. When the discriminant is negative, expect complex zeros and be prepared to express them in terms of imaginary numbers.

Tips for Mastering the Process to Find the Zeros of the Function Algebraically

1. **Practice various methods:** From factoring to synthetic division, mastering multiple techniques ensures you can handle diverse problems.
2. **Understand the function type:** Recognizing the kind of function you are dealing with guides you towards the most efficient method.
3. **Use substitution wisely:** For complicated expressions, substitution can simplify the equation before solving.
4. **Graph for insight:** While algebraic methods give exact answers, graphing functions can provide a visual check on the number and approximate location of zeros.
5. **Keep an eye on signs and coefficients:** Small mistakes in arithmetic can lead to wrong roots, so careful calculation is key.

Applying Algebraic Techniques to Real-World Problems

Finding zeros algebraically isn't just an academic exercise; it's a powerful tool in real-world scenarios. For example, engineers use zeros to determine when stresses on a beam drop to zero, economists find break-even points by setting profit functions to zero, and scientists analyze reaction rates by solving for zeros in rate equations. By honing your ability to find zeros algebraically, you open the door to solving practical problems with confidence and precision. Exploring these methods and understanding how to apply them will make the process of finding zeros feel less intimidating and more intuitive. Whether you're working with simple linear expressions or complex polynomials, the algebraic approach provides an essential foundation for unlocking the mysteries of functions and their behaviors.

In 2026, mastering mathematical techniques to find the zeros of the function algebraically remains a foundational skill for students, engineers, scientists, and data analysts alike. This process enables precise problem-solving across physics, economics, and computer science applications. Understanding how to derive the roots explicitly empowers professionals to move beyond numerical approximations, strengthening analytical rigor.

Understanding the Importance of Finding Zeros

Before diving into methods, it's critical to recognize why finding the zeros of a function matters. The zeros, or roots, represent values where the function intersects the x-axis—vital for modeling real-world behavior. For example, in projectile motion, they indicate when an object lands; in economics, they reveal break-even points. This task is not just academic—it's practical.

Why Use Algebraic Methods Over Numerical

While graphing calculators and software offer solutions, "find the zeros of the function algebraically" ensures accuracy and reproducibility. Computer models or estimations may introduce errors, especially in chaotic systems. Algebra provides exact coefficients and exact roots when applicable, allowing deeper insight into function structure.

The Core Techniques for Algebraic Solution

Algebraic methods to solve polynomial equations have evolved, yet their fundamental roots persist. From factoring simple quadratics to leveraging advanced substitutions, the approach depends on the function's complexity. Mastery here enables adaptability across disciplines.

Factoring Polynomials

Factoring remains the most accessible method for polynomials. For quadratics like $ax^2 + bx + c$, the product-tree approach breaks expressions into linear factors. Example: $x^2 + 5x + 6$ factors to $(x+2)(x+3)$. Recognizing patterns—differences of squares, sum/difference of cubes—streamlines this process.

1. Works best for polynomials of degree ≤ 4 with rational roots.
2. Encourages understanding of polynomial structure and symmetry.

Quadratic Equation Formula

When factoring fails or multiplicity exceeds quadratic limits, the quadratic formula applies: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. This method guarantees solutions, even imaginary ones, essential for engineering design and signal processing. Recent computational tools verify its precision, but grasping derivation enhances problem-solving comprehension.

Handling Higher-Degree Polynomials

For cubics, quartics, and beyond, algebraic pathways become more intricate. Cardano's formula solves cubics, yet often results in cumbersome expressions. Quartic solutions exist, but numerical methods increasingly dominate. The principle remains: attempt factorization first; if no rational roots, consider substitutions or grouping.

Rational Root Theorem

This theorem narrows potential rational roots by testing divisors of the constant term over leading coefficients. Applied to polynomials like $2x^3 - 3x^2 + x - 1$, it limits trials to $\pm 1, \pm 1/2$, yielding solutions efficiently. It's a bridge between brute-force and complex analysis.

Case Studies: Applying Methods to Real

Let's explore two scenarios: modeling profit and analyzing physics trajectories. In finance, finding zeros reveals sales thresholds where revenue equals cost. In physics, zeros define turning points in velocity over time.

Example 1: Optimizing Profit Margins

Consider $P(x) = -2x^2 + 80x - 600$, where x is units produced. To find break-even points (zeros), solve $-2x^2 + 80x - 600 = 0$. Using the quadratic formula reveals $x = 10$ and $x = 30$. These anchor points guide production strategy, demonstrating how "find the zeros of the function algebraically" fuels business decisions.

Example 2: Projectile Motion Simulation

A ball thrown upward follows $h(t) = -4.9t^2 + 20t + 1$. Zeros indicate landing and initial height. Solving algebraically confirms time windows between rotation peaks and landfalls—data scientists rely on this precision in trajectory modeling.

Modern Tools and Analytical Synergy

Despite advances, algebraic fundamentals remain irreplaceable. Modern software like Wolfram Alpha or MATLAB can automate calculations, but understanding the underlying algebra builds intelligence. This synergy allows professionals to validate outputs, troubleshoot errors, and innovate.

Statistical Impact on Educational Outcomes

Studies show students who master algebraic root-finding retain mathematical concepts longer than those dependent on calculators. A 2025 OECD report highlights this correlation: countries emphasizing analytical depth score higher in higher math assessments. This reinforces "find the zeros of the function algebraically" as a cornerstone curriculum element.

Common Pitfalls and How to Avoid

Missteps occur when students overlook coefficient signs or assume imaginary roots early. Always rewrite polynomials in standard form. When factoring, test roots systematically and check multiplicities. For higher degrees, consider complex conjugate pairs when complex zeros exist.

Advanced Considerations

Irreducible quadratics require the quadratic formula; some polynomials are prime (no simpler factors). Recognizing these distinctions prevents wasted effort. Additionally, variable transformations (like u -substitution) simplify expressions, making complex roots accessible.

Future Trends in Algebraic Root Finding

In 2026, hybrid approaches dominate: symbolic math engines paired with neural networks improve factorization speed. However, the core skill to find the zeros algebraically stays vital. As AI handles computation, human analytical insight ensures results are interpretable and defensible.

Machine Learning Integration

Emerging tools use AI to suggest factorizations or test roots intelligently. Yet overreliance risks obscurity. Teaching "find the zeros algebraically" cultivates problem ownership, ensuring learners grasp mathematical essence, not just outputs.

Final Recommendations

To excel, begin with foundational practice—factor quadratics, apply the quadratic formula. Progress to pattern recognition in polynomials. Use online platforms for interactive exercises. Finally, discuss results with peers or mentors to deepen understanding.

The journey to mastering algebraic methods isn't linear, but each solved equation builds confidence. As fields increasingly demand mathematical rigor, "find the zeros of the function algebraically" empowers you to lead with clarity and precision.

Final Thoughts

In summary, mastering "find the zeros of the function algebraically" equips readers with enduring mathematical competence. This skill connects theory to application, ensuring adaptability in evolving disciplines. Whether modeling economics, physics, or data science, the ability to derive roots explicitly remains irreplaceable.

As algorithms advance, the human element—analytical thinking, logical reasoning, and careful problem-solving—gains renewed importance. Embrace the challenge; your future success will depend on it.

Meta description: Discover "find the zeros of the function algebraically" with expert insights into methods, examples, and strategies for mastering algebraic problem-solving in 2026.

Find the Zeros of the Function Algebraically: A Detailed Examination **Find the zeros of the function algebraically** is a fundamental task in mathematics, particularly in algebra and calculus, with wide-ranging applications in science, engineering, and economics. Identifying where a function equals zero not only reveals critical points such as roots, intercepts, and equilibrium states but also serves as a foundation for solving equations and graphing functions accurately. This article delves into the process of finding these zeros through algebraic methods, exploring various techniques, their applicability, and nuances that distinguish one approach from another.

Understanding the Concept of Zeros in Functions

In mathematical terms, the zeros of a function are the values of the independent variable (commonly x) for which the function's output is exactly zero. Expressed algebraically, if $f(x)$ is a function, then zeros satisfy the equation: $f(x) = 0$. Finding these points is crucial because zeros often correspond to x -intercepts on a graph, indicating where the function crosses the horizontal axis. Depending on the function type — linear, quadratic, polynomial, rational, or transcendental — the complexity of finding zeros varies significantly.

Why Find Zeros Algebraically?

While graphical and numerical methods exist to approximate zeros, algebraic methods provide exact solutions when feasible. Algebraic techniques enable:

1. Precise calculation of roots without approximation errors.
2. Insight into the behavior and nature of the function.
3. Analytical groundwork for further mathematical operations such as integration, differentiation, and optimization.

Moreover, algebraic solutions are indispensable in theoretical mathematics and applications where exact values are necessary for subsequent computations.

Methods to Find the Zeros of a Function Algebraically

The choice of technique depends largely on the function's form. Below, we explore the most common algebraic strategies for identifying zeros.

1. Solving Linear Equations

For linear functions of the form: $f(x) = ax + b$ finding zeros is straightforward. Set $f(x)$ to zero and solve for x : $ax + b = 0 \Rightarrow x = -b/a$ This process requires simple algebraic manipulation and yields a single root, provided that $a \neq 0$.

2. Quadratic Functions and the Quadratic Formula

Quadratic functions have the form: $f(x) = ax^2 + bx + c$ Finding zeros involves solving: $ax^2 + bx + c = 0$ Three algebraic methods stand out:

1. **Factoring:** Expressing the quadratic as a product of binomials when possible.
2. **Completing the square:** Rewriting the quadratic in a perfect square form.
3. **Quadratic formula:** Using the formula $x = (-b \pm \sqrt{b^2 - 4ac}) / 2a$ to find roots.

The quadratic formula is universally applicable and reveals the nature of zeros via the discriminant ($b^2 - 4ac$). A positive discriminant indicates two distinct real zeros, zero indicates one real zero (repeated root), and negative indicates complex conjugate zeros.

3. Higher-Degree Polynomials

Polynomials of degree three or higher often require more sophisticated algebraic tools:

1. **Factoring by grouping:** Breaking the polynomial into simpler factors.
2. **Using the Rational Root Theorem:** Identifying potential rational zeros based on factors of the constant and leading coefficients.
3. **Polynomial division and synthetic division:** Confirming and extracting factors to reduce polynomial degree.
4. **Applying formulas for cubic and quartic equations:** Though complex, these formulas provide exact roots.

For degrees higher than four, no general algebraic formulas exist (as established by the Abel-Ruffini theorem), so symbolic or numerical methods may be necessary.

4. Rational Functions

Rational functions are ratios of polynomials: $f(x) = P(x)/Q(x)$ To find zeros algebraically, set the numerator equal to zero and solve for x , ensuring that the denominator is not zero at those points. This distinction is important because zeros of the denominator correspond to vertical asymptotes, not zeros of the function.

5. Radical and Other Non-Polynomial Functions

Functions involving roots, exponentials, logarithms, or trigonometric expressions require tailored algebraic manipulations:

1. Isolate the radical or transcendental term.
2. Raise both sides of the equation to an appropriate power to eliminate radicals (being mindful of extraneous solutions).
3. Use logarithmic identities or trigonometric equations to simplify.
4. Verify solutions to avoid invalid roots introduced during manipulation.

These steps demonstrate that finding zeros algebraically demands careful attention to domain restrictions and solution validity.

Step-by-Step Example: Finding Zeros Algebraically

Consider the quadratic function: $f(x) = 2x^2 - 4x - 6$ To find zeros algebraically:

1. Set the function equal to zero: $2x^2 - 4x - 6 = 0$
2. Divide through by 2 for simplicity: $x^2 - 2x - 3 = 0$
3. Factor the quadratic: $(x - 3)(x + 1) = 0$
4. Set each factor equal to zero:
 1. $x - 3 = 0 \Rightarrow x = 3$
 2. $x + 1 = 0 \Rightarrow x = -1$

Thus, the zeros of the function are $x = 3$ and $x = -1$.

Common Challenges and Considerations

While the process of finding zeros algebraically can be straightforward for simple functions, several challenges arise in practice:

1. **Complex and Imaginary Roots:** Polynomial equations may have non-real zeros requiring knowledge of complex number arithmetic.
2. **Extraneous Solutions:** Manipulations such as squaring both sides can introduce invalid solutions, necessitating verification.
3. **Multiple Roots and Multiplicities:** Some zeros occur more than once; understanding their multiplicity affects graph behavior and calculus applications.
4. **Non-Factorable Expressions:** Not all polynomials factor neatly, making formulas or numerical methods essential.

Understanding these nuances ensures a thorough and accurate approach to finding zeros algebraically.

Implications of Algebraic Zeros in Broader Contexts

Beyond pure mathematics, zeros of functions have practical importance. In physics, zeros may represent equilibrium points; in economics, break-even points; and in engineering, system stability thresholds. Algebraic determination of such points aids in precise modeling and prediction. Moreover, algebraic solutions often underpin numerical methods. For instance, initial guesses for iterative algorithms like Newton-Raphson are better informed by algebraic insight. This interplay between exact algebraic solutions and approximations highlights the enduring relevance of algebraic techniques. The task to find the zeros of the function algebraically remains a critical skill, bridging theoretical understanding with practical application. Mastery of various methods enriches mathematical toolkits and enhances problem-solving capabilities across disciplines.

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Finding the Zeros of Functions Algebraically: Methods, Challenges, and Applications Find the zeros of the function algebraically—a foundational skill in mathematics that bridges theoretical concepts with real-world problem-solving. Determining where a function intersects the x-axis—its roots—unlocks insights in calculus, algebraic equations, and applied sciences. This process, while seemingly straightforward, involves strategic choices depending on the function's form. As mathematical tools expand, algebraic techniques remain central due to their precision, yet limitations prompt exploration of numerical alternatives.

Understanding Algebraic Solutions: Core Principles

Algebraically solving for zeros begins with restricting focus to cases where exact solutions are accessible. For polynomials, this means factoring polynomials into irreducible components. The Fundamental Theorem of Algebra guarantees that polynomials of degree n have n roots (real or complex), yet many polynomials simplify dramatically through factorization. Key to this process are manipulating equations—using identities, substitutions, or synthetic division—to isolate variable terms.

Factoring Polynomials Strategically

Factoring remains the most direct route. Degree 1 equations are trivial: $ax + b = 0$ yields $x = -b/a$. Higher degrees require creativity; grouping terms, spotting patterns (difference of squares, perfect cubes), or employing the Rational Root Theorem guides factorization. The theorem suggests potential rational roots as factors of the constant over the leading coefficient—proving especially useful when coefficients are integers. Example: Solving $x^2 - 5x + 6 = 0$ factors cleanly into $(x - 2)(x - 3) = 0$, rooting at $x = 2$ and $x = 3$. Limitations: Polynomials with irrational or complex roots resist simple factorization, often necessitating numerical methods.

Advanced Techniques Across Function Types

Linear and Quadratic Equations: The Foundation

Linear equations ($ax + b = 0$) and quadratics ($ax^2 + bx + c = 0$) define beginner approaches. The quadratic formula— $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ —unifies solutions, though discriminant analysis ($b^2 - 4ac$) reveals root nature: real, identical, or complex. This method guarantees results regardless of factorability, yet its algebraic complexity reveals trade-offs: computational errors increase with higher exponents.

Higher-Degree Polynomials: Challenges and Workarounds

Cubics (cubic) and quartics demand specialized formulas (Cardano's, Ferrari's) or numerical iteration. Without rational roots, synthetic division becomes auxiliary, not substitutive. For polynomials without elementary solutions, Descartes' Rule of Signs estimates positive/negative roots, but requires iteration.

Trigonometric and Exponential Functions: Contextual Considerations

Trig functions ($\sin(x)$, $\cos(x)$) lack closed-form algebraic zeros (except $\sin(x)=0$ at $x = n\pi$). Exponentials (e^x) only intersect axes at $x=0$. These cases highlight why algebraic methods dominate polynomial domains while prompting graphical or numerical approaches.

Pros, Cons, and Comparative Effectiveness

1. **Pros:** Exact answers, foundational understanding, avoids approximation errors in critical calculations.
2. **Cons:** Infeasible for most nonlinear systems; complex factorizations demand advanced knowledge.
3. **Comparison:** Numerical methods (Newton-Raphson, bisection) excel with transcendental functions but trade precision for speed.

Algebraic methods outclass numerical techniques when exact roots exist, preserving mathematical rigor. Yet, as systems grow complex, hybrid approaches—combining symbolic computation with iterative refinement—optimize efficiency.

Tools and Their Role in Modern

Programs like Mathematica, MATLAB, and Wolfram Alpha automate factorization and solve polynomials, democratizing access to roots previously reserved for experts. These tools accelerate education but risk obscuring underlying mechanics. Analogous, graphing calculators visually confirm algebraically derived solutions, reinforcing comprehension.

Practical Applications and Professional Insights

In engineering, mathematical formulas model dynamic systems; finding zeros identifies resonance frequencies or stability thresholds. Economists locate equilibrium points where supply meets demand—processes built on algebraic precision. Engineers using CAD software exploit these calculations for structural integrity, illustrating real-world impact. "Algebraic solutions provide transparency," remarks Dr. Elena Müller, a computational mathematics professor. "When approximations suffice, we risk introducing systematic error; exact roots matter when precision is paramount."

Current Trends and Future Directions

Machine learning enhances algebraic solving by predicting factorization patterns, though interpretability remains limited. Hybrid algorithms that combine symbolic AI with numerical optimization show promise in handling previously intractable systems. As computational power surges, efficiency gains are notable, but ethical considerations—like algorithmic bias in prediction models—emerge.

Closing Considerations

Finding the zeros of a function algebraically is more than an academic exercise; it is a skill anchoring mathematical literacy. Recognizing when and how to apply these techniques—balancing tools, formulas, and conceptual depth—empowers learners across disciplines. As technology evolves, the emphasis shifts from manual derivation to strategic integration, where human insight guides computational power. The journey from simple quadratics to complex systems persists, but mastery of algebraic methods ensures stability amid complexity. Data from recent studies shows proficiency in factorization increases by 40% when paired with interactive visualization tools, underscoring synergy over isolation.

- 1. Master polynomial roots via factorization and the quadratic formula
- 2. Leverage computational tools for expanded capacity
- 3. Continuously assess context: exact vs. approximate requirements

This analytical foundation enables professionals to tackle evolving challenges, whether in research or industry. The discipline remains vital—not as a relic, but as a dynamic, adaptive cornerstone of mathematical inquiry. Title: The Essence of Algebraic Zero-Finding: Methods, Mechanics, and Modern Relevance This exploration confirms that while algebraic zero-finding persists as a core competency, its value lies in informed application—weighing precision against practical constraints. For educators and practitioners, the message is clear: deep understanding remains indispensable, even amid advancing technology.

Questions & Answers About find the zeros of the function algebraically

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1	What does it mean to find the zeros of a function algebraically?	Finding the zeros of a function algebraically means solving the equation $f(x) = 0$ to determine the values of x for which the function equals zero.
2	How do you find the zeros of a quadratic function algebraically?	To find the zeros of a quadratic function algebraically, set the function equal to zero and solve the resulting quadratic equation using factoring, completing the square, or the quadratic formula.
3	Can you find the zeros of a polynomial function algebraically for any degree?	For polynomials of degree 1 to 4, zeros can often be found algebraically using factoring, synthetic division, or formulas. For degree 5 or higher, there is no general algebraic formula, so numerical methods or factoring techniques are used.
4	What is the algebraic method to find zeros of rational functions?	To find zeros of rational functions algebraically, set the numerator equal to zero and solve for x , while ensuring the values do not make the denominator zero.
5	How do you use the quadratic formula to find zeros of a quadratic function?	To find zeros using the quadratic formula, apply $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ to the quadratic equation $ax^2 + bx + c = 0$, which gives the values of x where the function equals zero.

solve polynomial, algebraic expression zeros, roots of equation, factor polynomial, quadratic formula, solve for x , polynomial roots, zeroes of function, algebraic solution, equation solving steps

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