Inga Is Solving 2x2 + 12x 3 = 0. Which Steps Could She Use To Solve The Quadratic Equation? Select Three

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When faced with a quadratic equation like $2x^2 + 12x + 3 = 0$, students and math enthusiasts often wonder about the most effective methods to find its solutions. Inga, a diligent learner, is attempting to solve this equation and wants to understand the best steps to do so. Choosing the right approach not only simplifies the problem but also deepens understanding of quadratic equations. In this article, we explore three key methods Inga can use to solve quadratic equations systematically and efficiently, including factoring, completing the square, and the quadratic formula.

Understanding the Quadratic Equation

Before diving into the methods, it's essential to understand what a quadratic equation is. A quadratic equation is any second-degree polynomial equation in a single variable x with the general form:

$$ax^2 + bx + c = 0$$

where:
- $a \neq 0$,
- b and c are coefficients.

In Inga's case, the equation is:

$$2x^2 + 12x + 3 = 0$$

Our goal is to find the values of x that satisfy this equation.

Method 1: Factoring the Quadratic Equation

Factoring is often the first approach students learn because of its simplicity when applicable. It involves expressing the quadratic as a product of two binomials and then applying the zero product property.

Step 1: Rewrite the Equation

Ensure the quadratic is in standard form:

$$2x^2 + 12x + 3 = 0$$

Step 2: Find Factors of $a \times c$

Calculate $a \times c$:

$$2 \times 3 = 6$$

Next, find two numbers that multiply to 6 and add to $b = 12$.

- Factors of 6: 1 and 6, 2 and 3

Check sums:

- 1 + 6 = 7 (not 12)
- 2 + 3 = 5 (not 12)

No pair of factors of 6 adds up to 12. Therefore, factoring by simple splitting is not straightforward here.

Conclusion on Factoring

Since simple factoring isn't feasible, Inga can consider other methods such as completing the square or the quadratic formula.

Method 2: Completing the Square

Completing the square rewrites a quadratic in a form that makes solutions more apparent. It's especially useful when factoring isn't straightforward.

Step 1: Divide all terms by a

Divide the entire equation by 2:

$$x^2 + 6x + \frac{3}{2} = 0$$

Rearranged:

$$x^2 + 6x = -\frac{3}{2}$$

Step 2: Complete the square on the left side

To complete the square:

- Take half of the coefficient of x (which is 6), divide by 2:

$$\frac{6}{2} = 3$$

- Square it:

$$ 3^2 = 9 $$

- Add and subtract 9 on the left side:

$$ x^2 + 6x + 9 = -\frac{3}{2} + 9 $$

which simplifies to:

$$ (x + 3)^2 = \frac{15}{2} $$

Step 3: Take the square root of both sides

$$ x + 3 = \pm \sqrt{\frac{15}{2}} $$

Express the square root:

$$ x + 3 = \pm \frac{\sqrt{15}}{\sqrt{2}} $$

Rationalize the denominator:

$$ x + 3 = \pm \frac{\sqrt{15} \times \sqrt{2}}{\sqrt{2} \times \sqrt{2}} = \pm \frac{\sqrt{30}}{2} $$

Step 4: Solve for x

Subtract 3 from both sides:

$$ x = -3 \pm \frac{\sqrt{30}}{2} $$

These are the solutions obtained via completing the square.

Method 3: Using the Quadratic Formula

The quadratic formula is a universal method applicable to all quadratic equations:

$$ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} $$

Inga can use this formula to find the roots directly.

Step 1: Identify coefficients

From the original equation:

$$ 2x^2 + 12x + 3 = 0 $$

Coefficients:

- $a = 2$

- $b = 12$
- $c = 3$

Step 2: Calculate the discriminant D

Discriminant:

$$D = b^2 - 4ac = 12^2 - 4 \times 2 \times 3 = 144 - 24 = 120$$

Since $D > 0$, there are two real solutions.

Step 3: Plug into the quadratic formula

$$x = \frac{-12 \pm \sqrt{120}}{2 \times 2}$$

Simplify:

$$x = \frac{-12 \pm \sqrt{120}}{4}$$

Express $\sqrt{120}$ in simplest radical form:

$$\sqrt{120} = \sqrt{4 \times 30} = 2 \sqrt{30}$$

Substitute back:

$$x = \frac{-12 \pm 2 \sqrt{30}}{4}$$

Simplify numerator:

$$x = \frac{-12}{4} \pm \frac{2 \sqrt{30}}{4} = -3 \pm \frac{\sqrt{30}}{2}$$

Final solutions:

$$x = -3 + \frac{\sqrt{30}}{2} \quad \text{and} \quad x = -3 - \frac{\sqrt{30}}{2}$$

These solutions match those obtained via completing the square, confirming the consistency of methods.

Summary: Three Methods Inga Could Use to Solve the Equation

Method	Description	When to Use	Key Steps
Factoring	Expressing the quadratic as a product of binomials	When the quadratic factors easily	Find two numbers that multiply to $a \times c$ and add to b

Completing the Square	Rewriting the quadratic in the form $(x + p)^2 = q$	When factoring is difficult	Divide, complete the square, isolate x
Quadratic Formula	Directly computing roots using the formula	Always reliable, especially when roots are irrational	Identify a, b, c, compute discriminant, substitute

Choosing the Best Method for Inga

For Inga, the quadratic formula provides a straightforward solution without requiring factorization, especially since the quadratic doesn't factor easily. Completing the square offers insight into the structure of the quadratic, and factoring can be attempted first if the coefficients are conducive.

Practical Tips for Solving Quadratic Equations

- Always write equations in standard form $ax^2 + bx + c = 0$.
- Calculate the discriminant first to determine the nature of roots.
- Use the quadratic formula as a universal method.
- Simplify radicals whenever possible.
- Check solutions by substituting back into the original equation.

Conclusion

Inga has multiple effective strategies to solve the quadratic equation $2x^2 + 12x + 3 = 0$. Whether she opts for the quadratic formula, completing the square, or attempting to factor, each method offers valuable insights into the structure of quadratic equations. Understanding these methods not only helps in solving specific problems but also deepens overall mathematical comprehension. By mastering these approaches, Inga can confidently tackle similar equations in her studies and beyond.

Meta Description: Discover three effective methods Inga can use to solve quadratic equations like $2x^2 + 12x + 3 = 0$. Learn step-by-step techniques including factoring, completing the square, and the quadratic formula.

Frequently Asked Questions

What is the first step Inga should take to solve the quadratic equation $2x^2 + 12x + 3 = 0$?

Inga should identify the coefficients $a = 2$, $b = 12$, and $c = 3$ to prepare for applying a solution method like factoring, completing the square, or the quadratic formula.

Which method can Inga use to solve $2x^2 + 12x + 3 = 0$ if factoring is not straightforward?

Inga can use the quadratic formula: $x = [-b \pm \sqrt{(b^2 - 4ac)}] / (2a)$.

How does Inga determine whether to use the quadratic formula or factoring to solve the equation?

She examines the discriminant ($b^2 - 4ac$). If it's a perfect square, factoring may be easier; otherwise, the quadratic formula is a reliable choice.

What is the importance of calculating the discriminant in solving quadratic equations?

The discriminant indicates the nature of the roots: if positive, there are two real roots; if zero, one real root; if negative, complex roots.

After solving the quadratic equation, what should Inga do to verify her solutions?

She can substitute the solutions back into the original equation to check if they satisfy the equation, ensuring accuracy.

Additional Resources

Inga Is Solving $2x^2 + 12x + 3 = 0$: Which Steps Could She Use To Solve The Quadratic Equation? Select Three

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Introduction

Mathematics often presents students and practitioners with problems that require a systematic approach to find solutions. Among these, quadratic equations stand out due to their fundamental importance and wide applicability. The equation $2x^2 + 12x + 3 = 0$ exemplifies a typical quadratic that can be approached through various methods. This article investigates the steps Inga could take to solve this specific quadratic equation, focusing on three primary methods: factoring, completing the square, and the quadratic formula. By analyzing each approach in detail, we aim to provide a comprehensive guide that not only aids Inga but also enhances understanding for learners tackling quadratic equations in general.

Understanding the Quadratic Equation: The Basics

Before diving into solution strategies, it's essential to understand the structure of a quadratic equation. A standard quadratic equation is expressed as:

\[ax^2 + bx + c = 0 \]

where \(a \neq 0\), and \(b, c\) are real numbers. The solutions to the quadratic are the values of x that satisfy the equation. These solutions can be real or complex, depending on the discriminant:

$$D = b^2 - 4ac$$

- If $D > 0$, there are two real solutions.
- If $D = 0$, there is one real solution (a repeated root).
- If $D < 0$, solutions are complex conjugates.

In our specific case:

$$2x^2 + 12x + 3 = 0$$

the coefficients are $a=2$, $b=12$, and $c=3$. Calculating the discriminant:

$$D = (12)^2 - 4 \times 2 \times 3 = 144 - 24 = 120$$

Since $D > 0$, Inga can expect two distinct real solutions, making the problem a good candidate for all three methods discussed below.

Method 1: Factoring (When Possible)

The Approach

Factoring involves expressing the quadratic as a product of two binomials:

$$ax^2 + bx + c = (mx + n)(px + q)$$

such that:

$$mp = a$$
$$mq + np = b$$
$$nq = c$$

The goal is to find integers or rational numbers m, n, p, q satisfying these relations.

Applying Factoring to $2x^2 + 12x + 3$

1. Check for Common Factors

The coefficients don't share a common factor besides 1, so factoring out a common term isn't applicable here.

2. Identify Factors of $a \times c$

- $a \times c = 2 \times 3 = 6$
- Find factor pairs of 6: $1 \times 6, 2 \times 3, (-1) \times -6, (-2) \times -3$

3. Find a Pair that Sums to $b = 12$

- For the pair 2 and 3, their sum is 5, which doesn't match 12.
- For 1 and 6, sum is 7, still not 12.
- For negatives, sums are negative, so unlikely to help here.

4. Conclusion

The factor pairs of 6 don't sum to 12, indicating that simple factoring over rationals isn't feasible.

Alternative: Factorization via Rational Roots Theorem

- Rational roots are potential solutions of the form $\pm \frac{d}{a}$, where d divides c.

- Divisors of 3: $\pm 1, \pm 3$

- Test potential roots:

$$
x = 1: \quad 2(1)^2 + 12(1) + 3 = 2 + 12 + 3 = 17 \neq 0
$$
$$
x = -1: \quad 2(1) -12 + 3 = 2 - 12 + 3 = -7 \neq 0
$$
$$
x=3: \quad 2(9) + 36 + 3= 18 + 36 + 3= 57 \neq 0
$$
$$
x= -3: \quad 2(9) -36 + 3= 18 -36 + 3= -15 \neq 0
$$

- No rational roots, so factorization over rationals is not straightforward.

Summary

While factoring is elegant and straightforward for some quadratics, in this case, it’s impractical due to the non-integer roots and the inability to factor neatly over rationals. Therefore, Inga should consider alternative methods.

Method 2: Completing the Square

The Approach

Completing the square transforms the quadratic into a perfect square trinomial, allowing for straightforward solution extraction.

The general process:

1. Divide the entire equation by a to normalize the coefficient of x^2.
2. Rearrange the equation to isolate the constant term.
3. Add and subtract the square of half the coefficient of x inside the equation to complete the square.
4. Express as a perfect square binomial, then solve for x.

Step-by-Step Application to $2x^2 + 12x + 3 = 0$

1. Divide through by $a=2$:

\[

$$
x^2 + 6x + \frac{3}{2} = 0
$$

2. Isolate the constant:

$$
x^2 + 6x = -\frac{3}{2}
$$

3. Complete the square:

- Take half of the coefficient of x: $\frac{6}{2} = 3$
- Square it: $3^2 = 9$

4. Add and subtract 9 on the left:

$$
x^2 + 6x + 9 = -\frac{3}{2} + 9
$$

$$
(x + 3)^2 = -\frac{3}{2} + \frac{18}{2} = \frac{15}{2}
$$

5. Solve for x:

$$
x + 3 = \pm \sqrt{\frac{15}{2}}
$$

$$
x = -3 \pm \sqrt{\frac{15}{2}}
$$

6. Simplify the radical:

$$
\sqrt{\frac{15}{2}} = \frac{\sqrt{15}}{\sqrt{2}} = \frac{\sqrt{15} \times \sqrt{2}}{\sqrt{2} \times \sqrt{2}} = \frac{\sqrt{30}}{2}
$$

7. Final solutions:

$$
x = -3 \pm \frac{\sqrt{30}}{2}
$$

Method 3: The Quadratic Formula

The Approach

The quadratic formula provides a universal method applicable to all quadratic equations:

$$
x = \frac{-b \pm \sqrt{D}}{2a}
$$

where $D = b^2 - 4ac$.

Applying to Our Equation

- Recall $a=2$, $b=12$, $c=3$
- Discriminant:

$$
D = 12^2 - 4 \times 2 \times 3 = 144 - 24 = 120
$$

- Compute $\sqrt{D}$:

$$
\sqrt{120} = \sqrt{4 \times 30} = 2 \sqrt{30}
$$

- Plug into the formula:

$$
x = \frac{-12 \pm 2 \sqrt{30}}{2 \times 2} = \frac{-12 \pm 2 \sqrt{30}}{4}
$$

- Simplify numerator:

$$
x = \frac{-12}{4} \pm \frac{2 \sqrt{30}}{4} = -3 \pm \frac{\sqrt{30}}{2}
$$

Result:

$$
x = -3 \pm \frac{\sqrt{30}}{2}
$$

which matches the solutions obtained via completing the square.

Comparative Analysis of Methods

Method	Applicability	Complexity	Result	Remarks
Factoring	When roots are rational and factors are simple	Moderate to difficult	Not feasible here	No rational roots found; not ideal for this quadratic
Completing the Square	When coefficients are manageable	Moderate	$x = -3 \pm \frac{\sqrt{30}}{2}$	Provides exact solutions; insightful for understanding structure
Quadratic Formula	Universal, straightforward	Low	Same as completing the square	Most reliable method for all quadratics

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Conclusion

Inga’s problem of solving $2x^2 + 12x + 3 = 0$ showcases the importance of selecting appropriate solution strategies based on the quadratic's characteristics. While factoring can be efficient for

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