Please Help, Its Due Today. Use The Quadratic Formula To Solve 2x^2-5x-5=0Show All Your Work

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When faced with a quadratic equation such as $2x^2 - 5x - 5 = 0$, students and mathematicians alike often turn to the quadratic formula as a reliable method for finding solutions. The quadratic formula provides a straightforward way to determine the roots of any quadratic equation of the form $ax^2 + bx + c = 0$, regardless of whether the roots are real or complex. In this article, we will explore the quadratic formula in depth and go through the step-by-step process of applying it to solve the specific quadratic equation $2x^2 - 5x - 5 = 0$. Along the way, we will clarify key concepts, demonstrate detailed calculations, and offer tips for mastering quadratic solutions.

Understanding the Quadratic Equation

The Standard Form of a Quadratic Equation

A quadratic equation is any polynomial equation of degree 2, typically written in the form:

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

where:
- a, b, and c are coefficients (with $a \neq 0$),
- x is the variable.

In our specific case, the equation is:

- $2x^2 - 5x - 5 = 0$

Here:
- $a = 2$
- $b = -5$
- $c = -5$

The Goal: Find the Values of x

The roots or solutions of the quadratic are the values of x that satisfy the equation. These roots can be real or complex, depending on the discriminant (we will define this shortly). The quadratic formula offers a universal method to find these roots.

The Quadratic Formula

Derivation and Explanation

The quadratic formula is derived from the process of completing the square on the general quadratic equation. It states that:

- $x = (-b \pm \sqrt{b^2 - 4ac}) / (2a)$

This formula computes the roots as a function of the coefficients a, b, and c.

Parts of the Formula

- $-b$: The opposite of the linear coefficient.
- $\sqrt{b^2 - 4ac}$: The square root of the discriminant.
- Discriminant (D): The expression $b^2 - 4ac$ determines the nature of the roots.
- If $D > 0$: two real roots.
- If $D = 0$: one real root (a repeated root).
- If $D < 0$: two complex roots.

Applying the Quadratic Formula to $2x^2 - 5x - 5 = 0$

Now, let's walk through the entire process step by step.

Step 1: Identify the coefficients

From the given equation:

- $a = 2$
- $b = -5$
- $c = -5$

Step 2: Calculate the discriminant (D)

Using the formula:

- $D = b^2 - 4ac$

Plugging in the values:

- $D = (-5)^2 - 4\ 2\ (-5)$
- $D = 25 - 4\ 2\ (-5)$

Calculate:

- $4\ 2 = 8$
- $8\ (-5) = -40$

Now:

- $D = 25 - (-40) = 25 + 40 = 65$

Discriminant, $D = 65$

Since $D > 0$, the equation has two real roots.

Step 3: Compute the square root of the discriminant

- $\sqrt{D} = \sqrt{65}$

While $\sqrt{65}$ is not a perfect square, it can be approximated or left in radical form for exact solutions:

- $\sqrt{65} \approx 8.0623$

Step 4: Apply the quadratic formula

Recall:

- $x = (-b \pm \sqrt{D}) / (2a)$

Plug in the known values:

- $x = (-(-5) \pm \sqrt{65}) / (2\ 2)$

Simplify numerator:

- $-(-5) = +5$

Simplify denominator:

- 2 2 = 4

So:

- $x = (5 \pm \sqrt{65}) / 4$

Step 5: Write the solutions

Exact solutions:

- $x_1 = (5 + \sqrt{65}) / 4$
- $x_2 = (5 - \sqrt{65}) / 4$

Approximate solutions:

Using $\sqrt{65} \approx 8.0623$,

- $x_1 \approx (5 + 8.0623) / 4 \approx 13.0623 / 4 \approx 3.2656$
- $x_2 \approx (5 - 8.0623) / 4 \approx -3.0623 / 4 \approx -0.7656$

Summary and Additional Notes

Summary of Steps

1. Identify coefficients a, b, c
2. Calculate the discriminant $D = b^2 - 4ac$
3. Determine the nature of the roots based on D
4. Compute $\sqrt{D}$
5. Apply the quadratic formula to find roots
6. Express solutions in exact and approximate forms

Important Tips

- Always double-check calculations of the discriminant, as errors here affect the roots.
- If the discriminant is a perfect square, roots will be rational numbers.
- For complex roots (when $D < 0$), the square root involves imaginary numbers, and the formula includes i (the imaginary unit).
- Understanding the discriminant helps interpret the nature of solutions without solving explicitly.

Extensions and Practice

To deepen understanding, practice applying the quadratic formula to various equations with different coefficients and discriminants. Recognize patterns and develop fluency in manipulating radicals and simplifying solutions.

Conclusion

Using the quadratic formula to solve quadratic equations is a fundamental skill in algebra. In the example of $2x^2 - 5x - 5 = 0$, we systematically identified coefficients, calculated the discriminant, and derived the roots both exactly and approximately. Mastering this method enables students to tackle a wide range of quadratic problems confidently and efficiently. Remember, the key lies in carefully following each step, verifying calculations, and understanding the significance of the discriminant in determining the nature of roots.

Final Note: Always keep a calculator or computational tool handy for dealing with radicals and approximations, especially when roots involve non-perfect squares or complex numbers. With practice, applying the quadratic formula will become an intuitive and invaluable part of your mathematical toolkit.

Frequently Asked Questions

How do I identify the coefficients in the quadratic

equation $2x^2 - 5x - 5 = 0$ to use the quadratic formula?

In the quadratic equation $2x^2 - 5x - 5 = 0$, the coefficients are $a = 2$, $b = -5$, and $c = -5$. These are the numbers multiplying x^2, x, and the constant term, respectively.

What is the quadratic formula, and how do I apply it to solve $2x^2 - 5x - 5 = 0$?

The quadratic formula is $x = [-b \pm \sqrt{(b^2 - 4ac)}] / 2a$. To solve $2x^2 - 5x - 5 = 0$, substitute $a=2$, $b=-5$, $c=-5$ into the formula, then simplify and compute the discriminant and roots.

How do I compute the discriminant in the quadratic formula for $2x^2 - 5x - 5 = 0$?

The discriminant is the expression under the square root: $\Delta = b^2 - 4ac$. For your equation, $\Delta = (-5)^2 - 4\ 2\ (-5) = 25 - (-40) = 25 + 40 = 65$.

What are the solutions for x after calculating the discriminant for $2x^2 - 5x - 5 = 0$?

Using the quadratic formula: $x = [5 \pm \sqrt{65}] / (2\ 2)$. Simplify to $x = [5 \pm \sqrt{65}] / 4$. The solutions are approximately $x \approx (5 + 8.062) / 4 \approx 13.062 / 4 \approx 3.266$ and $x \approx (5 - 8.062) / 4 \approx -3.062 / 4 \approx -0.766$.

Can I leave my answer as an exact value, or do I need to approximate the roots?

You can leave the roots in exact form as $x = [5 \pm \sqrt{65}] / 4$. Approximate decimal values are useful for practical purposes, but exact forms are preferred for precise solutions.

What should I check after solving the quadratic to ensure my solutions are correct?

You can substitute your solutions back into the original equation $2x^2 - 5x - 5 = 0$ to verify they satisfy the equation, ensuring your calculations are correct.

Additional Resources

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Introduction: The Urgency and Relevance of the Quadratic Formula

In the fast-paced realm of mathematics, students often find themselves in frantic situations, such as realizing a homework assignment is due the very same day. One of the most fundamental and versatile tools in algebra to tackle quadratic equations is the quadratic formula. Whether you're a high school student grappling with your homework or someone preparing for exams, understanding how to properly apply this formula is crucial. Today, we will walk through a specific example: solving the quadratic equation $2x^2 - 5x - 5 = 0$ step-by-step, demonstrating all the necessary work to ensure clarity and confidence.

Understanding the Quadratic Equation and Its Standard Form

Before diving into the solution, it is essential to understand what a quadratic equation is and how it is typically presented.

A quadratic equation is any second-degree polynomial equation, which can generally be written as:

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

where:

- a, b, and c are constants with $a \neq 0$,
- x is the variable.

In our specific case:

$$
2x^2 - 5x - 5 = 0
$$

- $a = 2$,
- $b = -5$,
- $c = -5$.

The Quadratic Formula: A Universal Solution Tool

The quadratic formula provides a straightforward method to find solutions (roots) of any quadratic equation, regardless of whether the roots are real or complex. The formula states:

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

Here:

- The term $b^2 - 4ac$ is called the discriminant,
- The $\pm$ signifies that there are generally two solutions: one with addition, one with subtraction.

Understanding each component of the formula is vital:

- Discriminant ($D = b^2 - 4ac$): Determines the nature of the roots:
- If $D > 0$, two distinct real roots.
- If $D = 0$, one real root (a repeated root).
- If $D < 0$, two complex roots.

Step-by-Step Solution of $2x^2 - 5x - 5 = 0$

Now, we will apply the quadratic formula meticulously, showing all calculations.

1. Identify a, b, and c

From the given equation:

$$
a = 2, \quad b = -5, \quad c = -5
$$

2. Calculate the discriminant

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

Plugging in the values:

$$
D = (-5)^2 - 4 \times 2 \times (-5)
$$

Calculating step-by-step:

- $(-5)^2 = 25$
- $4 \times 2 \times (-5) = 8 \times (-5) = -40$

Therefore:

$$
D = 25 - (-40) = 25 + 40 = 65
$$

Since $D = 65$, which is positive, the quadratic has two distinct real roots.

3. Compute the square root of the discriminant

\[
\sqrt{D} = \sqrt{65}
\]

\(\sqrt{65} \) is an irrational number, approximately:

\[
\sqrt{65} \approx 8.0623
\]

4. Apply the quadratic formula

Now, substitute \(a \), \(b \), and \(\sqrt{D} \) into the formula:

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

which becomes:

\[
x = \frac{-(-5) \pm 8.0623}{2 \times 2}
\]

Simplify numerator:

\[
x = \frac{5 \pm 8.0623}{4}
\]

Now, compute each solution separately.

Calculating the Roots

First root (\(x_1 \)):

\[
x_1 = \frac{5 + 8.0623}{4} = \frac{13.0623}{4} \approx 3.2656
\]

Second root (\(x_2 \)):

\[
x_2 = \frac{5 - 8.0623}{4} = \frac{-3.0623}{4} \approx -0.7656
\]

Final Answer: The Roots of the Equation

Based on the above calculations:

\[
\boxed{
x \approx 3.2656 \quad \text{or} \quad x \approx -0.7656
}
\]

These approximate decimal solutions can be converted into exact radical form for completeness:

\[
x = \frac{5 \pm \sqrt{65}}{4}
\]

which is the precise algebraic answer.

Additional Notes: Validating and Interpreting the Results

1. Verification

It's always good practice to verify solutions by substituting them back into the original equation:

- For \(x \approx 3.2656 \):

\[
2(3.2656)^2 - 5(3.2656) - 5 \approx 0
\]

Calculating:

\[
2 \times 10.666 \approx 21.332
\]
\[
-5 \times 3.2656 \approx -16.328
\]
Adding:

\[
21.332 - 16.328 - 5 \approx 0.004
\]

Close to zero, considering rounding.

- For \(x \approx -0.7656 \):

\[

$$
2 \times (-0.7656)^2 \approx 2 \times 0.586 \approx 1.172
$$

$$
-5 \times (-0.7656) \approx 3.828
$$

Adding:

$$
1.172 + 3.828 - 5 \approx 0.000
$$

Again, confirming the solutions.

2. Graphical interpretation

Plotting the quadratic function $y = 2x^2 - 5x - 5$ would show its parabola intersecting the x-axis at approximately $x \approx 3.2656$ and $x \approx -0.7656$.

Conclusion: Mastering the Quadratic Formula in Practice

The process demonstrated above illustrates not only how to solve a quadratic equation using the quadratic formula but also emphasizes the importance of precision and verification. When pressed for time, remembering the step-by-step method—identifying coefficients, calculating the discriminant, applying the formula, and interpreting results—can make solving even complex equations manageable.

In real-world scenarios, such as homework deadlines, understanding this process ensures accuracy and confidence. Whether the roots are rational, irrational, or complex, the quadratic formula remains an invaluable tool for algebraic problem-solving. Practice solving various quadratic equations using this method, and you'll be prepared for any quadratic challenge that crosses your path—on homework, exams, or practical applications.

Remember: Always double-check your calculations, especially when dealing with irrational roots or when approximate answers are acceptable. With consistent practice, solving quadratics will become second nature, easing the stress of urgent deadlines and deepening your understanding of algebraic fundamentals.

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