

Solve $2x^2+5x+5=0$ Round Solutions To The Nearest Hundredth.

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When faced with a quadratic equation such as $2x^2 + 5x + 5 = 0$, solving for the variable x involves a systematic approach that can be applied to a wide range of similar problems. In this article, we will explore the methods to solve quadratic equations, focus on calculating solutions with precision, and demonstrate how to round the solutions to the nearest hundredth. Whether you're a student tackling homework or a teacher preparing instructional materials, understanding these steps is essential for mastering quadratic equations.

Understanding Quadratic Equations

What Is a Quadratic Equation?

A quadratic equation is a second-degree polynomial equation in a single variable x , expressed in the general form:

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

where:

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

In our case:

$$2x^2 + 5x + 5 = 0$$

has coefficients:

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

Quadratic equations are fundamental in algebra because they model various real-world phenomena, including projectile motion, area calculations, and economic models.

Methods of Solving Quadratic Equations

There are several ways to solve quadratic equations:

1. Factoring (when possible)
2. Completing the square
3. Using the quadratic formula
4. Graphical methods

For the quadratic $(2x^2 + 5x + 5 = 0)$, factoring is not straightforward due to the coefficients, so the quadratic formula is the most reliable method.

The Quadratic Formula

Derivation and Formula

The quadratic formula provides the solutions to any quadratic equation:

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

where:

- $(\Delta = b^2 - 4ac)$ is called the discriminant.

The nature of the solutions depends on the discriminant:

- If $(\Delta > 0)$, two real solutions.
- If $(\Delta = 0)$, one real solution (a repeated root).
- If $(\Delta < 0)$, two complex solutions.

Applying the Quadratic Formula to Our Equation

Given:

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

Calculate the discriminant:

$$\Delta = b^2 - 4ac = 5^2 - 4 \times 2 \times 5 = 25 - 40 = -15$$

Since $(\Delta = -15 < 0)$, the solutions are complex conjugates.

Calculating the Solutions

Step-by-Step Solution

1. Compute the discriminant:

$$\Delta = -15$$

2. Find the square root of the absolute value of the discriminant:

$$\sqrt{|\Delta|} = \sqrt{15} \approx 3.87298$$

3. Express solutions with imaginary parts:

$$x = \frac{-b \pm \sqrt{\Delta}}{2a} = \frac{-5 \pm \sqrt{-15}}{2 \times 2}$$

Since $\sqrt{-15} = i\sqrt{15}$, solutions are:

$$x = \frac{-5 \pm i\sqrt{15}}{4}$$

4. Write solutions explicitly:

$$x = \frac{-5}{4} \pm \frac{i\sqrt{15}}{4}$$

which can be approximated numerically as:

$$x \approx -1.25 \pm \frac{i \times 3.873}{4} \approx -1.25 \pm i \times 0.968$$

Rounding Solutions to the Nearest Hundredth

Since the solutions are complex, their real and imaginary parts can be rounded separately to two decimal places.

Real part:

$\backslash$
-1.25 \text{ (already at two decimal places) }
 $\backslash$

Imaginary part:

$\backslash$
0.968 \approx 0.97
 $\backslash$

Final solutions rounded to the nearest hundredth:

$\backslash$
 $x \approx -1.25 \pm i \times 0.97$
 $\backslash$

Summary of the Solution Process

- Identify the coefficients of the quadratic equation.
- Calculate the discriminant $(\Delta = b^2 - 4ac)$.
- Determine the nature of the solutions based on (Δ) .
- Apply the quadratic formula, considering complex solutions if $(\Delta < 0)$.
- Compute the real and imaginary parts separately, then round to the nearest hundredth.

Additional Tips for Solving Quadratic Equations

When to Use the Quadratic Formula

The quadratic formula is a universal method suitable for all quadratic equations, especially when factoring is difficult or impossible. It also provides insight into the nature of the solutions through the discriminant.

Handling Complex Solutions

When the discriminant is negative, the solutions are complex conjugates. Remember:

- The real part is $\left(\frac{-b}{2a} \right)$.
- The imaginary part is $\left(\pm \frac{\sqrt{-\Delta}}{2a} \right)$.

Rounding the imaginary part to two decimal places ensures clarity and precision in your solutions.

Practical Applications

Quadratic equations appear in various fields:

- Physics (projectile trajectories)
- Engineering (stress analysis)
- Economics (profit maximization)

Knowing how to solve and interpret these solutions is valuable across disciplines.

Common Mistakes to Avoid

- Miscalculating the discriminant—double-check the calculation.
- Forgetting to consider complex solutions when the discriminant is negative.
- Incorrectly rounding solutions—ensure rounding applies only to the final answer.
- Mixing real and imaginary parts—keep them separate and clear.

Conclusion

Solving the quadratic equation $(2x^2 + 5x + 5 = 0)$ reveals complex solutions due to the negative discriminant. By applying the quadratic formula, calculating the discriminant, and carefully rounding the results to the nearest hundredth, you can accurately determine both the real and imaginary parts of the solutions. Mastering these steps enhances your algebra skills and prepares you for more advanced mathematical problems involving quadratic functions.

Remember, always verify your solutions and understand the nature of the solutions—whether real or complex—as this influences how you interpret the results. With practice, solving quadratic equations becomes an intuitive process, and rounding solutions to a specified precision ensures clarity and professionalism in your mathematical work.

Frequently Asked Questions

How do I solve the quadratic equation $2x^2 + 5x + 5 = 0$?

Use the quadratic formula $x = [-b \pm \sqrt{b^2 - 4ac}] / 2a$ with $a=2$, $b=5$, $c=5$ to find the solutions.

What are the steps to find solutions to $2x^2 + 5x + 5 = 0$ and round to the nearest hundredth?

Calculate the discriminant $D = b^2 - 4ac$, then find the roots using the quadratic formula, and finally round each solution to two decimal places.

What is the discriminant of the quadratic $2x^2 + 5x + 5 = 0$?

The discriminant $D = 5^2 - 4 \cdot 2 \cdot 5 = 25 - 40 = -15$.

Since the discriminant is negative, are the solutions real or complex?

They are complex solutions because the discriminant is negative.

What are the complex solutions to $2x^2 + 5x + 5 = 0$ rounded to the nearest hundredth?

The solutions are $x = -1.25 \pm 1.9365i$, rounded to two decimal places: $x \approx -1.25 \pm 1.94i$.

Can I get real solutions for $2x^2 + 5x + 5 = 0$?

No, because the discriminant is negative, so the solutions are complex numbers.

How do I interpret the solutions to $2x^2 + 5x + 5 = 0$?

The solutions are complex conjugates, indicating the parabola does not cross the x-axis.

What is the quadratic formula used to solve equations like $2x^2 + 5x + 5 = 0$?

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, where $a=2$, $b=5$, $c=5$.

Is there a shortcut to solve $2x^2 + 5x + 5 = 0$ without using the quadratic formula?

No, for this equation, the quadratic formula is the most straightforward method, especially since the discriminant is negative.

Why do the solutions to $2x^2 + 5x + 5 = 0$ involve imaginary numbers?

Because the discriminant is negative (-15), leading to the square root of a negative number, which results in imaginary solutions.

Additional Resources

Solve $2x^2 + 5x + 5 = 0$ is a quadratic equation that presents an excellent opportunity to explore fundamental algebraic concepts, the quadratic formula, and the nuances involved in solving equations with real or complex solutions. Quadratic equations are a cornerstone of algebra, appearing frequently in various fields such as physics, engineering, finance, and everyday problem-solving. Understanding how to solve them accurately, especially when solutions are rounded to specific decimal places, is a critical skill. This article provides a comprehensive and detailed analysis of solving the quadratic equation $(2x^2 + 5x + 5 = 0)$, with solutions rounded to the nearest hundredth, emphasizing both the theoretical underpinnings and practical applications.

Understanding Quadratic Equations

Definition and Standard Form

A quadratic equation is a second-degree polynomial equation that can be expressed in the

standard form:

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

where:

- a , b , and c are constants,
- $a \neq 0$,
- x represents the variable or unknown.

In our specific case, the equation is:

$$2x^2 + 5x + 5 = 0$$

with $a=2$, $b=5$, and $c=5$.

Significance of Solving Quadratic Equations

Quadratic equations often model real-world phenomena such as projectile motion, area calculations, and financial profit/loss analysis. The solutions to these equations—roots or zeros—represent the points where the quadratic function intersects the x-axis. These roots can be real or complex, depending on the discriminant's value, which we will explore next.

Discriminant Analysis and Nature of Roots

The Discriminant Formula

The discriminant (Δ) of a quadratic equation $ax^2 + bx + c = 0$ is given by:

$$\Delta = b^2 - 4ac$$

This value determines the nature and number of solutions:

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

Calculating the Discriminant for Our Equation

Applying the formula to our quadratic:

$$\Delta = (5)^2 - 4 \times 2 \times 5 = 25 - 40 = -15$$

Since $(\Delta = -15 < 0)$, the equation has two complex conjugate solutions. This insight is crucial because it indicates the solutions will involve imaginary numbers, and we must use the quadratic formula incorporating the imaginary unit (i) .

Applying the Quadratic Formula

The Quadratic Formula

The solutions to a quadratic equation are given by:

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

When (Δ) is negative, $(\sqrt{\Delta})$ involves imaginary numbers:

$$\sqrt{\Delta} = \sqrt{-1 \times |\Delta|} = i \sqrt{|\Delta|}$$

where (i) is the imaginary unit satisfying $(i^2 = -1)$.

Calculating the Solutions

For our specific equation:

$$x = \frac{-5 \pm \sqrt{-15}}{2 \times 2} = \frac{-5 \pm i \sqrt{15}}{4}$$

Calculating the square root of 15:

$$\sqrt{15} \approx 3.87298$$

Thus, the solutions are:

$$x = \frac{-5 \pm i \times 3.87298}{4}$$

Splitting into real and imaginary parts:

$$x = -\frac{5}{4} \pm \frac{i \times 3.87298}{4}$$

which simplifies to:

$$x = -1.25 \pm i \times 0.968245$$

Rounded to the nearest hundredth:

$$x \approx -1.25 \pm i \times 0.97$$

Interpreting the Solutions

Complex Roots and Their Significance

The solutions:

$$x \approx -1.25 \pm 0.97i$$

are complex conjugates. Their real part is (-1.25) , and the imaginary parts are $(\pm 0.97i)$. This indicates that the quadratic function $(2x^2 + 5x + 5)$ does not cross the x -axis, and its graph is a parabola opening upwards (since $(a=2>0)$) that lies entirely above the x -axis.

In practical terms, these solutions imply that for real numbers, the quadratic has no zeros—meaning no real solution exists. However, in fields that allow complex solutions, these roots are essential, especially in advanced mathematics, physics, and engineering applications involving complex analysis.

Alternative Approaches and Verification

Completing the Square

Although the quadratic formula provides a straightforward solution, completing the square offers a different perspective:

$$2x^2 + 5x + 5 = 0$$

Divide through by 2:

$$x^2 + \frac{5}{2}x + \frac{5}{2} = 0$$

Rewrite:

$$x^2 + \frac{5}{2}x = -\frac{5}{2}$$

Complete the square:

$$x^2 + \frac{5}{2}x + \left(\frac{5}{4}\right)^2 = -\frac{5}{2} + \left(\frac{5}{4}\right)^2$$

Calculate:

$$\left(\frac{5}{4}\right)^2 = \frac{25}{16}$$

Add this to both sides:

$$\left(x + \frac{5}{4}\right)^2 = -\frac{5}{2} + \frac{25}{16}$$

Express $-\frac{5}{2}$ with denominator 16:

$$-\frac{5}{2} = -\frac{40}{16}$$

So:

$$\left(x + \frac{5}{4}\right)^2 = -\frac{40}{16} + \frac{25}{16} = -\frac{15}{16}$$

Taking square roots:

$$x + \frac{5}{4} = \pm \sqrt{-\frac{15}{16}} = \pm i \frac{\sqrt{15}}{4}$$

Thus:

$$x = -\frac{5}{4} \pm i \frac{\sqrt{15}}{4}$$

which matches the earlier solutions, confirming the accuracy.

Practical Implications and Real-World Applications

When Do Complex Solutions Matter?

In most real-world contexts—such as physics where the solutions represent measurable quantities—complex roots imply no real solution exists within the physical domain. For example, in projectile motion, a negative discriminant indicates that the trajectory does not intersect with a certain plane, or the situation is physically impossible under given parameters.

However, in engineering, complex solutions are vital in signal processing, control systems, and electrical engineering, where they describe oscillations, stability, and phase shifts. They also form the foundation for advanced mathematical fields like complex analysis.

Importance of Rounding to the Hundredth

Rounding solutions to the nearest hundredth ensures clarity and usability, especially in practical scenarios where measurements or calculations are approximations. It also aids in communication, avoiding unwieldy decimal representations.

In our case, the roots are:

$$x \approx -1.25 \pm 0.97i$$

which are sufficiently precise for most practical purposes, like initial engineering calculations or educational demonstrations.

Summary and Final Remarks

The quadratic equation $(2x^2 + 5x + 5 = 0)$ exemplifies the process of solving equations with complex roots. The key steps involve:

- Recognizing the nature of the roots via the discriminant.
- Applying the quadratic formula with complex number handling.
- Interpreting the roots in the context of the quadratic's graph and real-world implications.
- Confirming solutions through alternative methods like completing the square.

This analysis not only underscores the importance of algebraic techniques but also highlights how mathematical understanding extends beyond purely abstract exercises into practical, real-world applications. The roots' approximate values, rounded to the nearest hundredth, are:

$$x \approx -1.25 \pm 0.97i$$

which encapsulate the essence of complex solutions in quadratic equations.

Understanding these concepts prepares students, professionals, and enthusiasts alike to approach similar problems with confidence, accuracy, and clarity.

In conclusion, solving quadratic equations like $(2x^2 + 5x + 5=0)$ involves analyzing

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