

Please Help!Solve By Using The Square Root Property. $16x^2+24x+9=81$

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Mathematics can often present challenging problems that require a strategic approach to solve. Among the various techniques used in algebra, the Square Root Property stands out as a particularly effective method for solving quadratic equations, especially those that can be manipulated into perfect square forms. If you've encountered the equation $16x^2 + 24x + 9 = 81$ and are unsure how to proceed, this guide will walk you through a detailed, step-by-step process to find the solution efficiently and accurately.

Understanding the significance of solving quadratic equations is essential because these equations appear frequently across different areas of mathematics, physics, engineering, and real-world problem-solving scenarios. Recognizing when and how to apply the Square Root Property can simplify complex problems and lead to quick solutions. This article aims to provide a comprehensive explanation of the method, demonstrate the solution process for the specific equation, and offer useful tips and insights to enhance your algebraic skills.

Introduction to the Square Root Property

Before diving into solving the specific equation, it's crucial to understand what the Square Root Property is and when it can be applied.

What Is the Square Root Property?

The Square Root Property states that if you have an equation in the form:

$$x^2 = k$$

where k is a real number, then the solutions are:

$$x = \pm \sqrt{k}$$

provided $k \geq 0$. This property allows you to solve for x simply by taking the square root of both sides, considering both the positive and negative roots.

Conditions for Applying the Square Root Property

- The equation must be in the form $x^2 = k$.
- k must be a non-negative real number ($k \geq 0$).
- The quadratic expression should be set equal to a constant.

If your quadratic equation isn't in this form, you'll need to manipulate it—such as completing the square or rearranging—to apply the Square Root Property effectively.

Step-by-Step Solution of the Equation $16x^2 + 24x + 9 = 81$

Let's now apply the Square Root Property to the given equation:

$$16x^2 + 24x + 9 = 81$$

Follow these steps carefully to find the solution.

Step 1: Move All Terms to One Side

Start by subtracting 81 from both sides to set the equation equal to zero:

$$16x^2 + 24x + 9 - 81 = 0$$

Simplify:

$$16x^2 + 24x - 72 = 0$$

Now, the quadratic is in standard form:

$$16x^2 + 24x - 72 = 0$$

Step 2: Simplify the Equation

Notice that all coefficients are divisible by 8:

$$8(2x^2 + 3x - 9) = 0$$

Dividing both sides by 8:

$$\backslash[2x^2 + 3x - 9 = 0 \backslash]$$

This simplified form makes calculations easier.

Step 3: Complete the Square

To apply the Square Root Property, it's often easiest to first complete the square.

- First, divide the entire quadratic by the coefficient of (x^2) , which is 2:

$$\backslash[x^2 + \frac{3}{2}x - \frac{9}{2} = 0 \backslash]$$

- Isolate the quadratic and linear terms:

$$\backslash[x^2 + \frac{3}{2}x = \frac{9}{2} \backslash]$$

- Complete the square on the left side:

- Take half of the coefficient of (x) , which is $(\frac{3}{2})$:

$$\backslash[\frac{1}{2} \times \frac{3}{2} = \frac{3}{4} \backslash]$$

- Square this value:

$$\backslash[\left(\frac{3}{4} \right)^2 = \frac{9}{16} \backslash]$$

- Add $(\frac{9}{16})$ to both sides to complete the square:

$$\backslash[x^2 + \frac{3}{2}x + \frac{9}{16} = \frac{9}{2} + \frac{9}{16} \backslash]$$

- Convert the right side to a common denominator:

$$\backslash[\frac{9}{2} = \frac{72}{16} \backslash]$$

So,

$$\backslash[$$

$$\frac{72}{16} + \frac{9}{16} = \frac{81}{16}$$

- Rewrite the left side as a perfect square:

$$\left(x + \frac{3}{4} \right)^2 = \frac{81}{16}$$

Step 4: Apply the Square Root Property

Now that the equation is in the form $\left(x + \frac{3}{4} \right)^2 = \frac{81}{16}$, you can apply the Square Root Property.

- Take the square root of both sides:

$$x + \frac{3}{4} = \pm \sqrt{\frac{81}{16}}$$

- Simplify the right side:

$$x + \frac{3}{4} = \pm \frac{\sqrt{81}}{\sqrt{16}} = \pm \frac{9}{4}$$

Step 5: Solve for x

Now, solve for x :

- When:

$$x + \frac{3}{4} = \frac{9}{4}$$

then

$$x = \frac{9}{4} - \frac{3}{4} = \frac{6}{4} = \frac{3}{2}$$

- When:

$$x + \frac{3}{4} = -\frac{9}{4}$$

then

$$x = -\frac{9}{4} - \frac{3}{4} = -\frac{12}{4} = -3$$

Solutions:

$$x = \frac{3}{2} \quad \text{or} \quad x = -3$$

Summary of the Solution Process

To recap, here are the main steps used to solve the quadratic equation using the Square Root Property:

1. Rearranged the original equation to gather all terms on one side.
2. Simplified the quadratic equation by factoring out common coefficients.
3. Completed the square to rewrite the quadratic in perfect square form.
4. Applied the Square Root Property by taking square roots of both sides.
5. Solved for x to find the solutions.

This method simplifies solving quadratics that can be expressed as perfect squares, making it a valuable tool in your algebra toolkit.

Additional Tips for Using the Square Root Property

- Always check if the quadratic can be factored into a perfect square before completing the square.
- Remember to consider both positive and negative roots when taking the square root.
- Simplify radicals whenever possible to make the solution clearer.
- If the quadratic isn't a perfect square, completing the square is often the most straightforward approach.
- For equations not in the form $x^2 = k$, consider other methods like

factoring or the quadratic formula.

Applications of the Square Root Property in Real Life

Understanding how to apply the Square Root Property isn't just an academic exercise; it has real-world applications:

- Physics: Calculating distances, velocities, or energy levels where quadratic relationships are involved.
- Engineering: Solving for parameters in structural analysis or electrical circuits.
- Finance: Modeling certain types of quadratic profit or loss scenarios.
- Statistics: Calculating standard deviations involves square roots.

Mastering the Square Root Property enhances problem-solving skills across these fields and beyond.

Conclusion

Solving quadratic equations can sometimes seem daunting, but with the right approach, problems like $16x^2 + 24x + 9 = 81$ become manageable. The Square Root Property offers an elegant method, especially when the quadratic can be expressed as a perfect square. By following the detailed steps outlined above—rearranging, completing the square, applying the square root, and solving—you can confidently tackle similar equations.

Remember, practice makes perfect. Take time to work through various quadratic problems using this method, and you'll develop a strong algebraic intuition that will serve you well in academics and real-world applications. If you encounter equations that aren't perfect squares, don't hesitate to explore other methods like factoring or the quadratic formula, which are equally powerful tools in your mathematical toolkit.

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Frequently Asked Questions

How do I start solving the equation $16x^2 + 24x + 9 = 81$ using the Square Root Property?

First, simplify the equation by bringing all terms to one side: $16x^2 + 24x + 9 - 81 = 0$, which simplifies to $16x^2 + 24x - 72 = 0$. Then, check if the quadratic can be written as a perfect square or use other methods like factoring or completing the square before applying the Square Root Property.

Can I directly apply the Square Root Property to the equation $16x^2 + 24x + 9 = 81$?

Not directly, because the equation is quadratic and not in the form of a perfect square. To use the Square Root Property, the expression should be a perfect square trinomial set equal to a value, so you may need to complete the square first.

How do I complete the square for the quadratic $16x^2 + 24x - 72 = 0$?

Divide the entire equation by 16 to simplify: $x^2 + (3/2)x - 4 = 0$. Then, rewrite as $x^2 + (3/2)x = 4$, and complete the square by adding $(3/4)^2 = 9/16$ to both sides: $x^2 + (3/2)x + 9/16 = 4 + 9/16$. Simplify and solve for x .

After completing the square, how do I use the Square Root Property to solve for x ?

Once you have the equation in the form $(x + k)^2 = c$, you can apply the Square Root Property: $x + k = \pm\sqrt{c}$. Then, solve for x by subtracting k from both sides.

What is the solution to the equation $16x^2 + 24x + 9 = 81$ after solving?

After completing the process, the solutions are $x = -3/4$ and $x = 1/4$.

Is it necessary to verify the solutions after using the Square Root Property?

Yes, always substitute the solutions back into the original equation to verify they satisfy it, ensuring no extraneous solutions were introduced during the process.

Can the Square Root Property be used directly to solve any quadratic equation?

No, the Square Root Property can only be used when the quadratic can be written in the form $(x + a)^2 = b$, i.e., when it is a perfect square trinomial. Otherwise, other methods like factoring or quadratic formula are more appropriate.

Additional Resources

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In the world of algebra, solving quadratic equations is a fundamental skill that opens doors to understanding more complex mathematical concepts. One of the most effective methods for tackling certain types of quadratic equations is the Square Root Property. This approach provides a straightforward pathway to solutions when the equation fits specific forms, especially those that can be rewritten as perfect squares. Today, we explore how to solve the quadratic equation:

$$16x^2 + 24x + 9 = 81$$

using the Square Root Property, unraveling each step to ensure clarity and comprehension for students, educators, and math enthusiasts alike.

Understanding the Square Root Property

Before diving into the problem, it's essential to grasp what the Square Root Property entails. The property states:

> If an equation is in the form $(x + a)^2 = b$, then the solutions for x are $x = -a \pm \sqrt{b}$.

This means that whenever you can rewrite a quadratic as a perfect square equal to some number, solving becomes as simple as taking the square root of both sides, remembering both positive and negative roots.

When is the Square Root Property applicable?

- When the quadratic is expressed or can be rewritten as a perfect square trinomial.
- When the equation is set equal to a constant, not zero, after rearrangement.
- When the quadratic has coefficients that allow it to be factored into a perfect square.

Step-by-Step Solution to the Equation

Let's move through the process of solving the given quadratic step-by-step, emphasizing the application of the Square Root Property.

Step 1: Rewrite the equation in standard form

The original equation is:

$$16x^2 + 24x + 9 = 81$$

First, bring all terms to one side to set the equation to zero:

$$16x^2 + 24x + 9 - 81 = 0$$

Simplify:

$$16x^2 + 24x - 72 = 0$$

This is the standard quadratic form: $ax^2 + bx + c = 0$.

Step 2: Divide through by the leading coefficient (if necessary)

To make the quadratic easier to work with, especially for completing the square, divide every term by 16:

$$(16x^2)/16 + (24x)/16 - 72/16 = 0$$

Simplify:

$$x^2 + (3/2)x - (9/2) = 0$$

Our new quadratic is:

$$x^2 + (3/2)x = 9/2$$

Step 3: Complete the square

The goal is to rewrite the quadratic in a perfect square form. To do this, focus on the x terms:

$$x^2 + (3/2)x$$

Find the number to complete the square:

- Take half of the coefficient of x: $(3/2) / 2 = (3/4)$
- Square this number: $(3/4)^2 = 9/16$

Add and subtract this value inside the equation to complete the square:

$$x^2 + (3/2)x + 9/16 - 9/16 = 9/2$$

Rewrite as:

$$(x + 3/4)^2 - 9/16 = 9/2$$

Step 4: Isolate the perfect square

Add 9/16 to both sides:

$$(x + 3/4)^2 = 9/2 + 9/16$$

Find a common denominator to combine the right side:

- $9/2 = (72/16)$
- 9/16 remains the same

Sum:

$$(72/16) + (9/16) = 81/16$$

Now, the equation becomes:

$$(x + 3/4)^2 = 81/16$$

Applying the Square Root Property

At this stage, the quadratic is in the perfect square form suitable for the Square Root Property:

$$> (x + 3/4)^2 = 81/16$$

Taking the square root of both sides gives:

$$x + 3/4 = \pm \sqrt{81/16}$$

Calculate the square root of the right side:

$$\sqrt{81/16} = \sqrt{81} / \sqrt{16} = 9 / 4$$

Now, solve for x by subtracting 3/4 from both sides:

$$x = -3/4 \pm 9/4$$

This yields two solutions:

1. $x = -3/4 + 9/4 = (-3 + 9) / 4 = 6/4 = 3/2$
2. $x = -3/4 - 9/4 = (-3 - 9) / 4 = -12/4 = -3$

Final Solutions and Interpretation

The solutions to the quadratic equation are:

- $x = 3/2$
- $x = -3$

These solutions can be verified by substituting back into the original equation, demonstrating the correctness of the process.

Summary of the Methodology

Here's a concise list of steps for solving quadratic equations using the Square Root Property:

- Rewrite the quadratic in standard form, moving all terms to one side.
- Simplify the equation by dividing through by the leading coefficient (if needed).
- Complete the square for the quadratic part:
 - Take half of the coefficient of x .
 - Square it.
 - Add and subtract this square inside the equation.
- Rearrange to form a perfect square trinomial.
- Isolate the perfect square on one side.
- Take the square root of both sides, considering both positive and negative roots.
- Solve for the variable.

Practical Applications and Significance

Using the Square Root Property is not just a theoretical exercise; it has practical implications:

- Educational Foundations: It strengthens understanding of quadratic functions, perfect squares, and properties of square roots.
- Real-World Problem Solving: Many problems involving areas, physics, and engineering can be simplified using this technique.
- Advanced Mathematics: Mastery of this method paves the way for tackling

more complex algebraic and calculus problems.

Final Thoughts

The problem $16x^2 + 24x + 9 = 81$ exemplifies how completing the square and applying the Square Root Property can lead to elegant solutions. While it might seem complex at first glance, breaking it down into manageable steps reveals the underlying simplicity. With practice, this method becomes a vital tool in the mathematician's toolkit, enabling quick and accurate solutions to quadratic equations that fit the perfect square form.

Whether you're a student mastering algebra or a professional applying math in real-world scenarios, understanding and applying the Square Root Property is an essential skill. It not only simplifies problem-solving but also deepens your understanding of the beautiful structure underlying quadratic equations.

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