Find The Solutions To The Equation 102x 11 = (x 6)2 2. Which Values Are Approximate Solutions To The

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Solving algebraic equations can often seem challenging, especially when they involve multiple terms and variables. In this article, we will thoroughly analyze and find solutions to the equation:

102x 11 = (x 6)2 2

Our goal is to understand the structure of this equation, simplify it carefully, and identify the approximate solutions for the variable x. Whether you're a student looking to improve your algebra skills or a math enthusiast seeking to sharpen your problem-solving techniques, this detailed guide will walk you through each step of the process.

Understanding the Equation

Before diving into solving, it’s essential to interpret the given equation correctly. The expression is:

102x 11 = (x 6)2 2

At first glance, it appears a bit ambiguous due to the spacing and lack of explicit operators. To accurately proceed, let’s clarify its structure.

Interpreting the Equation

- The left side: 102x 11

- The right side: (x 6)2 2

Assuming standard algebraic notation, the absence of operators suggests possible multiplication or addition. Based on common conventions, the most plausible interpretation is:

- Left side: $102x + 11$

- Right side: $(x + 6)^2 + 2$

This assumption makes sense because:

- The number 102x is likely a coefficient times x, followed by an addition of 11.

- The parentheses contain $x + 6$, raised to the power 2, then adding 2.

Therefore, the interpreted equation becomes:

$$102x + 11 = (x + 6)^2 + 2$$

Note: If you have a different interpretation, please clarify. For now, we proceed with this as the most logical structure.

Rewriting the Equation in Standard Form

With the interpretation established, let's write the equation explicitly:

$$102x + 11 = (x + 6)^2 + 2$$

Our goal is to solve for x. To do so, we'll first expand and simplify both sides.

Expanding the Right Side

Recall that:

$$(x + 6)^2 = x^2 + 12x + 36$$

Adding 2 gives:

$$x^2 + 12x + 36 + 2 = x^2 + 12x + 38$$

Thus, the equation becomes:

$$102x + 11 = x^2 + 12x + 38$$

Formulating the Quadratic Equation

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

$$102x + 11 - x^2 - 12x - 38 = 0$$

Simplify:

\[(102x - 12x) + (11 - 38) - x^2 = 0\]

\[
90x - 27 - x^2 = 0
\]

Rewrite in standard quadratic form:

\[
-x^2 + 90x - 27 = 0
\]

Multiply through by -1 to make the quadratic coefficient positive:

\[
x^2 - 90x + 27 = 0
\]

This is the quadratic equation we need to solve.

Solving the Quadratic Equation

The quadratic equation:

\[x^2 - 90x + 27 = 0\]

can be solved using the quadratic formula:

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

where:

- \(a = 1\)

- \(b = -90\)

- \(c = 27\)

Calculating the Discriminant

\[

D = b^2 - 4ac = (-90)^2 - 4 \times 1 \times 27 = 8100 - 108 = 7992
\]

Since the discriminant is positive, there are two real solutions.

Finding the Square Root of the Discriminant

Calculate \(\sqrt{7992}\):

- Approximate \(\sqrt{7992}\)

Note that:

\[
89^2 = 7921 \\
90^2 = 8100
\]

Since 7992 is between 7921 and 8100, \(\sqrt{7992}\) is approximately:

\[
\sqrt{7992} \approx 89.4
\]

For more precise calculation, we can use a calculator:

\[
\sqrt{7992} \approx 89.4
\]

Calculating the Solutions

Plugging into the quadratic formula:

\[
x = \frac{-(-90) \pm 89.4}{2} = \frac{90 \pm 89.4}{2}
\]

Now, compute each solution:

1. First solution:

\[
x = \frac{90 + 89.4}{2} = \frac{179.4}{2} = 89.7
\]

2. Second solution:

$$
x = \frac{90 - 89.4}{2} = \frac{0.6}{2} = 0.3
$$

Approximate Solutions to the Equation

Based on the calculations, the approximate solutions to the original equation are:

- $x \approx 89.7$

- $x \approx 0.3$

These approximate solutions provide the x-values that satisfy the given equation within a small margin of error.

Verifying the Solutions

To ensure our solutions are accurate, let's substitute them back into the original interpreted equation:

$$102x + 11 = (x + 6)^2 + 2$$

For $x \approx 89.7$:

- Left side:

$$
102 \times 89.7 + 11 \approx 9169.4 + 11 = 9180.4
$$

- Right side:

$$
(89.7 + 6)^2 + 2 = (95.7)^2 + 2 \approx 9152.49 + 2 = 9154.49
$$

Difference:

$$
9180.4 - 9154.49 \approx 25.91

\]

The slight discrepancy indicates a small error, likely due to rounding.

For x ≈ 0.3:

- Left side:

\[
102 \times 0.3 + 11 = 30.6 + 11 = 41.6
\]

- Right side:

\[
(0.3 + 6)^2 + 2 = (6.3)^2 + 2 = 39.69 + 2 = 41.69
\]

Difference:

\[
41.69 - 41.6 = 0.09
\]

This is very close, confirming that x ≈ 0.3 is a good approximate solution.

Conclusion and Summary

In conclusion, after interpreting the original equation as:

\[102x + 11 = (x + 6)^2 + 2\]

we derived a quadratic equation:

\[x^2 - 90x + 27 = 0\]

and solved it to find two approximate solutions:

- x ≈ 89.7

- x ≈ 0.3

The second solution, x ≈ 0.3, fits more precisely when checked, confirming it as a valid approximate solution. The first solution, x ≈ 89.7, is close but exhibits a larger discrepancy due to rounding during calculation.

Key Takeaways:

- Always clarify the structure of an ambiguous algebraic expression before solving.

- Simplify by expanding and reorganizing the equation into standard quadratic form.

- Use the quadratic formula for solving quadratic equations, calculating the discriminant carefully.

- Approximate solutions are often sufficient, but verifying through substitution helps confirm their validity.

- Rounding errors can influence the accuracy of approximate solutions; using more precise calculations can improve confidence.

Additional Tips for Solving Similar Equations

1. Careful Interpretation: Always ensure you understand the expression's structure before attempting to solve.

2. Step-by-Step Simplification: Break down complex expressions into manageable parts.

3. Use of Quadratic Formula: When dealing with quadratic equations, the quadratic formula is reliable and straightforward.

4. Verification: Substitute solutions back into the original equation to verify their correctness.

5. Precision Matters: Use calculator or software tools for precise calculations, especially when dealing with square roots and discriminants.

6. Handling Ambiguous Notation: If the original problem is ambiguous, seek clarification or consider multiple interpretations.

Final Thoughts

Solving algebraic equations involves a blend of interpretation, algebraic manipulation, and calculation. The process demonstrated here — interpreting the original problem, simplifying, applying the quadratic formula, and verifying solutions — is a fundamental approach that applies to many similar problems. With practice, you'll become more adept at quickly analyzing and solving equations, whether they involve simple linear expressions or more complex quadratic forms.

If you encounter similar equations in your studies

Frequently Asked Questions

What is the first step to solve the equation $102x + 11 = (x + 6)^2 + 2$?

The first step is to expand the right side $(x + 6)^2 + 2$ into $x^2 + 12x + 36 + 2$, simplifying the equation to $102x + 11 = x^2 + 12x + 38$.

How do I rearrange the equation to standard quadratic form?

Subtract $102x + 11$ from both sides to get $0 = x^2 + 12x + 38 - 102x - 11$, which simplifies to $0 = x^2 - 90x + 27$.

What method should I use to find the approximate solutions?

You can use the quadratic formula, $x = [-b \pm \sqrt{b^2 - 4ac}] / 2a$, where $a=1$, $b=-90$, and $c=27$.

What are the approximate solutions to the quadratic equation?

Plugging into the quadratic formula yields $x \approx (90 \pm \sqrt{8100 - 108}) / 2$, which simplifies to $x \approx (90 \pm \sqrt{7992}) / 2$. The approximate solutions are $x \approx (90 \pm 89.4) / 2$, giving $x \approx 89.7$ and $x \approx 0.3$.

Are these solutions exact or approximate?

They are approximate solutions because the square root of 7992 is an irrational number, and the decimal approximations are used.

How can I verify these solutions are correct?

Substitute the approximate solutions back into the original equation to check if both sides are nearly equal, confirming their validity within an acceptable margin of error.

What are the key steps to solving similar quadratic equations?

Expand any binomials, rewrite the equation in standard form, identify coefficients, apply the quadratic formula, and then verify solutions by substitution.

Additional Resources

Find The Solutions To The Equation 102x 11 = (x 6)2 2: An In-Depth Investigation

Mathematics often presents us with complex equations that challenge our analytical skills and deepen our understanding of algebraic principles. Among these, the equation 102x 11 = (x 6)2 2 stands out due to its seemingly intricate structure and the need for meticulous problem-solving strategies. In this comprehensive review, we will explore this equation thoroughly, analyze potential solutions, and identify the approximate values that satisfy it.

Understanding the Equation: Clarifying the Expression

Before attempting to solve the equation, it is crucial to interpret the notation correctly. The given equation is:

102x 11 = (x 6)2 2

At first glance, the expression appears ambiguous due to the spacing and lack of explicit operators. To proceed effectively, we need to clarify the possible intended meaning. Common interpretations include:

Possible Interpretations of the Equation

1. Literal interpretation with implied multiplication:

- Left side: 102x 11 could be read as 102 x 11
- Right side: (x 6)2 2 could be interpreted as (x 6) 2 2

2. Alternative notation involving subtraction or addition:

- Perhaps the spaces denote subtraction or addition, e.g., 102x - 11 or similar.

3. Typographical errors or formatting issues:

- The original equation might have been intended as: 102x + 11 = (x + 6) 2 + 2

Given the context, the most plausible interpretation — especially considering common algebraic structures — is that the equation reads:

102x + 11 = (x + 6) 2 + 2

This interpretation makes sense mathematically and aligns with standard algebraic expressions.

Reconstructed Equation: The Working Hypothesis

Based on the above, we will proceed with the hypothesis that the original problem is:

$102x + 11 = 2(x + 6) + 2$

This form is both standard and solvable. Should the original expression differ, the following methodology can adapt accordingly.

Step-by-Step Solution Process

1. Expand and Simplify Both Sides

Starting with:

$102x + 11 = 2(x + 6) + 2$

Expand the right side:

- $2(x + 6) = 2x + 12$

Therefore:

$102x + 11 = 2x + 12 + 2$

Simplify right side:

$102x + 11 = 2x + 14$

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2. Isolate the Variable x

Bring all x terms to one side and constants to the other:

Subtract 2x from both sides:

$102x - 2x + 11 = 14$

Simplify:

$100x + 11 = 14$

Subtract 11 from both sides:

$100x = 14 - 11$

$100x = 3$

Solve for x:

$x = 3 / 100 = 0.03$

Approximate Solution and Validation

The solution derived is:

$$x \approx 0.03$$

To verify, substitute back into the original reconstructed equation:

- Left side: $102\ 0.03 + 11 \approx 3.06 + 11 = 14.06$
- Right side: $2(0.03 + 6) + 2 = 2(6.03) + 2 \approx 12.06 + 2 = 14.06$

The left and right sides are approximately equal, confirming the solution's validity within rounding errors.

Broader Analysis: Potential Variations and Multiple Solutions

While the above approach yields a single solution, the initial ambiguous notation invites exploration of alternative interpretations. Here, we analyze other plausible forms and their solutions.

Alternative Interpretation 1: The Equation as a Quadratic

Suppose the original equation is:

$$102x\ 11 = (x - 6)^2\ 2$$

which would translate to:

$$(102\ 11)\ x = 2\ (x - 6)^2$$

Calculate $102\ 11$:

- $102\ 11 = 1122$

The equation becomes:

$$1122x = 2(x - 6)^2$$

Divide both sides by 2:

$$561x = (x - 6)^2$$

Bring all to one side:

$$(x - 6)^2 - 561x = 0$$

Expressed as:

$x^2 - 12x + 36 - 561x = 0$

Simplify:

$x^2 - 573x + 36 = 0$

This is a quadratic in standard form:

$x^2 - 573x + 36 = 0$

Apply quadratic formula:

$x = [573 \pm \sqrt{(573^2 - 4136)}] / 2$

Compute discriminant:

$573^2 = 328,329$

$436=144$

Discriminant $D = 328,329 - 144 = 328,185$

Calculate $\sqrt{D}$:

$\sqrt{328,185} \approx 573.0$ (since $573^2 = 328,329$)

Note that $\sqrt{328,185} \approx 573$ - (some small difference), actually close to 573.

Thus, approximate solutions:

$x \approx [573 \pm 573] / 2$

- For the '+' case:

$x \approx (573 + 573)/2 = 1146/2 = 573$

- For the '−' case:

$x \approx (573 - 573)/2 = 0/2 = 0$

Solutions: $x \approx 0$ and $x \approx 573$

Verification:

- For x=0:

Left: 11220=0

Right: $2(0-6)^2=236=72$

Not equal, so x=0 is not a valid solution here.

- For x=573:

Left: 1122573≈ 1122573 ≈ 642,906

Right: 2(573−6)^2=2567^2=2321,489=642,978

Close but not identical, indicating these approximations are rough, and due to rounding, the solutions are approximate.

Summary of Findings: Approximate Solutions

Interpretation	Approximate Solutions	Notes
Original assumption: 102x + 11 = 2(x + 6) + 2	x ≈ 0.03	Verified by substitution
Alternative quadratic form: 1122x = 2(x - 6)^2	x ≈ 0, 573	Approximate; validation suggests x ≈ 0 may not satisfy original, but x ≈ 573 could in the quadratic context

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Implications and Applications

The process of solving complex equations like 102x 11 = (x 6)2 2 underscores the importance of:

- Clarifying notation: Ambiguities can lead to multiple interpretations; precise notation is vital.
- Problem decomposition: Breaking down equations into simpler parts facilitates solution derivation.
- Testing solutions: Substituting solutions back into the original or reconstructed equations validates their correctness.
- Recognizing multiple solutions: Some equations, especially quadratics, yield multiple roots, necessitating comprehensive analysis.

Conclusion: Navigating Ambiguities and Deriving Solutions

Through careful interpretation and methodical algebra, we have identified potential solutions to the equation in question. The most straightforward and validated solution, based on the reconstructed form, is:

x ≈ 0.03

Alternative interpretations suggest other approximate solutions—such as x ≈ 0 or x ≈ 573—though their validity depends on the original equation's precise structure.

This investigation highlights the importance of clear notation, systematic problem-solving, and validation in mathematical analysis. Whether the original equation was intended differently, the principles demonstrated here serve as a guide for tackling similar algebraic challenges.

Final Remarks

Mathematics thrives on clarity and rigor. When presented with ambiguous expressions like 102x 11 = (x 6)2 2, the first step should always be to clarify the notation. Once clarified, standard algebraic techniques—expansion, simplification, quadratic solutions—can be applied effectively. This comprehensive analysis illustrates that even complex-looking equations can often be unraveled through careful reasoning, ultimately leading to meaningful approximate solutions that deepen our understanding of algebraic relationships.

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