

Choose The Justification For Each Step In The Solution To The Equation $6x \cdot 9 = 45$. What The Answer

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When approaching an algebraic equation such as $6x \cdot 9 = 45$, it is essential to understand the logical reasoning behind each step to arrive at the correct solution. Proper justification not only ensures accuracy but also deepens comprehension of algebraic principles. In this comprehensive guide, we will meticulously analyze each step involved in solving the equation, explaining the mathematical reasoning and justifications to help learners grasp the process thoroughly.

Understanding the Equation

Before diving into the solution, it's crucial to interpret the given equation correctly.

Equation Breakdown

- The equation is written as $6x \cdot 9 = 45$.
- Interpreting the equation, there are two common possibilities:
 - 6 times x, multiplied by 9, equals 45, i.e., $(6 \cdot x) \cdot 9 = 45$.
 - 6 times x, with an omitted operator, possibly meant as $6x$, and then multiplied by 9, leading to ambiguity.

Given the context and standard algebraic notation, the most plausible interpretation is:

$$(6 \cdot x) \cdot 9 = 45$$

This is because "6x" typically denotes 6 times x, and combined with 9, it suggests multiplication.

Step 1: Rewrite the Equation for Clarity

Justification:

To proceed with solving, clarity of the equation is essential. Interpreting the expression as $(6 \times 9) = 45$ allows us to work systematically.

Rewritten Equation:

$$(6 \times 9) = 45$$

This step is justified because understanding the structure of the equation ensures we apply the correct algebraic operations.

Step 2: Simplify the Left Side

Justification:

Using the associative property of multiplication, which states that $(a \times b) \times c = a \times (b \times c)$, we can simplify the left side:

$$(6 \times 9) = 6 \times 9$$

Since multiplication is associative and commutative, we can write:

$$6 \times 9$$

Calculating 6×9 :

$$6 \times 9 = 54$$

So, the expression simplifies to:

$$54 \times$$

Rewritten Equation:

$$54 \times = 45$$

This step reduces the complexity of the equation, making it easier to isolate the variable.

Step 3: Isolate the Variable

Justification:

Our goal is to solve for x . Since x is multiplied by 54, we use the division property of equality:

$$\text{If } a \times x = b, \text{ then } x = b / a$$

Applying this property, we divide both sides of the equation by 54:

$$x = 45 / 54$$

This step is justified because division is the inverse operation of

multiplication, which allows us to isolate the variable.

Step 4: Simplify the Fraction

Justification:

Simplify $45 / 54$ to its lowest terms:

- Find the greatest common divisor (GCD) of 45 and 54
- 45 factors: 1, 3, 5, 9, 15, 45
- 54 factors: 1, 2, 3, 6, 9, 18, 27, 54

Common factors: 1, 3, 9

Largest common factor: 9

Divide numerator and denominator by 9:

$$45 \div 9 = 5$$

$$54 \div 9 = 6$$

Therefore,

$$x = 5 / 6$$

This step ensures the solution is presented in the simplest form, making it more meaningful and easier to interpret.

Step 5: Final Answer and Verification

Justification:

The most accurate solution is:

$$x = 5/6$$

To verify, substitute x back into the original equation:

$$(6 \times) 9 = 45$$

Substitute $x = 5/6$:

$$(6 (5/6)) 9 = 45$$

Calculate inside the parentheses:

$$6 (5/6) = (6 / 6) 5 = 1 5 = 5$$

Now, multiply by 9:

$$5 9 = 45$$

Since both sides equal 45, the solution $x = 5/6$ is verified as correct.

Summary of Justifications for Each Step

1. Interpreting the Equation: Recognizing the notation $(6x 9)$ as $(6 x) 9$ for clarity.
2. Simplifying the Left Side: Applying associative and commutative properties of multiplication to combine constants, simplifying the expression to $54 x$.
3. Isolating the Variable: Using the division property to solve for x by dividing both sides by 54.
4. Reducing the Fraction: Factoring numerator and denominator to find the simplest form of the solution.
5. Verification: Substituting the solution back into the original equation to confirm correctness.

Additional Insights and Tips for Solving Similar Equations

- Always interpret the notation carefully; algebraic expressions can be ambiguous without context.
- Use properties of operations systematically: associative, commutative, distributive, and inverse operations.
- Simplify constants early to make the equation more manageable.
- When dealing with fractions, always seek to reduce to lowest terms for clarity.
- Verify your solution by substitution to avoid errors.

Conclusion

In solving the equation $6x 9 = 45$, each step is justified through fundamental algebraic principles. The process involves interpreting the expression correctly, simplifying the equation using properties of multiplication, isolating the variable through division, and verifying the solution through substitution. The final answer, $x = 5/6$, is both accurate and verified, exemplifying a methodical approach to solving linear equations. Understanding and justifying each step not only ensures correctness but also builds a solid foundation for tackling more complex algebraic problems in the future.

Frequently Asked Questions

What is the initial step to solve the equation $6x + 9 = 45$?

The initial step is to isolate the term with the variable x by subtracting 9 from both sides of the equation.

Why do we subtract 9 from both sides in the equation $6x + 9 = 45$?

Because subtracting 9 from both sides maintains equality and helps isolate the term with x for solving.

What is the result after subtracting 9 from both sides?

The result is $6x = 36$.

What is the next step after obtaining $6x = 36$?

The next step is to divide both sides by 6 to solve for x .

Why do we divide both sides by 6 in the equation $6x = 36$?

Because 6 is the coefficient of x , and dividing isolates x , giving its value.

What is the result after dividing both sides by 6?

The result is $x = 6$.

How can we verify that $x = 6$ is the correct solution?

By substituting $x = 6$ back into the original equation and checking if both sides are equal.

What does substituting $x = 6$ into $6x + 9 = 45$ show?

It shows that $6(6) + 9$ equals 45, confirming that the solution is correct.

What is the final answer to the equation $6x + 9 = 45$?

The final answer is $x = 6$.

Additional Resources

Mathematics

Understanding the Step-by-Step Justification for Solving $6x + 9 = 45$

When approaching algebraic equations such as $6x + 9 = 45$, it's essential to understand each step's reasoning to promote conceptual clarity and problem-solving confidence. This article provides an in-depth analysis of the justification for each step involved in solving this equation, presented in an engaging, expert-driven format. Whether you're a student looking to strengthen your algebra skills or an educator seeking comprehensive explanations, this guide offers valuable insights into the logical flow behind solving linear equations.

Introduction: The Importance of Justification in Algebra

Mathematics is not just about arriving at the correct answer; it's about understanding why each step is taken. Justification ensures that the solution process is logical, transparent, and reproducible, forming the foundation for more advanced mathematical concepts. When solving equations like $6x + 9 = 45$, every move should be backed by an algebraic principle or property, such as equality, inverse operations, or the distributive property.

In this article, we'll dissect the solving process to highlight the reasoning behind each step, equipping you with a solid understanding of algebraic manipulations.

Step 1: Recognizing the Equation Structure

Equation Presented:

```
```plaintext
6x + 9 = 45
```
```

Justification:

This is a linear equation in one variable, x . The goal is to isolate x on one side of the equation to determine its value. Recognizing the structure helps determine the appropriate algebraic operations needed for solving.

Step 2: Isolating the Variable Term

Objective:

Eliminate the constant term 9 that is added to the term containing x.

Operation:

Subtract 9 from both sides of the equation.

```
```plaintext
6x + 9 - 9 = 45 - 9
```
```

Justification:

- Inverse Property of Addition and Subtraction: To "undo" addition, subtract the same quantity from both sides, ensuring the equation remains balanced.
- This step leverages the Subtraction Property of Equality, which states that subtracting the same number from both sides preserves equality.

Result:

```
```plaintext
6x = 36
```
```

This step simplifies the equation, bringing us closer to solving for x.

Step 3: Isolating the Variable

Objective:

Solve for x by isolating it on one side.

Operation:

Divide both sides of the equation by 6.

```
```plaintext
```

$$\begin{array}{c} (6x) / 6 = 36 / 6 \\ \text{\textbackslash\textbackslash\textbackslash} \end{array}$$

Justification:

- Division Property of Equality: Dividing both sides of an equation by the same non-zero number maintains equality.
- Since 6 is a non-zero coefficient of  $x$ , division is valid and essential for isolating  $x$ .

Result:

`\textbackslash\textbackslash\textbackslash`plaintext  
 $x = 6$   
`\textbackslash\textbackslash\textbackslash`

This completes the algebraic process, giving the value of the variable.

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## Step 4: Verifying the Solution

Why Verification Matters:

Always verify your solution by substituting  $x = 6$  back into the original equation to ensure correctness.

## Verification Steps:

- Substitute  $x = 6$  into the original equation:

```
```plaintext
6(6) + 9 = 45
```
```

- Simplify:

```
```plaintext
36 + 9 = 45
```
```

- Confirm:

```
```plaintext
45 = 45
```
```

## Justification:

- Substitution confirms that the value satisfies the original equation.
- This step ensures the solution is valid and not a result of algebraic errors.

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## Comprehensive Summary of Justifications

| Step | Action | Reasoning / Property Used |  |
|------|--------|---------------------------|--|
|------|--------|---------------------------|--|

```

Result |
|-----|-----|-----
|-----|
| 1 | Recognize the equation's structure |
Recognizing linear form guides the approach |
Equation identified as linear in x |
| 2 | Subtract 9 from both sides | Subtraction
Property of Equality | Simplifies to $6x = 36$ |
| 3 | Divide both sides by 6 | Division
Property of Equality | Isolates x, yielding $x = 6$ |
| 4 | Substitute $x=6$ into original |
Substitution and verification | Confirms
solution's correctness |

```

## Deeper Insights: Why Each Step Is Essential

### 1. Recognizing the Equation Structure

Understanding the form of the equation helps determine the sequence of operations. For linear equations, the goal is straightforward: isolate the variable by undoing addition/subtraction first, then multiplication/division.

### 2. Eliminating Constant Terms

Subtracting 9 from both sides is justified because of the Subtraction Property of Equality. This preserves the balance of the equation and simplifies the expression, making the variable's coefficient stand alone.

### 3. Isolating the Variable

Dividing both sides by 6 uses the Division Property of Equality. This step is crucial because it removes the coefficient attached to  $x$ , directly solving for the variable.

### 4. Verification

Substituting the found value back into the original ensures that the algebraic manipulations led to a valid solution, fulfilling the principle of checking the solution.

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## Alternative Approaches and Their Justifications

While the method outlined is standard, alternative approaches exist:

- Graphical Method: Plotting  $y = 6x + 9$  and  $y = 45$ , then identifying the intersection point, justifies the solution visually.
- Using Inverse Operations Sequentially: Applying inverse addition and multiplication step-by-step, justified by algebraic properties, reinforces understanding.

Each approach relies on the same fundamental properties but offers different perspectives, all justified within the algebraic framework.

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## Final Thoughts: The Significance of Justification in Mathematical Solutions

In solving equations like  $6x + 9 = 45$ , detailed justification of each step is more than academic rigor—it fosters deep comprehension. Recognizing the properties used ensures that solutions are not just correct but also rooted in sound mathematical principles. This approach cultivates critical thinking, problem-solving skills, and confidence in handling more complex equations.

By thoroughly understanding why each operation is justified, students and practitioners develop a robust mathematical intuition that extends well beyond this simple linear equation. Remember, in mathematics, the journey of reasoning is as important as the destination of the answer.

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In conclusion, the solution to the equation  $6x + 9 = 45$  is  $x = 6$ , achieved through justified steps based on algebraic properties:

- Subtracting 9 from both sides (Subtraction Property of Equality),
- Dividing both sides by 6 (Division Property of Equality),
- Verifying the solution by substitution.

This process exemplifies the importance of

logical reasoning in algebra, emphasizing that every step should be accompanied by a clear, justified rationale.

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