

$4x + 3(4x + 7) = 4(7x + 3)$

$4x + 3(4x + 7) = 4(7x + 3)$ is a mathematical equation that involves algebraic expressions. Solving such equations is fundamental in understanding how to manipulate algebraic formulas, isolate variables, and find their values. This particular equation provides an excellent example of how to approach a linear equation with variables on both sides, requiring the application of distributive properties, combining like terms, and simplifying to find the value of x . Whether you are a student learning algebra for the first time or someone seeking to refine your skills, understanding how to solve this equation will deepen your grasp of algebraic concepts and problem-solving strategies.

Understanding the Components of the Equation

Before diving into the solution process, it's crucial to understand the different parts of the equation:

The Equation Breakdown

- The left side: $4x + 3(4x + 7)$
- The right side: $4(7x + 3)$

This equation involves:

- A linear term with variable x : $4x$
- A product involving a constant and a binomial: $3(4x + 7)$ on the left side
- A product involving a constant and a binomial: $4(7x + 3)$ on the right side

Why Is This Equation Important?

- It demonstrates the distributive property, where multiplication is distributed over addition.
- It shows how to combine like terms for simplification.
- It introduces the concept of balancing an equation to solve for the unknown variable.

Step-by-Step Solution Process

To solve the equation $4x + 3(4x + 7) = 4(7x + 3)$, follow the steps below:

1. Apply the Distributive Property

Distribute the multiplication over the addition inside the parentheses:

1. On the left: $3(4x + 7) = 3 \cdot 4x + 3 \cdot 7 = 12x + 21$

2. On the right: $4(7x + 3) = 4 \cdot 7x + 4 \cdot 3 = 28x + 12$

Now, rewrite the equation with these expanded forms:

$$4x + 12x + 21 = 28x + 12$$

2. Combine Like Terms

On the left side, combine the terms with x:

$$(4x + 12x) + 21 = 28x + 12$$

Which simplifies to:

$$16x + 21 = 28x + 12$$

3. Isolate Variable Terms on One Side

Subtract 16x from both sides to gather the x terms on the right:

$$16x + 21 - 16x = 28x + 12 - 16x$$

Simplify:

$$21 = 12x + 12$$

4. Move Constant Terms to the Other Side

Subtract 12 from both sides:

$$21 - 12 = 12x + 12 - 12$$

Simplify:

$$9 = 12x$$

5. Solve for x

Divide both sides by 12:

$$x = \frac{9}{12}$$

Simplify the fraction:

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

Final answer: $x = \frac{3}{4}$

Understanding the Solution Steps in Detail

Breaking down the process helps reinforce understanding and ensures clarity in how algebraic solutions are derived.

Applying the Distributive Property

- The distributive property states that $a(b + c) = ab + ac$.
- It transforms expressions with parentheses into a sum of products, making them easier to combine and simplify.

Combining Like Terms

- Like terms are terms that contain the same variables raised to the same power.
- Combining like terms simplifies the equation and makes it easier to isolate the variable.

Balancing the Equation

- The fundamental rule in solving equations is maintaining equality.
- Whatever you do to one side, do to the other to keep the balance.

Fraction Simplification

- Simplify fractions by dividing numerator and denominator by their greatest common divisor (GCD).

Common Mistakes and How to Avoid Them

While solving algebraic equations like $4x + 3(4x + 7) = 4(7x + 3)$, students often encounter pitfalls. Here are some common errors and tips to avoid them:

Mistake 1: Forgetting to Distribute

- Always remember to distribute multiplication over addition inside parentheses.
- *Tip:* Rewrite expressions explicitly to avoid skipping steps.

Mistake 2: Combining Terms Incorrectly

- Only combine like terms—those with the same variable and exponent.
- *Tip:* Double-check the variables before combining.

Mistake 3: Not Maintaining Balance

- When moving terms from one side to the other, change their signs accordingly.
- *Tip:* Think of it as "adding the opposite" to both sides.

Mistake 4: Simplifying Fractions Improperly

- Always reduce fractions to their simplest form for clarity.
- *Tip:* Use GCD to simplify fractions.

Additional Practice Problems

To reinforce your understanding, try solving the following similar equations:

1. $2x + 3(5x + 2) = 4(3x + 7)$

2. $5(2x - 4) = 3(4x + 6)$

3. $7x + 2(3x + 5) = 4(5x + 2)$

4. $3(2x + 8) = 2(4x + 10)$

5. $6x + 4(3x + 1) = 5(2x + 4)$

Practicing these problems will enhance your skills in applying algebraic principles and prepare you for more complex equations.

Real-World Applications of Solving Linear Equations

Understanding how to solve equations like $4x + 3(4x + 7) = 4(7x + 3)$ is not just an academic exercise. These skills are applicable in various real-life situations, including:

Financial Planning

- Calculating the total cost when multiple items with different prices and quantities are involved.
- Example: Solving for the unknown quantity or price in budgeting scenarios.

Engineering and Physics

- Determining unknown forces, velocities, or other quantities in equations representing physical systems.
- Example: Balancing equations representing forces or energy.

Business and Economics

- Analyzing profit, cost, and revenue models that involve linear relationships.
- Example: Finding break-even points or optimal production levels.

Data Analysis and Statistics

- Fitting linear models to data to predict outcomes.
- Example: Solving for coefficients in regression equations.

Summary and Key Takeaways

To summarize:

- Solving equations like $4x + 3(4x + 7) = 4(7x + 3)$ involves applying the distributive property, combining like terms, and isolating the variable.
- The step-by-step approach ensures clarity and reduces errors.
- Practice with similar problems enhances problem-solving skills.
- These algebraic techniques have broad applications across various fields.

Remember: The key to mastering algebra is understanding the underlying principles, practicing regularly, and approaching each problem systematically. With these skills, you'll be well-equipped to tackle more complex equations and real-world problems involving linear relationships.

If you're interested in further learning, consider exploring topics such as quadratic equations, systems of equations, and algebraic functions to expand your mathematical toolkit.

Frequently Asked Questions

What is the first step to solve the equation $4x + 3(4x + 7) = 4(7x + 3)$?

Distribute the 3 on the left side and the 4 on the right side to eliminate parentheses, resulting in $4x + 12x + 21 = 28x + 12$.

How do you simplify the equation after distributing the terms?

Combine like terms on the left side to get $16x + 21$, so the equation becomes $16x + 21 = 28x + 12$.

What is the next step after simplifying both sides of the equation?

Subtract $16x$ from both sides to gather variable terms on one side, resulting in $21 = 12x + 12$.

How do you isolate x in the equation $21 = 12x + 12$?

Subtract 12 from both sides to get $9 = 12x$, then divide both sides by 12 to solve for x .

What is the solution to the equation $4x + 3(4x + 7) = 4(7x + 3)$?

The solution is $x = 3/4$.

Are there any extraneous solutions in this type of linear equation?

No, linear equations like this typically have a unique solution unless division by zero occurs, which is not the case here.

Can this equation be solved graphically, and if so, how?

Yes, by graphing the two expressions $4x + 3(4x + 7)$ and $4(7x + 3)$ as functions and finding their

intersection point.

What common mistakes should be avoided when solving this equation?

Avoid incorrect distribution, combining unlike terms prematurely, and forgetting to divide to isolate x ; carefully perform each step to ensure accuracy.

Additional Resources

$4x + 3(4x + 7) = 4(7x + 3)$: An In-Depth Exploration of Algebraic Equations

When delving into the world of algebra, equations like $4x + 3(4x + 7) = 4(7x + 3)$ serve as fundamental building blocks for understanding how variables and constants interact. This particular equation, while seemingly straightforward, provides a rich platform for exploring the principles of linear equations, distributive properties, and solving for unknown variables. As such, it offers both educational value and practical applications in various fields, including engineering, computer science, and everyday problem-solving.

In this comprehensive review, we'll analyze this equation from multiple angles—its structure, the process of solving it, common pitfalls, and its broader significance. By dissecting each component, we aim to provide clarity and insight for students, educators, and anyone interested in mastering algebraic concepts.

Understanding the Structure of the Equation

The Components at a Glance

The equation $4x + 3(4x + 7) = 4(7x + 3)$ is a linear algebraic expression involving a single variable, x . It contains several key elements:

- Variables: The unknown x , which we aim to solve for.
- Constants: Numerical values such as 3, 7, and 4.
- Operators: Addition (+), multiplication (or implied), and parentheses that dictate the order of operations.

Breaking down the equation helps in understanding how each part contributes to the overall structure:

- The left side has two terms: $4x$ and $3(4x + 7)$.
- The right side is $4(7x + 3)$.

The Role of Parentheses and Distribution

Parentheses are crucial in algebra because they specify the order of operations. In this equation:

- $3(4x + 7)$: The 3 multiplies the entire binomial inside the parentheses.

- $4(7x + 3)$: The 4 multiplies the binomial on the right.

Applying the distributive property helps in expanding these expressions:

- $3(4x + 7) = 3 \cdot 4x + 3 \cdot 7 = 12x + 21$

- $4(7x + 3) = 4 \cdot 7x + 4 \cdot 3 = 28x + 12$

By expanding these, the equation becomes:

$$4x + 12x + 21 = 28x + 12$$

which simplifies the process of solving for x .

Step-by-Step Solution Process

Step 1: Expand Both Sides

Using the distributive property:

- Left side: $4x + 3(4x + 7) = 4x + 12x + 21$

- Right side: $4(7x + 3) = 28x + 12$

Thus, the equation simplifies to:

$$4x + 12x + 21 = 28x + 12$$

Step 2: Combine Like Terms

On the left:

$$(4x + 12x) = 16x$$

So, the simplified equation:

$$16x + 21 = 28x + 12$$

Step 3: Isolate Variable Terms on One Side

Subtract $16x$ from both sides:

$$16x + 21 - 16x = 28x + 12 - 16x$$

which simplifies to:

$$21 = 12x + 12$$

Step 4: Isolate the Variable

Subtract 12 from both sides:

$$21 - 12 = 12x + 12 - 12$$

which simplifies to:

$$9 = 12x$$

Step 5: Solve for x

Divide both sides by 12:

$$x = 9 / 12$$

Simplify the fraction:

$$x = 3 / 4$$

Final answer: $x = 0.75$

Common Challenges and Tips

Misapplication of Distributive Property

One common mistake is failing to distribute correctly or skipping steps, leading to incorrect solutions. Always expand parentheses fully before combining like terms.

Simplification Errors

Ensure that like terms are correctly combined. For example, adding $4x$ and $12x$ yields $16x$, not a different value.

Handling Fractions

When dividing both sides by coefficients, be cautious with fractions. Simplify fractions where possible to avoid calculation errors.

Cross-Checking Solutions

After solving for x , substitute back into the original equation to verify the solution's correctness. For $x = 0.75$:

- Left side: $4(0.75) + 3(40.75 + 7) = ?$

- Right side: $4(70.75 + 3) = ?$

Calculate:

- Left: $3 + 3(3 + 7) = 3 + 3(10) = 3 + 30 = 33$

- Right: $4(5.25 + 3) = 4(8.25) = 33$

Since both sides equal 33, the solution checks out.

Broader Significance and Applications

Educational Value

This equation exemplifies fundamental algebraic principles, making it an ideal teaching tool for students learning to manipulate expressions and solve for variables. It reinforces core concepts such as distribution, combining like terms, and isolating variables.

Practical Applications

Linear equations similar to this are used in:

- Finance: Calculating interest or budgeting scenarios.
- Physics: Relating variables like speed, distance, and time.
- Engineering: Designing systems where relationships between quantities are linear.

Critical Thinking and Problem-Solving Skills

Working through this equation fosters critical thinking by requiring multiple steps, verification, and error-checking, skills transferable to complex real-world problems.

Variations and Extensions

Incorporating Additional Variables

Introducing more variables or parameters can deepen complexity, such as:

$$4x + 3(4x + 7) = 4(7x + y)$$

which requires solving for two variables.

Exploring Nonlinear Equations

Transforming similar equations into quadratic or higher-degree forms can expand understanding of polynomial behavior and solutions.

Using Technology

Graphing calculators or algebra software (like Desmos or WolframAlpha) can visually demonstrate solutions, making understanding more intuitive.

Final Thoughts

The equation $4x + 3(4x + 7) = 4(7x + 3)$ serves as a quintessential example of linear algebra that encapsulates essential principles like distribution, combining like terms, and solving for unknowns. Its

straightforward structure makes it accessible for learners, yet it also offers opportunities for exploring more complex concepts. Mastery of such equations builds a strong foundation for advanced mathematics and critical problem-solving skills across numerous disciplines.

By carefully analyzing each step, avoiding common pitfalls, and verifying solutions, students and practitioners can develop confidence and competence in handling algebraic equations. Whether in academic settings or practical applications, understanding and solving equations like this remain vital skills that empower logical reasoning and analytical thinking.

Pros of mastering equations like this:

- Reinforces fundamental algebraic principles
- Enhances problem-solving skills
- Applicable across various scientific and practical fields
- Builds confidence in tackling more complex equations

Cons or challenges:

- Potential for calculation errors if steps are skipped
- Misapplication of distributive property can lead to incorrect solutions
- Fractions and negative numbers may complicate calculations initially

In conclusion, the exploration of $4x + 3(4x + 7) = 4(7x + 3)$ not only demystifies a specific algebraic problem but also exemplifies the analytical mindset necessary for mathematical literacy. Continuous practice and careful reasoning are key to mastering such equations, paving the way for success in both academic pursuits and real-world problem-solving.

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