Solve For X: 3x/5-1 = X/2-2/3

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Understanding how to solve for an unknown variable in algebraic expressions is a fundamental skill that unlocks the door to more advanced mathematics. One such problem involves solving an equation with fractions, specifically:

$$\frac{3x}{5} - 1 = \frac{X}{2} - \frac{2}{3}$$

This type of problem appears frequently in algebra coursework and standardized tests, making it essential to master the steps involved in finding the value of x. In this comprehensive guide, we will walk through the process of solving this equation systematically, ensuring clarity at each stage. By the end of this article, you'll understand not only how to solve this particular equation but also develop a methodical approach applicable to similar algebraic problems.

Understanding the Equation

Before diving into the solution, it's important to understand what the equation represents and the challenges it presents.

Equation Breakdown

- Variables: The unknown x appears in the numerator of a fraction.
- Fractions: The presence of multiple fractions requires careful handling to avoid errors.
- Constants: The numbers -1, -2/3 are constants that shift the values of each side.

Goals

- Isolate x on one side of the equation.
- Simplify all fractions to facilitate solving.
- Find the exact value of x.

Step-by-Step Approach to Solving the Equation

To solve the equation systematically, follow these key steps:

1. Understand the Equation Structure

- Recognize that the equation equates two algebraic expressions, each involving fractions and constants.
- Note that the variable x appears in the numerator of a fraction.

2. Clear Fractions by Finding a Common Denominator

- The denominators are 5, 2, and 3.
- To eliminate fractions, find the least common denominator (LCD).

Calculating the LCD:

- Prime factors:
- 5 (prime)
- 2 (prime)
- 3 (prime)
- LCD = 2 3 5 = 30

3. Multiply the Entire Equation by the LCD

- Multiply both sides of the equation by 30 to clear denominators.

Result:

$$
30 \times \left(\frac{3x}{5} - 1 \right) = 30 \times \left(\frac{x}{2} - \frac{2}{3} \right)
$$

Simplify each term:

- Left side:
- $30 \times \frac{3x}{5} = 6 \times 3x = 18x$
- $30 \times (-1) = -30$
- Right side:
- $30 \times \frac{x}{2} = 15x$
- $30 \times \left(- \frac{2}{3}\right) = -20$

New Equation:

$$
18x - 30 = 15x - 20
$$

Solving the Simplified Equation

With the fractions eliminated, the equation is much easier to work with:

$$
18x - 30 = 15x - 20

\]

1. Collect like terms

- Subtract \(15x \) from both sides:

\[

18x - 15x - 30 = -20

\]

Simplifies to:

\[

3x - 30 = -20

\]

2. Isolate the term with \(x \)

- Add 30 to both sides:

\[

3x = -20 + 30

\]

\[

3x = 10

\]

3. Solve for x

- Divide both sides by 3:

$$
x = \frac{10}{3}
$$

Final Solution and Verification

The solution to the equation is:

$$
x = \frac{10}{3}
$$

Verification:

To ensure the solution is correct, substitute $x = \frac{10}{3}$ back into the original equation.

Original equation:

$$
\frac{3x}{5} - 1 = \frac{x}{2} - \frac{2}{3}
$$

Substitute $x = \frac{10}{3}$:

- Left side:

$$
\frac{3 \times \frac{10}{3}}{5} - 1 = \frac{10}{5} - 1 = 2 - 1 = 1
$$

- Right side:

$$
\frac{\frac{10}{3}}{2} - \frac{2}{3} = \frac{10/3}{2} - \frac{2}{3} = \frac{10/3 \times 1/2} - \frac{2}{3} = \frac{10}{3} \times \frac{1}{2} - \frac{2}{3} = \frac{10}{6} - \frac{2}{3}
$$

Simplify:

$$
\frac{10}{6} = \frac{5}{3}
$$

$$
\frac{2}{3} \text{ remains the same}
$$

So,

$$
\frac{5}{3} - \frac{2}{3} = \frac{3}{3} = 1
$$

Both sides equal 1, confirming that $x = \frac{10}{3}$ is the correct solution.

Understanding the Importance of This Method

Mastering the process of solving equations with fractions is crucial in algebra. It develops skills such as:

- Recognizing the least common denominator to clear fractions.
- Maintaining balance across equations during operations.
- Simplifying expressions systematically.
- Verifying solutions to prevent errors.

This approach not only applies to similar problems but also builds a foundation for tackling more complex algebraic equations, including those with variables in denominators, radicals, or exponents.

Additional Tips for Solving Fractional Equations

To improve your algebra skills further, consider the following tips:

1. **Always find the LCD:** This simplifies the process of clearing fractions.

2. **Distribute carefully:** When multiplying through an entire equation, distribute multiplication to each term accurately.

3. **Check your work:** Substitute your solution back into the original equation to verify correctness.

4. **Practice regularly:** Repetition helps internalize the steps and develop confidence.

5. **Stay organized:** Keep each step clear to avoid mistakes, especially with multiple fractions.

Summary

Solving the equation $\frac{3x}{5} - 1 = \frac{x}{2} - \frac{2}{3}$ involves:

- Identifying the denominators and finding the LCD (30).
- Multiplying both sides by the LCD to eliminate fractions.
- Simplifying the resulting algebraic equation.
- Isolating x through addition and division.
- Verifying the solution by substitution.

The solution, $x = \frac{10}{3}$, demonstrates a clear and effective approach to handling equations with multiple fractions. By practicing these steps, students and learners can confidently solve similar algebraic problems and build a strong foundation for advanced mathematics.

Keywords: solve for x, algebra, fractions, linear equations, solving equations with fractions, algebraic solutions, mathematical problem-solving

Frequently Asked Questions

How do I solve the equation (3x/5) - 1 = (x/2) - 2/3 for x?

First, find a common denominator to eliminate fractions. The denominators are 5, 2, and 3, so the common denominator is 30. Multiply both sides by 30 to clear fractions: 30(3x/5 - 1) = 30(x/2 - 2/3). Simplify to get 63x - 30 = 15x - 20. Then, solve for x: 18x - 30 = 15x - 20, which leads to 3x = 10, so x = 10/3.

What are the steps to isolate x in the equation (3x/5) - 1 = (x/2) - 2/3?

Step 1: Clear fractions by multiplying through by 30 (the least common multiple of 5, 2, and 3). Step 2: Simplify both sides: 63x - 30 = 15x - 20. Step 3: Rearrange terms to gather x on one side: 18x - 15x = -20 + 30. Step 4: Simplify: 3x = 10. Finally, divide both sides by 3: x = 10/3.

Is there a shortcut to solve (3x/5) - 1 = (x/2) - 2/3 without dealing with fractions?

Yes, multiply both sides of the original equation by the least common denominator (30) to eliminate fractions quickly. This transforms the equation into a linear form, making it easier to solve for x without dealing with fractions at each step.

How do I verify the solution x = 10/3 in the original equation?

Substitute x = 10/3 into the original equation: (3(10/3))/5 - 1 = (10/3)/2 - 2/3. Simplify each side: (10)/5 - 1 = (10/3)/2 - 2/3, which becomes 2 - 1 = (10/3)(1/2) - 2/3. Calculate: 1 = (10/6) - 2/3 = 5/3 - 2/3 = 1. Both sides equal 1, so the solution is correct.

What common mistakes should I avoid when solving (3x/5) - 1 =

(x/2) - 2/3?

Avoid forgetting to multiply both sides by the least common denominator, which can lead to incorrect fractions. Also, be careful with signs when rearranging terms, and double-check your algebraic steps to ensure no errors in simplification or arithmetic.

Additional Resources

Solve For X: 3x/5 - 1 = X/2 - 2/3 — this algebraic equation exemplifies the fundamental process of isolating variables to find their specific values, a cornerstone concept in mathematics. Equations like this serve as a gateway to understanding how algebra functions as a language of relationships, patterns, and problem-solving strategies. In this article, we will dissect this equation step-by-step, explore the methodologies involved, and discuss the broader implications of mastering such algebraic skills.

Understanding the Equation: Context and Significance

The Role of Variables in Algebra

At its core, algebra introduces variables—symbols that represent unknown quantities. In the equation $3x/5 - 1 = x/2 - 2/3$, the variable 'x' is the unknown we aim to determine. Solving for 'x' involves manipulating the equation to express 'x' explicitly, thereby revealing its value.

Understanding how to manipulate equations fosters critical thinking, logical reasoning, and quantitative literacy. Whether in academic settings, scientific research, or real-world applications like finance and engineering, the ability to solve for unknowns is essential.

Why This Equation Matters

This particular equation combines fractions, variables, and constants, making it an excellent example to illustrate key algebraic techniques. It also demonstrates how to handle multiple fractions and rational expressions, which are common stumbling blocks for students. Mastering such equations enhances problem-solving agility and mathematical fluency.

Deconstructing the Equation: Initial Observations

The Equation at a Glance

The original equation is:

$3x/5 - 1 = x/2 - 2/3$

Key observations:

- It contains two fractions involving 'x' (3x/5 and x/2).
- Constants are present on both sides (-1 and -2/3).
- The goal is to isolate 'x' to find its numerical value.

Goals and Approach

The primary goal:

- To solve for 'x' explicitly.

The approach:

1. Eliminate fractions to simplify the equation.
2. Collect like terms.

3. Isolate 'x' on one side.

4. Simplify to find the exact value of 'x'.

Step-by-Step Solution Process

1. Clearing Fractions: Finding the Least Common Denominator (LCD)

Fractions complicate algebraic operations. To manage them effectively, we first find the least common denominator (LCD) of all fractions involved.

- Denominators are 5, 2, and 3.
- The LCD of 5, 2, and 3 is:
- Prime factorization:
- 5 (prime)
- 2 (prime)
- 3 (prime)
- LCD = $2 \times 3 \times 5 = 30$

Multiplying both sides of the entire equation by 30 clears all fractions:

$(30)(3x/5 - 1) = (30)(x/2 - 2/3)$

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2. Applying the Multiplication

Distribute 30:

- 30 (3x/5) - 30 1 = 30 (x/2) - 30 (2/3)

Calculations:

- 30 (3x/5) = (30/5) 3x = 6 3x = 18x
- 30 1 = 30
- 30 (x/2) = (30/2) x = 15x
- 30 (2/3) = (30/3) 2 = 10 2 = 20

Rewritten equation:

18x - 30 = 15x - 20

---

3. Simplify and Rearrange Terms

Now, collect like terms:

18x - 15x = -20 + 30

Simplify:

3x = 10

---

4. Solving for 'x'

Divide both sides by 3:

x = 10 / 3

This fraction simplifies to:

x = 3▯ or approximately 3.333...

Verification of the Solution

Plugging 'x' Back Into the Original Equation

To ensure the solution is correct, substitute x = 10/3 into the original equation:

Left side:

(3 (10/3)) / 5 - 1 = (10) / 5 - 1 = 2 - 1 = 1

Right side:

(x/2) - 2/3 = (10/3) / 2 - 2/3 = (10/3) (1/2) - 2/3 = (10/6) - 2/3

Simplify:

(10/6) = 5/3

Express 2/3 as a common denominator:

2/3 = 2/3

Now, compare:

5/3 - 2/3 = (5 - 2)/3 = 3/3 = 1

Since both sides equal 1, the solution x = 10/3 is verified.

Broader Implications and Applications

The Importance of Fraction Handling

This problem underscores the significance of mastering fraction operations in algebra. Fractions are prevalent in real-world problems, from financial calculations to engineering measurements. Being comfortable with LCDs, cross-multiplied equations, and rational expressions is vital.

Algebra as a Critical Thinking Tool

Solving such equations develops logical reasoning, pattern recognition, and strategic planning skills. These are transferable beyond mathematics, supporting decision-making in diverse fields such as data analysis, computer science, and economics.

From Basic to Complex Equations

While this example is straightforward, the principles extend to more complex equations involving multiple variables, exponents, radicals, and systems of equations. The foundational skills demonstrated here serve as building blocks for advanced mathematical concepts.

Common Challenges and Tips for Solving Similar Equations

Handling Multiple Fractions

- Always find the LCD to clear fractions early.
- Be meticulous with multiplication to avoid errors.

Maintaining Equation Balance

- Whatever operation you perform on one side, perform on the other.

- Keep track of signs and constants carefully.

Verifying Solutions

- Substituting solutions back into the original equation helps confirm accuracy and catch algebraic slips.

Practice Problems for Mastery

- Equations similar in structure:

- $(4x/7) + 2 = x/3 + 5$

- $(5x/8) - 3 = x/4 - 1/2$

- These reinforce fraction handling and variable isolation.

Conclusion: The Power of Algebraic Problem-Solving

The equation $3x/5 - 1 = x/2 - 2/3$ exemplifies the elegance and utility of algebra. By systematically applying techniques like finding the LCD, clearing fractions, and isolating variables, one can unlock solutions to complex-looking problems. Mastery of such skills not only enhances mathematical literacy but also equips individuals with problem-solving tools applicable across disciplines and everyday scenarios. As with many areas of mathematics, the key lies in understanding foundational concepts, practicing methodical steps, and verifying solutions to build confidence and competence in algebraic reasoning.

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