Which Equations Are Equivalent To Negative One-fourth (x) + Three-fourths = 12 Select All That Apply.

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When working with linear equations, such as $-\frac{1}{4}x + \frac{3}{4} = 12$, it's important to understand how to manipulate and identify equivalent equations. Equivalence in equations means that different equations can represent the same relationship between variables, even if they look different on the surface. This article will explore which equations are equivalent to $-\frac{1}{4}x + \frac{3}{4} = 12$, explain how to determine equivalency, and provide a comprehensive guide to selecting all equations that match this specific relationship.

Understanding the Original Equation

Before identifying equivalent equations, it is crucial to understand the structure and solution of the original equation.

Original Equation Breakdown

- The given equation: $-\frac{1}{4}x + \frac{3}{4} = 12$
- The goal: To find all equations that are equivalent to this one.
- Key concept: Equivalence means the equations have the same solution set—i.e., the same value(s) of x satisfy both equations.

Solving the Original Equation

To understand what makes an equation equivalent, let's solve the original:

1. Subtract $\frac{3}{4}$ from both sides:
$-\frac{1}{4}x + \frac{3}{4} - \frac{3}{4} = 12 - \frac{3}{4}$

2. Simplify:
$-\frac{1}{4}x = 12 - \frac{3}{4}$

3. Convert $\frac{3}{4}$ to a decimal or improper fraction:
- $\frac{3}{4} = 0.75$ or 3/4

4. Calculate:
$-\frac{1}{4}x = 12 - 0.75 = 11.25$

5. Multiply both sides by -4 to isolate x:

- $x = 11.25 (-4) = -45$

Solution: The original equation is satisfied when $x = -45$.

Key takeaway: Any equation equivalent to $-\frac{1}{4}x + \frac{3}{4} = 12$ must have $x = -45$ as its solution.

How to Identify Equivalent Equations

To find all equations equivalent to the original, focus on transformations that do not change the solution set.

Principles of Equation Equivalence

- Adding or subtracting the same quantity to both sides.
- Multiplying or dividing both sides by a non-zero number.
- Performing valid algebraic manipulations that preserve the solution set.

Common Transformations

- Adding or subtracting constants:
- For example, $-\frac{1}{4}x + \frac{3}{4} + c = 12 + c$ (where c is any real number).
- Multiplying both sides by a non-zero number:
- For example, multiplying the entire equation by -4:
$-\frac{1}{4}x + \frac{3}{4} = 12$ becomes $x - 3 = -48$.
- Rearranging the equation:
- Moving terms around without changing their signs or values.

Examples of Equations Equivalent To the Original

Let's explore specific equations that are equivalent to $-\frac{1}{4}x + \frac{3}{4} = 12$.

1. Multiplying Both Sides by -4

- Starting with $-\frac{1}{4}x + \frac{3}{4} = 12$:

Multiply both sides by -4:

$(-4)(-\frac{1}{4}x + \frac{3}{4}) = (-4)(12)$

Simplify:

$x - 3 = -48$

- Equation: $x - 3 = -48$

- Solution: $x = -45$ (same as original).

2. Subtracting ¾ from Both Sides and then simplifying

- Starting with the original:

$-\frac{1}{4}x + \frac{3}{4} = 12$

- Subtract ¾:

$-\frac{1}{4}x = 12 - \frac{3}{4}$

- Simplify:

$-\frac{1}{4}x = 11.25$

- Multiply both sides by -4:

$x = 11.25\ (-4) = -45$

- Equation: $x = -45$, which is equivalent.

3. Rewriting the Equation in Slope-Intercept Form

- Starting from $-\frac{1}{4}x + \frac{3}{4} = 12$:

Subtract ¾:

$-\frac{1}{4}x = 11.25$

- Multiply both sides by -4:

$x = -45$

- Equivalent Equation: $x = -45$

Selecting All Equations That Are Equivalent

When presented with multiple options, how do you determine which equations are equivalent to $-\frac{1}{4}x + \frac{3}{4} = 12$? The key is checking whether each equation has the same solution — $x = -45$.

Criteria to Determine Equivalence

- Does the equation simplify to $x = -45$?
- Does it lead to the same solution set?

- Is the structure of the equation consistent with the original after valid algebraic manipulations?

Examples of Equations That Are Equivalent

- Equation A: $x = -45$
- Equation B: $-\frac{1}{4}x + \frac{3}{4} = 12$ (original)
- Equation C: $-\frac{1}{4}x = 11.25$
- Equation D: $x - 3 = -48$
- Equation E: $4x = -180$ (since multiplying $-\frac{1}{4}x + \frac{3}{4} = 12$ by -4 yields $x - 3 = -48$, which leads to $x = -45$)

All these equations share the solution $x = -45$, making them equivalent.

Common Mistakes to Avoid

When identifying equivalent equations, be cautious of:

- Equations that alter the solution set, such as adding or subtracting different constants without corresponding adjustments.
- Dividing by zero or multiplying both sides by zero.
- Incorrect algebraic manipulations that change the solution set.

Summary: Which Equations Are Equivalent To $-\frac{1}{4}x + \frac{3}{4} = 12$?

In conclusion, the equations that are equivalent to $-\frac{1}{4}x + \frac{3}{4} = 12$ are those that share the same solution: $x = -45$. These include, but are not limited to:

- $-\frac{1}{4}x + \frac{3}{4} = 12$
- $x = -45$
- $-\frac{1}{4}x = 11.25$
- $x - 3 = -48$
- $4x = -180$

Any equation that can be derived from the original through valid algebraic operations and simplifies to $x = -45$ is equivalent. Recognizing these transformations helps in solving equations efficiently and understanding the relationships between different forms of the same linear relationship.

Final Tips for Recognizing Equivalent Equations

- Always check the solution set after manipulations.
- Use inverse operations carefully.
- Confirm that the simplified form matches the original solution.
- Practice transforming equations to become more familiar with equivalence.

By mastering these concepts, you'll be well-equipped to identify all equations equivalent to $-\frac{1}{4}x + \frac{3}{4} = 12$, and enhance your algebra skills for solving linear equations effectively.

Frequently Asked Questions

Which of the following equations is equivalent to -1/4 x + 3/4 = 12?

Any equation that simplifies to the same solution for x as the original equation.

Does the equation 4(-1/4 x + 3/4) = 4(12) represent an equivalent to -1/4 x + 3/4 = 12?

Yes, multiplying both sides of the original equation by 4 maintains equivalence.

Is the equation -1/4 x = 12 - 3/4 equivalent to the original?

Yes, because subtracting 3/4 from both sides isolates the term with x, leading to an equivalent form.

Would the equation x = -4(12 - 3/4) be equivalent to -1/4 x + 3/4 = 12?

Yes, solving for x in that form yields the same solution, making it equivalent.

Are the equations -1/4 x + 3/4 = 12 and 4(-1/4 x + 3/4) = 48 equivalent?

Yes, multiplying both sides of the original equation by 4 results in the second equation, which is equivalent.

Can the equation -1/4 x + 3/4 = 12 be rewritten as x = -4(12 - 3/4)?

Yes, solving the original for x gives x = -4(12 - 3/4), so they are equivalent.

Additional Resources

Which Equations Are Equivalent To Negative One-fourth (x) + Three-fourths = 12 Select All That Apply is a fundamental question in algebra that tests understanding of equation equivalence and the ability to manipulate algebraic expressions. Recognizing equivalent equations is crucial for solving equations efficiently and accurately, especially in educational settings where foundational skills are developed. This article explores the various equations that are equivalent to the given equation, providing detailed explanations, methods for verification, and insights into common pitfalls. By understanding the principles behind equivalence transformations, students and learners can strengthen their algebraic skills and approach similar problems with confidence.

Understanding the Original Equation

The original equation presented is:

(-1/4)x + 3/4 = 12

Before identifying equivalent equations, it’s vital to understand what this equation represents and how to manipulate it. This equation is linear in one variable, x, with fractional coefficients. The goal often involves solving for x, but understanding equivalence also involves recognizing other forms of the same relationship.

Key features:
- The coefficient of x is -1/4.
- The constant term on the left is 3/4.
- The right side is 12.

Implication: Any equivalent equation must represent the same set of solutions for x, meaning the value of x that satisfies the original must satisfy the equivalent equations.

Methods to Find Equivalent Equations

Transforming the original equation into equivalent forms involves algebraic operations that preserve the solution set:

- Addition or subtraction of the same quantity from both sides
- Multiplication or division of both sides by a non-zero constant
- Re-arranging terms (e.g., moving all variables to one side)

The key is that these operations do not alter the solution set, only the form of the equation.

Step-by-Step Transformation Example

Starting with the original:

$(-1/4)x + 3/4 = 12$

Step 1: Isolate the term with x:

Subtract 3/4 from both sides:

$(-1/4)x + 3/4 - 3/4 = 12 - 3/4$

- Simplifies to:

$(-1/4)x = 12 - 3/4$

- Convert 12 to quarters: $12 = 48/4$

- So:

$(-1/4)x = 48/4 - 3/4 = (48 - 3)/4 = 45/4$

Step 2: Solve for x:

Divide both sides by -1/4:

$x = (45/4) \div (-1/4)$

Division by a fraction is equivalent to multiplication by its reciprocal:

$x = (45/4)\ (-4/1) = 45/4\ -4/1$

Multiply numerators and denominators:

$x = (45\ -4) / (4\ 1) = (-180) / 4 = -45/1 = -45$

Solution: $x = -45$

Any equation equivalent to the original must have the same solution for x, which is $x = -45$.

Identifying Equivalent Equations

Now, let's explore different equations that are equivalent to the original. Equivalence means they share the same solution set, which in this case is x = -45.

Equations Derived by Valid Operations

1. Multiplying or dividing both sides by a non-zero constant

2. Adding or subtracting the same expression from both sides

3. Rearranging terms

Examples of Equivalent Equations

Below are some equations that are equivalent to the original, along with explanations:

Equation A:

(-1/4)x + 3/4 = 12

Original equation; obviously equivalent.

Equation B:

(-1/4)x = 45/4

Derived by subtracting 3/4 from both sides.

- Pros: Simplifies the equation to isolate the term with x.
- Cons: None; this is equivalent.

Equation C:

x = -45

Derived by dividing both sides by -1/4.

- Pros: The simplest form, directly gives the solution.
- Cons: Requires understanding division of fractions.

Equation D:

4(-1/4)x + 4(3/4) = 4 12

Multiply both sides by 4 (a non-zero constant)

Simplifies to:

(-1)x + 3 = 48

- This is equivalent because multiplying both sides by 4 is a valid operation.

- Rearranged as: x = -3

- Note: This is not equivalent because the solution x = -3 does not satisfy the original equation (which has solution x = -45). Therefore, this is not equivalent.

In this case, multiplying both sides by 4 changes the solution set, so this is a common pitfall.

Equation E (Equivalent):

-x + 3 = 48

Derived from the previous step, but as noted, the solution differs.

Therefore, this is not equivalent.

Equation F (Equivalent):

(-1/4)x + 3/4 = 12

Original.

Summary of Equivalent Equations

Equation	Explanation	Is it equivalent?	Solution Check
$(-1/4)x + 3/4 = 12$	Original	Yes	Yes, $x = -45$
$(-1/4)x = 45/4$	Subtract 3/4	Yes	Yes
$x = -45$	Divide both sides by -1/4	Yes	Yes
$4(-1/4)x + 4(3/4) = 4\ 12$	Multiply both sides by 4	Yes	Yes
$-x + 3 = 48$	Simplification of previous	No	$x = -45$? No, $x= -45$? Let's verify: $-(-45)+3=45+3=48$ → matches, so yes, solution $x = -45$	Yes

Note: Multiplying both sides by 4 yields an equation with a different solution unless transformations are handled carefully.

Common Pitfalls and Misconceptions

While transforming equations, students often make mistakes that lead to non-equivalent forms:

- Multiplying both sides by zero: Invalid, as it destroys information.
- Multiplying both sides by a variable expression: Not valid unless the expression is non-zero.
- Changing the solution set unintentionally: For example, dividing by an expression that could be zero or applying an operation that alters solutions.

Pros and Cons of Different Operations

- Multiplying/dividing both sides by a non-zero number is generally safe.
- Adding/subtracting the same amount preserves equivalence.
- Rearrangement of terms preserves equivalence, as long as operations are valid.

Which Equations Are Equivalent? Select All That Apply

Given the original equation, the following are equivalent:

- $(-1/4)x + 3/4 = 12$
- $(-1/4)x = 45/4$
- $x = -45$

The following are not equivalent due to altered solution sets:

- 4(-1/4)x + 4(3/4) = 4 12 (solution x = -3, which does not satisfy the original)
- -x + 3 = 48 (solution x = -45, so this is equivalent; earlier verification confirms this)

Practical Tips for Recognizing Equivalent Equations

- Always perform inverse operations to isolate the variable.
- Check solutions in the original equation after transformations.
- Be cautious with operations that involve multiplying/dividing by expressions that could be zero.
- Remember that multiplying or dividing both sides by a non-zero constant preserves equivalence.

Conclusion

In algebra, recognizing equations equivalent to a given one is an essential skill that hinges on understanding the properties of equality and the valid transformations. The key takeaway is that equations like (-1/4)x + 3/4 = 12, (-1/4)x = 45/4, and x = -45 are all equivalent, representing the same solution set. Conversely, transformations that involve multiplying both sides by expressions that could be zero or changing the structure without maintaining the solution set are invalid, leading to non-equivalent equations.

By mastering these concepts, students can confidently manipulate equations, verify their solutions, and deepen their understanding of algebraic relationships. Practice with multiple forms of equations will help solidify these skills, making the process of solving and analyzing equations more intuitive and reliable.

In summary:

Equivalent equations include:

- (-1/4)x + 3/4 = 12
- (-1/4)x = 45/4
- x = -45
- -x + 3 = 48

Non-equivalent equations (due to solution discrepancies):

- 4(-1/4)x + 4(3/4) = 4 12 (solution x = -3)

Understanding these distinctions clarifies the concept of equation

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