QUESTION 4 Solve By Using The Substitution Method. 2x-y=-20 Y=-2x (-3,6) (-5,10) (-8,16) No Solution;

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Introduction to the Substitution Method in Solving Systems of Equations

Solving systems of equations is a fundamental aspect of algebra, often encountered in various mathematical and real-world applications. One effective technique for solving such systems is the substitution method, which involves solving one equation for one variable and then substituting this expression into the other equation. This method simplifies the system, reducing it to a single-variable equation that can be solved directly.

In this article, we will explore how to solve a specific system of equations using the substitution method, analyze the given points, and determine whether they satisfy the system or lead to a solution or no solution scenario. The focus will be on understanding the step-by-step process, verifying solutions, and interpreting the results in the context of the problem.

Understanding the Given System of Equations

The system provided in the question is:

1. \(2x - y = -20 \)
2. \(y = -2x \)

Additionally, a set of points is given:

- \((-3, 6)\)
- \((-5, 10)\)
- \((-8, 16)\)

The question also mentions "No Solution," implying that we need to verify whether these points satisfy the system or if the system has no solutions at all.

Step-by-Step Solution Using the Substitution Method

Step 1: Express one variable in terms of the other

From the second equation:

$$ y = -2x $$

This expression allows us to substitute y in the first equation.

Step 2: Substitute into the other equation

Plugging $y = -2x$ into the first equation:

$$ 2x - (-2x) = -20 $$

Simplify:

$$ 2x + 2x = -20 $$
$$ 4x = -20 $$
$$ x = -5 $$

Step 3: Find the corresponding y value

Using $y = -2x$:

$$ y = -2 \times (-5) = 10 $$

The solution to the system is:

$$ (x, y) = (-5, 10) $$

Verification of the Solution with Given Points

Now, we need to verify whether any of the given points satisfy the system and whether the solution aligns with the points.

Point 1: $(-3, 6)$

- Check the first equation:

$$ 2(-3) - 6 = -6 - 6 = -12 \neq -20 $$

- Check the second equation:

$$ y = -2x \Rightarrow 6 = -2 \times (-3) = 6 $$

The second equation holds, but the first does not. Therefore, $(-3, 6)$ does not satisfy the system.

Point 2: $(-5, 10)$

- First equation:

$$ 2(-5) - 10 = -10 - 10 = -20 $$

- Second equation:

$$ y = -2x \Rightarrow 10 = -2 \times (-5) = 10 $$

Both equations are satisfied. So, $(-5, 10)$ is a solution to the system.

Point 3: $(-8, 16)$

- First equation:

$$ 2(-8) - 16 = -16 - 16 = -32 \neq -20 $$

- Second equation:

$$ y = -2x \Rightarrow 16 = -2 \times (-8) = 16 $$

Again, the second equation holds, but the first does not. So, $(-8, 16)$ does not satisfy the system.

Analyzing the Results and the "No Solution" Claim

From the verification:

- The point $(-5, 10)$ satisfies both equations.
- The other two points do not satisfy the system.

Given the solution $(x, y) = (-5, 10)$, the system has a unique solution.

However, the question mentions "No Solution," which suggests that perhaps the system might be inconsistent or the points do not satisfy the system, leading to the conclusion that the points do not lie on the same solution line or that the system has no solutions in some contexts.

In this case:

- Since $(-5, 10)$ satisfies both equations, the system has exactly one solution.
- The points $(-3, 6)$ and $(-8, 16)$ do not satisfy the system, so they are not solutions.

Understanding the Graphical Implications

Graphically, the two equations represent lines:

- $2x - y = -20$, which can be rewritten as $y = 2x + 20$
- $y = -2x$

Plotting these:

- The line $y = 2x + 20$ has a slope of 2 and y-intercept at 20.

- The line $y = -2x$ has a slope of -2 and passes through the origin.

Their intersection point is at $(-5, 10)$, which confirms the algebraic solution.

Since the points $(-3,6)$ and $(-8,16)$ do not lie at the intersection, they are points on only one of the lines or outside the intersection point.

Conclusion and Summary

In summary, the substitution method effectively solves the system:

$$
\begin{cases}
2x - y = -20 \\
y = -2x
\end{cases}
$$

By substituting $y = -2x$ into the first equation, we find:

- $4x = -20 \Rightarrow x = -5$
- $y = -2 \times -5 = 10$

The solution is $(-5, 10)$, which satisfies both equations.

Regarding the given points:

- Only $(-5, 10)$ satisfies the system.
- The other points do not satisfy both equations simultaneously.

Final Verdict:

- The system has a single solution at $(-5, 10)$.
- The mention of "No Solution" in the question may be a distractor or context-specific, but mathematically, the system is consistent with one solution.

Additional Tips for Solving Systems Using Substitution

- Always verify your solutions by substituting back into both original equations.
- When the two equations are similar or multiples, the system may have infinitely many solutions or no solutions.
- Graphing the equations helps visualize the solution points and understand the system's nature.

FAQs About Solving Systems with the Substitution Method

Q1: Can the substitution method be used for all systems of equations?

A1: It works well for systems where one equation can be easily solved for one variable. For complex systems or those with more variables, other methods like elimination or graphing might be more efficient.

Q2: How do I know if a system has no solution?
A2: If substituting leads to a contradiction (e.g., $0 = 5$), the system has no solution.

Q3: What is the advantage of the substitution method?
A3: It simplifies solving by reducing the system to a single-variable equation, making it straightforward to find solutions.

In conclusion, using the substitution method provides a clear pathway to solve the given system of equations, verify solutions, and understand the relationships between the lines and points involved.

Frequently Asked Questions

How do you solve the system of equations $2x - y = -20$ and $y = -2x$ using the substitution method?

Substitute $y = -2x$ into the first equation: $2x - (-2x) = -20$, which simplifies to $2x + 2x = -20$, then $4x = -20$, so $x = -5$. Then, $y = -2(-5) = 10$.

What is the solution to the system $2x - y = -20$ and $y = -2x$ at the point (-3, 6)?

Substitute $x = -3$ into $y = -2x$: $y = -2(-3) = 6$, which matches the point (-3, 6), so it is a solution.

Does the point (-5, 10) satisfy the system of equations $2x - y = -20$ and $y = -2x$?

Yes, substituting $x = -5$: $y = -2(-5) = 10$, which matches the point (-5, 10), confirming it is a solution.

Is the point (-8, 16) a solution to the system $2x - y = -20$ and $y = -2x$?

Substitute $x = -8$: $y = -2(-8) = 16$, which matches the point (-8, 16), so yes, it is a solution.

Are there any points that are solutions to the system other than the given points?

No, the solution is unique at $x = -5$, $y = 10$, which is the only point satisfying both equations simultaneously.

What does it mean if the system has no solution in the context of the substitution method?

It means that the equations represent parallel lines with no intersection point, so substitution leads to a contradiction.

Can the substitution method be used to solve any system of equations

involving linear equations?

Yes, especially when one equation is already solved for one variable, making substitution straightforward.

How do you determine if the system has a solution, no solution, or infinitely many solutions?

By solving the system; if substitution leads to a true statement, there is a solution; if it leads to a contradiction, no solution; if both equations are the same, infinitely many solutions.

What is the significance of the points (-3, 6), (-5, 10), and (-8, 16) in solving the system?

All these points satisfy the equations when substituted, confirming they are solutions to the system.

Why does the system have a solution at (-5, 10) but not at other points like (-3, 6) or (-8, 16)?

Because substituting x = -5 yields y = 10, which exactly satisfies both equations, whereas the other points are also solutions; all are valid solutions, indicating multiple solutions exist.

Additional Resources

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Introduction

Mathematics often presents us with systems of equations that require strategic approaches to find solutions. One such approach is the substitution method, a technique that simplifies the process of solving simultaneous equations by expressing one variable in terms of the other and then substituting it back into the second equation. In this article, we will explore the problem titled "QUESTION 4"—which involves solving a system of equations using the substitution method, analyzing specific points, and determining whether the given points are solutions or if the system has no solution. The problem states:

- The equations:
\(2x - y = -20 \)
\(y = -2x \)

- The points to verify:
\((-3, 6)\), \((-5, 10)\), \((-8, 16)\)

- The question of whether the system has no solution.

This article aims to unpack the solution method step by step, provide detailed explanations, and clarify the reasoning behind each step for readers who seek a comprehensive understanding of solving systems of equations with substitution.

Understanding the System of Equations

Before diving into the solution process, it's essential to understand what the system of equations represents and what it means for a point to be a solution.

The Equations

1. Equation 1: $2x - y = -20$
2. Equation 2: $y = -2x$

Equation 2 is already solved for y. It expresses y explicitly in terms of x, which simplifies the substitution process.

The Points

The points to verify are:

- $(-3, 6)$
- $(-5, 10)$
- $(-8, 16)$

In coordinate geometry, a point (x, y) is a solution to the system if, when substituted into both equations, the equations are satisfied (i.e., both sides are equal).

Step 1: Applying the Substitution Method

The substitution method involves taking one of the equations and solving for one variable, then substituting that into the other equation.

Given:
$y = -2x$

This is convenient because y is already isolated.

Next steps:

- Substitute $y = -2x$ into Equation 1.

Step 2: Substituting into the First Equation

Equation 1:
$$2x - y = -20$$

Substitute $y = -2x$:
$$2x - (-2x) = -20$$

Simplify:
$$2x + 2x = -20$$

Combine like terms:
$$4x = -20$$

Solve for x:
$$x = \frac{-20}{4} = -5$$

Having found $x = -5$, find y using Equation 2:
$$y = -2x = -2 \times (-5) = 10$$

Result:
The solution to the system is $(x, y) = (-5, 10)$.

Step 3: Verifying the Given Points

Now, check whether the provided points satisfy both equations.

Point 1: $(-3, 6)$

- Substitute into Equation 1:
$2(-3) - 6 = -6 - 6 = -12 \neq -20$
Not satisfied.

- Substitute into Equation 2:
$y = -2x$
$6 = -2 \times (-3) = 6$
Satisfied.

Since the point does not satisfy the first equation, $(-3, 6)$ is not a solution.

Point 2: $(-5, 10)$

- Substitute into Equation 1:
$2(-5) - 10 = -10 - 10 = -20$
Satisfied.

- Substitute into Equation 2:
$y = -2x$
$10 = -2 \times (-5) = 10$
Satisfied.

$(-5, 10)$ satisfies both equations, confirming it is a solution.

Point 3: $(-8, 16)$

- Substitute into Equation 1:
$2(-8) - 16 = -16 - 16 = -32 \neq -20$
Not satisfied.

- Substitute into Equation 2:
$16 = -2 \times (-8) = 16$
Satisfied.

Since the point does not satisfy the first equation, $(-8, 16)$ is not a solution.

Step 4: Interpreting the Results

From the substitution method, we determined that:

- The unique solution to the system is $(-5, 10)$.
- Of the three points given, only $(-5, 10)$ satisfies both equations.
- The other two points are not solutions to the system.

Step 5: Does the System Have No Solution?

The original problem mentions "No Solution" as a possibility. To clarify:

- The equations are consistent (they intersect at exactly one point, \((-5, 10)\)).
- The other points do not satisfy both equations, so they are not solutions.
- Since there is an actual solution, the system does not have no solution.

Conclusion:
The system has exactly one solution, and it is the point \((-5, 10)\). The mention of "No Solution" in the problem may serve as a distractor or to test understanding. Based on the calculations, the system is consistent with one solution.

Summary of Key Points

- The substitution method is a straightforward approach when one of the equations is already solved for a variable.
- Substituting \(y = -2x \) into the other equation yielded \(x = -5 \), leading to \(y=10 \).
- The only point among the given options that satisfies both equations is \((-5, 10)\).
- The system is consistent and has a single solution, so the "No Solution" statement does not apply here.

Additional Insights

Why Use the Substitution Method?

- It simplifies solving systems where one variable is already isolated.
- It reduces the problem to a single variable, making calculations easier.
- It's particularly effective with linear equations, as in this case.

When to Be Cautious

- If substituting leads to contradictions (e.g., \(0 = c \) where \(c \) is not zero), the system has no solution.
- If substitutions lead to identities (e.g., \(0 = 0 \)), the system has many solutions (dependent equations).

Final Remarks

Solving systems of equations is a fundamental skill in algebra, and the substitution method remains a reliable tool when applied correctly. By carefully substituting and verifying points, students can confidently analyze the solutions and determine the nature of the system—whether it has a unique solution, infinitely many, or none at all. In this particular problem, the clear solution at \((-5, 10)\) exemplifies the effectiveness of substitution and reinforces the importance of verification with given points.

End of Article

[Question 4 Solve By Using The Substitution Method 2x Y 20 Y]

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