Solve The System Using Substitution. Show Work. X=y6 Y=63x

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Understanding the System of Equations

When tackling systems of equations, one common and effective method is substitution. This approach involves solving one of the equations for one variable and then substituting this expression into the other equation, simplifying the problem into a single-variable equation. The system provided is:

- $X = y6$
- $Y = 63X$

Before diving into solving, it's essential to understand the structure and relationships between these equations.

Analyzing the Given Equations

Let's carefully interpret the equations:

1. Equation 1: $X = y6$

- This appears to be a typo or formatting issue, but based on context, it's likely intended as:

$$X = y \times 6$$

- Or simply:

$$X = 6y$$

2. Equation 2: $Y = 63X$

- This indicates the relationship between Y and X.

Note: The variables X and Y are capitalized, and the first equation involves lowercase y. To proceed consistently, we'll assume:

- y is a variable.
- X and Y are other variables.

Clarification of variables:

- The first equation relates X and y: $X = 6 y$.
- The second relates Y and X: $Y = 63 X$.

Step-by-Step Solution Using Substitution

Let's outline the steps for solving this system:

Step 1: Express one variable in terms of another

From the first equation:

$$
X = 6 y
$$

We can express y in terms of X:

$$
y = \frac{X}{6}
$$

Step 2: Substitute into the second equation

The second equation is:

$$
Y = 63 X
$$

Since Y is related to X, and y is related to X, the problem likely aims to find the values of X, Y, and y that satisfy both equations.

Step 3: Find consistent solutions

Given that the equations involve three variables, but only two equations are provided, the system is underdetermined unless additional constraints are present. However, the goal might be to express all variables in terms of one another.

Expressing Variables in Terms of Each Other

Using the relations:

$$
X = 6 y \quad \Rightarrow \quad y = \frac{X}{6}
$$

$$
Y = 63 X
$$

Thus, the solutions are:

- $y = \dfrac{X}{6}$
- $Y = 63 X$

How to interpret the solution?

Since X is a free parameter, we can choose any value for X, and then find corresponding y and Y. For example:

X	$y = \frac{X}{6}$	$Y = 63 X$
1	$\frac{1}{6}$	63
2	$\frac{2}{6} = \frac{1}{3}$	126
3	$\frac{3}{6} = \frac{1}{2}$	189

In essence, the solutions form a line in the three-dimensional space of (X, y, Y).

Graphical Representation of the Solution

Visualizing the solutions can provide insight:

- The relation $y = \frac{X}{6}$ indicates a straight line passing through the origin with a slope of $\frac{1}{6}$ in the (X, y) plane.
- The relation $Y = 63 X$ indicates a line with a steep slope in the (X, Y) plane.

Plotting these relationships:

- For any chosen X, the point (X, y, Y) is determined.
- The set of all solutions forms a line where y and Y are directly proportional to X.

Special Cases and Additional Constraints

If the system was part of a real-world problem, additional constraints might limit the values of X, y, or Y. For example:

- Non-negativity constraints: $X, y, Y \geq 0$.
- Specific values for one variable.

Without further constraints, the solution set remains a parametric line.

Summary of the Solution Process

Here's a concise summary of solving the given system:

1. Identify the equations and variables: Recognize $X = 6 y$ and $Y = 63 X$.
2. Express one variable in terms of another: $y = \frac{X}{6}$.
3. Use substitution: Since Y depends on X, and y depends on X, express all variables in terms of X.
4. Parameterize the solution: Choose X as a free parameter and compute corresponding y and Y.
5. Interpret the solution: The solutions form a line in the three-dimensional space.

Practical Applications of Solving Using Substitution

Understanding how to solve systems of equations via substitution is fundamental in various fields:

- Algebra and Pre-Calculus: For solving linear systems.
- Economics: To find equilibrium points.
- Physics: To determine relationships between variables.
- Engineering: For analyzing systems with multiple interdependent components.

Tips for Solving Systems Using Substitution Effectively

- Always verify the equations are written correctly.
- Choose the easiest equation to solve for a variable.
- Substitute carefully to avoid errors.
- Simplify expressions after substitution.

- Check the solutions back in the original equations.

Conclusion

Solving the system \(X = 6 y \) and \(Y = 63 X \) using substitution involves expressing one variable in terms of another and substituting into the remaining equations. This method simplifies the problem into a single-variable solution, providing a parametric line of solutions. Whether used in academic exercises or real-world applications, mastering substitution is essential for effectively solving systems of equations.

Meta description: Learn how to solve the system of equations \(X = 6 y \) and \(Y = 63 X \) using substitution with step-by-step instructions, graphs, and practical tips. Perfect for algebra students and enthusiasts.

Frequently Asked Questions

How do you solve the system of equations using substitution when given X = y6 and Y = 63x?

First, substitute X = y6 into the second equation Y = 63x. Since X = y6, then y = X/6. Replace y in the second equation with (X/6), so Y = 63x. To solve, express everything in terms of one variable and substitute back to find the solution.

What is the first step to solve the system where X = y6 and Y = 63x using substitution?

The first step is to express y in terms of X from the first equation: y = X/6. Then, substitute this expression into the second equation to solve for the variables.

How do you find the values of x and y in the system X = y6 and Y = 63x?

Substitute y = X/6 into Y = 63x. Since Y = 63x, and from the first equation X = y6, replace y with X/6 to relate X and x, then solve for the variables accordingly.

Can you provide a step-by-step solution for the system X = y6 and Y = 63x?

Yes. First, from X = y6, express y = X/6. Next, substitute y into the second equation: Y = 63x. Since Y is also given as a variable, express y in terms of x and substitute back to find the values of x and y.

Then, solve for each variable step by step.

What are common mistakes to avoid when solving this system using substitution?

Common mistakes include mixing up variables, forgetting to substitute correctly, or not simplifying equations properly. Always double-check your substitution and ensure all variables are expressed consistently before solving.

How do you verify your solution after solving the system X = y6 and Y = 63x?

Substitute the found values of x and y back into the original equations to check if both equations are satisfied. If both hold true, the solution is correct.

What real-world scenarios could be modeled by the system X = y6 and Y = 63x?

Such a system could model scenarios where one variable depends on a power of another (e.g., y raised to a power), and the other relates linearly to x, such as in physics for volume and surface area calculations or in economics for related quantities.

Additional Resources

Solve The System Using Substitution. Show Work. X = y6, Y = 63x

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Introduction

In the realm of algebra, systems of equations are fundamental tools used to find the values of variables that satisfy multiple conditions simultaneously. Among various methods available, the substitution method stands out for its straightforward approach, especially when one of the equations is already solved for a variable or can easily be manipulated to do so. This article delves into solving a particular system of equations using substitution, with a focus on the given system:

$$
\begin{cases}
x = y^6 \\
y = 63x
\end{cases}
$$

Through a comprehensive exploration, we will demonstrate each step, show detailed work, and analyze the solutions obtained, providing insights into the process and its mathematical implications.

Understanding the System

Before jumping into the solution, it's crucial to understand the structure and nature of the given system:

- The first equation, $x = y^6$, expresses x explicitly in terms of y.
- The second equation, $y = 63x$, expresses y explicitly in terms of x.

The symmetry and explicit forms suggest that substitution is an efficient method because one variable can be directly replaced in the other equation, reducing the system to a single-variable equation.

Step 1: Rearranging for Substitution

Given the system:

$$
\begin{cases}
x = y^6 \\
y = 63x
\end{cases}
$$

We notice that the second equation provides y in terms of x. To use substitution, we can substitute this expression into the first equation:

$$
x = (y)^6
$$

But since $y = 63x$, substitute:

$$
x = (63x)^6
$$

This substitution transforms the system into a single equation involving only x.

Step 2: Developing the Single-Variable Equation

Substituting $y = 63x$ into the first equation yields:

$$
x = (63x)^6
$$

Expanding the right-hand side:

\[
x = 63^6 \times x^6
\]

This simplifies to:

\[
x = 63^6 \times x^6
\]

Our goal is to find all real solutions \(x\) satisfying this equation.

Step 3: Solving the Resulting Equation

The equation:

\[
x = 63^6 \times x^6
\]

can be rewritten as:

\[
x - 63^6 \times x^6 = 0
\]

Factor out \(x\):

\[
x \left(1 - 63^6 \times x^5 \right) = 0
\]

Set each factor equal to zero:

- Factor 1:

\[
x = 0
\]

- Factor 2:

\[
1 - 63^6 \times x^5 = 0
\]

which simplifies to:

\[

$$
63^6 \times x^5 = 1
$$

and further:

$$
x^5 = \frac{1}{63^6}
$$

Step 4: Finding the Roots

Solution 1:

$$
x = 0
$$

Substitute into $y = 63x$:

$$
y = 63 \times 0 = 0
$$

Thus, one solution is:

$$
\boxed{(x, y) = (0, 0)}
$$

Solution 2:

From:

$$
x^5 = \frac{1}{63^6}
$$

Taking the fifth root:

$$
x = \left(\frac{1}{63^6} \right)^{1/5}
$$

which simplifies to:

$$
x = \frac{1}{63^{6/5}}
$$

Recall that:

$$
x = \frac{1}{63^{6/5}}
$$

Now, find y:

$$
y = 63x = 63 \times \frac{1}{63^{6/5}} = 63^{1} \times 63^{-6/5} = 63^{1 - 6/5} = 63^{\frac{5}{5} - \frac{6}{5}} = 63^{-\frac{1}{5}}
$$

Expressed as a root:

$$
y = \frac{1}{63^{1/5}}
$$

Hence, the second solution pair is:

$$
\boxed{\left(x, y \right) = \left(\frac{1}{63^{6/5}}, \frac{1}{63^{1/5}} \right)}
$$

Summary of Solutions

The system yields two real solutions:

1. The trivial solution:

$$
(x, y) = (0, 0)
$$

2. The non-trivial solution:

$$
\left(x, y \right) = \left(\frac{1}{63^{6/5}}, \frac{1}{63^{1/5}} \right)
$$

Deep Dive: Analyzing the Nature of the Solutions

The Trivial Solution

- Interpretation: Both variables are zero, satisfying the system trivially.
- Mathematical relevance: Often, trivial solutions serve as a baseline or boundary condition in

systems, especially in algebraic contexts.

The Non-Trivial Solution

- Expression analysis: The solution involves fractional exponents, indicating roots of the constant base 63.
- Approximate numerical values:

Since $63^{1/5}$ is the fifth root of 63, approximate calculations are:

$$
63^{1/5} \approx e^{\frac{1}{5} \ln 63} \approx e^{\frac{1}{5} \times 4.143} \approx e^{0.829} \approx 2.291
$$

Therefore,

$$
y \approx \frac{1}{2.291} \approx 0.436
$$

And,

$$
63^{6/5} = 63^{1 + 1/5} = 63 \times 63^{1/5} \approx 63 \times 2.291 \approx 144.33
$$

So,

$$
x \approx \frac{1}{144.33} \approx 0.00692
$$

- Implication: The non-trivial solution involves small positive values, indicating a particular relationship between x and y governed by the constants.

Graphical Interpretation

Plotting the two equations:

- $x = y^6$ is a curve symmetric about the x-axis, with $x \geq 0$, since even powers are non-negative.
- $y = 63x$ is a straight line passing through the origin with slope 63.

The intersection points correspond to solutions. The line intersects the curve at the origin and at the point where the substitution yields the non-zero solution, confirming our algebraic findings.

Reflection on the Methodology

The substitution method proved effective here because:

- The first equation explicitly expressed \(x\) in terms of \(y\).
- The second equation expressed \(y\) in terms of \(x\).

Using substitution simplified the system to a single-variable polynomial equation, allowing straightforward solutions.

Advantages of substitution:

- Simplifies systems with one variable isolated.
- Facilitates solving for real solutions, including trivial and non-trivial roots.

Limitations:

- Becomes cumbersome if the substitution leads to high-degree polynomials or complex expressions.
- May require careful handling of roots and extraneous solutions.

Final Remarks

The process of solving algebraic systems by substitution is foundational in mathematics, offering clarity and precision. In this specific system, the explicit expressions enabled direct substitution, leading to manageable algebraic equations and clear solutions. Understanding the nature of these solutions, including their approximate numerical values and graphical interpretations, deepens comprehension of algebraic relationships.

This exploration underscores the importance of methodical work, showing that even seemingly straightforward systems can unveil interesting mathematical structures and solutions when approached thoroughly.

References

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