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Web Resources

Systems of Linear Equations
www.mathwarehouse.com/algebra/linear_equation/systems-of-equation/

Interactive System of Linear Equations:

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Graph Paper Maker (free): www.mathworksheetsgo.com/paper/

Online Graphing Calculator: www.mathworksheetsgo.com/calculator/
I. Model Problems

The **substitution method** can be used to solve systems of linear equations. To use the substitution method, use one of the equations to solve for one variable in terms of the other. Substitute this expression into the other equation and solve the resulting equation. Substitute the value into one of the original equations to find the value of the other variable.

**Example 1** Solve the system by substitution:

\[
\begin{align*}
x + y &= 10 \\
y &= 2x + 1
\end{align*}
\]

Notice that the second equation gives the value of \(y\) in terms of \(x\), so if \(y\) can be substituted into the first equation.

\[
\begin{align*}
x + (2x + 1) &= 10 \\
3x + 1 &= 10 \\
3x &= 9 \\
x &= 3 \\
3 + y &= 10 \\
y &= 7
\end{align*}
\]

The solution is \(x = 3, y = 7\), or \((3, 7)\).

Sometimes you need to multiply one of the equations by a constant before you can add the equations together.

**Example 2** Solve the system by substitution:

\[
\begin{align*}
2x - y &= 2 \\
3x + 2y &= 38
\end{align*}
\]

To solve this system, solve the first equation for \(y\) in terms of \(x\), then substitute into the second equation.
2x = y + 2  
Add y to each side of the first equation.

y = 2x – 2  
Subtract 2 from each side of the first equation.

3x + 2(2x – 2) = 38  
Substitute \( y = 2x – 2 \) into the second equation.

7x – 4 = 38  
Simplify.

7x = 42  
Add 4 to each side.

x = 6  
Divide each side by 7.

y = 2(6) – 2  
Substitute \( x = 6 \) into the second equation to solve for \( y \).

y = 10  
Simplify.

The solution is \( x = 6, y = 10, \text{ or } (6, 10) \).
II. Practice

Solve each system of linear equations. Use the elimination method.

1. \[
\begin{align*}
y &= 4x + 3 \\
y &= x
\end{align*}
\]

2. \[
\begin{align*}
y &= -2x + 10 \\
y &= x + 1
\end{align*}
\]

3. \[
\begin{align*}
3x + 5y &= 10 \\
y &= x + 2
\end{align*}
\]

4. \[
\begin{align*}
-2x + y &= 6 \\
y &= -4x - 12
\end{align*}
\]

5. \[
\begin{align*}
y &= -\frac{1}{4}x + 5 \\
y &= x + 2
\end{align*}
\]

6. \[
\begin{align*}
3x - 6y &= -3 \\
-\frac{1}{3}x + 8 &= y
\end{align*}
\]

7. \[
\begin{align*}
-\frac{2}{3}x + 3y &= -34 \\
y &= -5x + 40
\end{align*}
\]

8. \[
\begin{align*}
3x + 4y &= 11 \\
y &= 2x
\end{align*}
\]

9. \[
\begin{align*}
-3x + 5y &= 10 \\
2x + \frac{1}{2}y &= 24
\end{align*}
\]

10. \[
\begin{align*}
y &= x + 1 \\
y &= -4x + 10
\end{align*}
\]

11. \[
\begin{align*}
-2x + \frac{1}{3}y &= 7 \\
6x - \frac{1}{3}y &= -9
\end{align*}
\]

12. \[
\begin{align*}
-4x + 8y &= 12 \\
y &= -12x + 64
\end{align*}
\]

13. \[
\begin{align*}
4x - \frac{1}{3}y &= -8 \\
y &= 4x + 16
\end{align*}
\]

14. \[
\begin{align*}
y &= -3x + 5 \\
y &= -x - 11
\end{align*}
\]

15. \[
\begin{align*}
y &= \frac{1}{2}x + 14 \\
2x - 2y &= -36
\end{align*}
\]

16. \[
\begin{align*}
y &= 4x - 19 \\
\frac{2}{3}x + 4y &= 24
\end{align*}
\]
17. \begin{align*}
  x - 8y &= -14 \\
  2x + \frac{1}{3}y &= 21
\end{align*}

18. \begin{align*}
  y &= \frac{2}{3}x + 4 \\
  y &= 5x - 35
\end{align*}

III. Challenge Problems

19. Use substitution to calculate the values of \(x, y\) and \(z\):
   \begin{align*}
     2x + 3y - z &= 14 \\
     x &= y - 1 \\
     z &= 3y + 2
   \end{align*}

20. Use substitution to calculate the values of \(x, y\) and \(z\):
   \begin{align*}
     3x - 7y + 5z &= 38 \\
     4x + 3y - 9z &= 34 \\
     -5x - 2y + 4z &= -56
   \end{align*}

21. Use substitution to calculate the values of \(x, y\) and \(z\):
   \begin{align*}
     4x - 5y + 10z &= 170 \\
     -2y + 7z &= 90 \\
     3z &= 30
   \end{align*}

22. A theater sold 160 children’s tickets and 90 adult tickets. If the theater made $1,600 from the sales of the tickets, what were the prices of each ticket?

23. Anna has 62 nickels and dimes. If the total value of her coins equals $4.45, how many nickels and dimes does she have?

24. Three times one number minus another number equals 34. If the sum of the numbers is 22, what are the two numbers?
25. Correct the Error.

Question: Solve \( \begin{align*}
2x + 3y &= 35 \\
2x - y &= 15
\end{align*} \) 

Solution:

Solve the second equation for \( y \) in terms of \( x \):
\[ y = 2x - 15 \]

Substitute \( y = 2x - 15 \) into the first equation:
\[ 2x + 3(2x - 15) = 35 \]

Simplify:
\[ 2x + 6x + 45 = 35 \Rightarrow 8x = -10 \text{ or } x = -10/8 \]

Substitute \( x = -10/8 \) to find \( y = 2(-10/8) - 15 = -35/2 \)

What is the error? Explain how to solve the problem.
IV. Answer Key

1. (-1, -1)
2. (3, 4)
3. (0, 2)
4. (-3, 0)
5. (4, 2)
6. (9, 5)
7. (6, -10)
8. (1, 2)
9. (10, 8)
10. (9/5, 14/5)
11. (-1, 15)
12. (5, 4)
13. (-1, 12)
14. (8, -19)
15. (-8, 10)
16. (6, 5)
17. (10, 3)
18. (9, 10)
19. $x = 8, y = 9, z = 29$
20. $x = -10, y = 1, z = 7$
21. $x = 5, y = -10, z = 10$
22. children’s tickets are $5.50 each; adult tickets are $8 each.
23. 35 nickels and 27 dimes
24. the first number is 14, the second number is 8
25. The student did not distribute correctly. The correct answer is (10, 5).