

5.2

Solving Systems of Linear Equations by Substitution

Activity 5.2

Essential Question How can you use substitution to solve a system of linear equations?

Answer:

Either (1) Solve for x first. Re-write one of the equations (“1st” equation) so that it is solving for x . Replace x in the 2nd equation with your just-found expression for x and then solve the resulting equation for y . Replace the variable y (in either equation 1 or 2) with its new, numerical value and then solve the resulting equation for x . The solution of the system is the ordered pair (x,y) .

or (2) Solve for y first - Solve a 1st equation for y . Replace y in the 2nd equation with your just-found expression for y and then solve the resulting equation for x . Replace the variable x (in either equation) with its new, numerical value and then solve the resulting equation for y . The solution of the system is the ordered pair (x,y) .

EXAMPLE 1 Solving a System of Linear Equations by Substitution

Solve the system by substitution. $y = 2x - 4$ Equation 1
 $7x - 2y = 5$ Equation 2

Step 1: Equation 1 is already solved for y .

Step 2: Substitute $2x - 4$ for y in Equation 2.

$$\begin{aligned}
 7x - 2y &= 5 && \text{Equation 2} \\
 7x - 2(2x - 4) &= 5 && \text{Substitute } 2x - 4 \text{ for } y. \\
 7x - 4x + 8 &= 5 && \text{Distributive Property} \\
 3x + 8 &= 5 && \text{Combine like terms.} \\
 3x &= -3 && \text{Subtract 8 from each side.} \\
 x &= -1 && \text{Divide each side by 3.}
 \end{aligned}$$

Step 3: Substitute -1 for x in Equation 1 and solve for y .

$$\begin{aligned}
 y &= 2x - 4 && \text{Equation 1} \\
 &= 2(-1) - 4 && \text{Substitute } -1 \text{ for } x. \\
 &= -2 - 4 && \text{Multiply.} \\
 &= -6 && \text{Subtract.}
 \end{aligned}$$

∴ The solution is $(-1, -6)$.

Check

Equation 1

$$\begin{aligned}
 y &= 2x - 4 \\
 -6 &\stackrel{?}{=} 2(-1) - 4 \\
 -6 &= -6 \quad \checkmark
 \end{aligned}$$

Equation 2

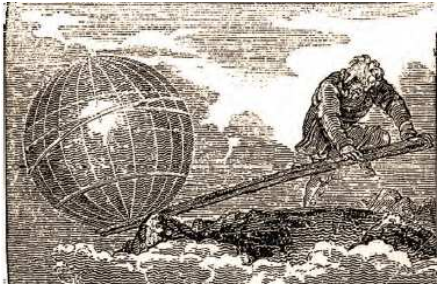
$$\begin{aligned}
 7x - 2y &= 5 \\
 7(-1) - 2(-6) &\stackrel{?}{=} 5 \\
 5 &= 5 \quad \checkmark
 \end{aligned}$$

Try:

$$\begin{aligned}
 2x &= y - 10 \\
 x + 7 &= y
 \end{aligned}$$

$$\begin{aligned}
 8x - \frac{1}{3}y &= 0 \\
 12x + 3 &= y
 \end{aligned}$$

1 ACTIVITY: Solving a Secret Code



Work with your group. Decode the quote by Archimedes.

How to decode: If answer (x,y) is equal to $(-4,12)$ and key says (E,N) then put letter E wherever -4 is and N wherever 12 shows up.

_____ ,

-8 -7 7 -5 -4 -5 -3 -2 -1 -3 0 -5 1 2 3 1 -3 4 5

_____ .

-3 4 5 -7 6 -7 -1 -1 -4 2 7 -5 1 8 -5 -5 -3 9 1 8

(A,C)

$$\begin{aligned} x + y &= -3 \\ x - y &= -3 \end{aligned}$$

(D,E)

$$\begin{aligned} x + y &= 0 \\ x - y &= 10 \end{aligned}$$

(G,H)

$$\begin{aligned} x + y &= 0 \\ x - y &= -16 \end{aligned}$$

(I,L)

$$\begin{aligned} x + 2y &= -9 \\ 2x - y &= -13 \end{aligned}$$

(M,N)

$$\begin{aligned} x + 2y &= 4 \\ 2x - y &= -12 \end{aligned}$$

(O,P)

$$\begin{aligned} x + 2y &= -2 \\ 2x - y &= 6 \end{aligned}$$

(R,S)

$$\begin{aligned} 2x + y &= 21 \\ x - y &= 6 \end{aligned}$$

(T,U)

$$\begin{aligned} 2x + y &= -7 \\ x - y &= 10 \end{aligned}$$

(V,W)

$$\begin{aligned} 2x + y &= 20 \\ x - y &= 1 \end{aligned}$$