→ looking for an ordered pair (x, y)

7.2 Solve Linear Systems by Substitution

Goal • Solve systems of linear equations by substitution.

SOLVING A LINEAR SYSTEM USING THE SUBSTITUTION METHOD

Get x or y alone

Step 1 Solve one of the equations for one of its variables. (either x or y) When possible, solve for a variable that has a coefficient of 1 or -1. ← avoid fractions
(# in front of x/y)

Step 2 Substitute the expression from Step 1 into the other equation and solve for the other variable. Will have one coordinate at end.

Step 3 Substitute the value (#) from Step 2 into the revised equation from Step 1 and solve. Gives other coordinate.

Step 4 Check the ordered pair in both original equations.

Example 1 - ***Use the substitution method***

Solve the linear system: $x = -2y + 2$ **Equation 1**

$3x + y = 16$ **Equation 2**

1. Use $-2y+2$ for x. Equation 1 is already solved for x.

2. Substitute $-2y+2$ for x in Equation 2 and solve for y.

$3x + y = 16$	Write Equation 2.
$3(-2y+2) + y = 16$	Substitute $-2y+2$ for x.
$-6y + 6 + y = 16$	Distributive property
$-5y + 6 = 16$	Simplify. Combine like terms
$-6 \quad -6$	
$\frac{-5y}{-5} = \frac{10}{-5}$	Subtract 6 from each side.
$y = -2$	Divide each side by -5.

(?, -2)

3. Substitute -2 for y in the original Equation 1 to find the value of x.

$x = -2y + 2 = -2(-2) + 2 = 4 + 2 = 6$

The solution is $(6, -2)$.

Remember to check your solution in each of the original equations.

$x = -2y + 2$

$3x + y = 16$

Check.

$6 \stackrel{?}{=} -2(-2) + 2$

$6 \stackrel{?}{=} 4 + 2$

$6 = 6$ ✓

$3(6) + (-2) \stackrel{?}{=} 16$

$18 + -2 \stackrel{?}{=} 16$

$16 = 16$ ✓

Example 2 - *Use the substitution method*

Solve the linear system: $4x - 2y = 14$ **Equation 1**

$2x + y = -3$ **Equation 2**

Solution

① Solve equation 2 for y

$2x + y = -3$

$-2x \quad -2x$

$y = -2x - 3$

② $4x - 2(-2x - 3) = 14$

$4x + 4x + 6 = 14$

$8x + 6 = 14$

$-6 \quad -6$

$\frac{8x}{8} = \frac{8}{8}$

$x = 1$

③ $y = -2x - 3$

$y = -2(1) - 3$

$y = -2 - 3$

$y = -5$

$(1, -5)$

④ Check.

Must be in originals.

$4x - 2y = 14$

$4(1) - 2(-5) \stackrel{?}{=} 14$

$4 + 10 \stackrel{?}{=} 14$

$14 = 14$ ✓

$2x + y \stackrel{?}{=} -3$

$2(1) + (-5) \stackrel{?}{=} -3$

$2 + -5 = -3$

$-3 = -3$ ✓

Checkpoint **Solve the linear system using the substitution method.**

1. $5x - 4y = -1$
   $y = 6x + 5$

$5x - 4(6x+5) = -1$

$5x - 24x - 20 = -1$

$-19x - 20 = -1$

$+20 \quad +20$

$\frac{-19x}{-19} = \frac{19}{-19}$

$x = -1$

$y = 6(-1) + 5$

$y = -6 + 5$

$y = -1$

$(-1, -1)$

Check

$5(-1) - 4(-1) \stackrel{?}{=} -1$

$-5 + 4 \stackrel{?}{=} -1$

$-1 = -1$ ✓

$-1 \stackrel{?}{=} 6(-1) + 5$

$-1 \stackrel{?}{=} -6 + 5$

$-1 = -1$ ✓

2. $x + y = 5$
   $7x - 9y = 3$

$y = -x + 5$

$7x - 9(-x+5) = 3$

$7x + 9x - 45 = 3$

$16x - 45 = 3$

$+45 \quad +45$

$\frac{16x}{16} = \frac{48}{16}$

$x = 3$

$y = -3 + 5$

$y = 2$

$(3, 2)$

Check

$3 + 2 \stackrel{?}{=} 5$

$5 = 5$ ✓

$7(3) - 9(2) \stackrel{?}{=} 3$

$21 - 18 \stackrel{?}{=} 3$

$3 = 3$ ✓

Example 3 – Many businesses pay website hosting companies to store and maintain the computer files that make up their websites. Internet service providers also offer website hosting. The costs for website hosting offered by a website hosting company and an Internet service provider are shown in the table. Find the number of months after which the total cost for website hosting will be the same for both companies.

x - independent variable

y - dependent

	Company	Set-up fee (dollars)	Cost per month (dollars)
A	Internet service provider	10	21.95
B	Website hosting company	None	22.45

A: $y = 10 + 21.95x$

B: $y = 0 + 22.45x$

$y = 21.95x + 10$

$y = 22.45x$

$21.95x + 10 = 22.45x$

$-21.95x \quad -21.95x$

$\frac{10}{.5} = \frac{.5x}{.5}$

$20 = x$

$y = 22.45(20)$

$y = 449$

$(20, 449)$

Check:

$449 \stackrel{?}{=} 21.95(20) + 10$

$449 \stackrel{?}{=} 439 + 10$

$449 = 449$ ✓

$449 \stackrel{?}{=} 22.45(20)$

$449 = 449$ ✓

At 20 months the total for website hosting will be the same for both companies. ($449 is the cost)