

7.2: Solve Systems of Equations by Substitution

Goals: *Find the solution to a system of equations by substitution

*Use substitution to find a solution to real-world systems of equations

Steps to Substitution

1. Isolate one of the variables
2. Substitute into OTHER equation. Use parenthesis
3. Solve for variable and plug back into equation not used
4. Check!

Ex: $y = 3x + 2$
 $x + 2y = 11$

Since y is already isolated, you can plug $3x + 2$ in for y into second equation.

$$\begin{aligned}x + 2(3x + 2) &= 11 && \text{Solve for } x \text{ like normal} \\x + 6x + 4 &= 11 \\7x + 4 &= 11 \\7x &= 7 \\x &= 1 && \text{Now plug this into } y = 3x + 2 \text{ to get } y \\y &= 3(1) + 2 \\y &= 3 + 2 \\y &= 5\end{aligned}$$

Final answer: $(1, 5)$

Ex: $y + 2x = 5$
 $3x + y = 10$

$(5, -5)$

Ex: $3x + y = -7$
 $-2x + 4y = 0$

$(-2, -1)$

Things to Look For

*Coefficient of 1

*Divisibility by coefficients

Ex: $x - 2y = -6$
 $4x + 6y = 4$

Since x has a coefficient of 1, isolate x by adding $2y$ in the first equation. So:

$$\begin{aligned}x &= -6 + 2y \\ \text{Now, substitute } -6 + 2y \text{ in for } x \text{ into} \\ \text{second equation}\end{aligned}$$

$$\begin{aligned}4(-6 + 2y) + 6y &= 4 \\ -24 + 8y + 6y &= 4 \\ -24 + 14y &= 4 \\ 14y &= 28 \\ y &= 2\end{aligned}$$

$$\begin{aligned}\text{Plug into } x &= -6 + 2y \\ x &= -6 + 2(2) \\ x &= -6 + 4 \\ x &= -2\end{aligned}$$

Final Answer: $(-2, 2)$

Ex: $x - y = 3$
 $x + 2y = -6$

$(0, -3)$

Ex: $y = 2x - 3$
 $x + 3y = 5$

$(2, 1)$

Ex: $-5x - y = 12$
 $3x - 5y = 4$

$(-2, -2)$

Ex: $-\frac{1}{2}x + y = -1$
 $-2x + 8y = -7$

$(\frac{1}{2}, -\frac{3}{4})$

Ex: $2x + y = -6$
 $4x - y = -18$

$(-4, 2)$

Ex: 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 offered are shown in the table below. Find the number of months after which the total cost for website hosting will be the same for both companies.

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

$y = 10 + 21.95x$
 $y = 22.45x$
 $22.45x = 10 + 21.95x$
 $0.5x = 10$
 $x = 20$

x: A food cooperative is a business that usually offers special prices on locally grown food and produce. Some cooperatives are clubs and others are retail stores. The weekly costs for seasonal produce offered by a club-based and a store-based food cooperative are shown in the table. Find the number of weeks at which the total cost of weekly produce will be the same.

Type of Cooperative	Club fee (dollars)	Cost per week (dollars)
Club	\$20	\$15
Retail	None	\$17.50

$y = 20 + 15x$
 $y = 17.5x$

$20 + 15x = 17.5x$
 $20 = 2.5x$
 $x = 8$