

Unit 1 Day 1: Solving Systems Algebraically

A system of equations is two or more equations who have a common solution for their common variables

The two ways to solve systems algebraically are by Substitution or Elimination

There are 3 different possible solutions: ordered pair, no solution, or infinitely many

same line

↑ intersecting lines

↑ parallel lines

SUBSTITUTION

- 1) Isolate one of the variables.
- 2) Substitute the equivalent expression into the other equation, and solve.
- 3) Substitute the answer into either equation to find the other variable.
- 4) Write your answer as an ordered pair. (or infinitely many, or none)

*Substitution is nice when there is an x or a y with a coefficient of 1 (or -1).

↳ false statement
 $8=7$
 $5=2$

Ex. 1) Solve by substitution:

$$\begin{aligned} 2x + y &= 3 \\ -3x - 7y &= 1 \end{aligned}$$

$$y = 3 - 2x$$

$$-3x - 7(3 - 2x) = 1 \quad y = 3 - 2(2)$$

$$-3x - 21 + 14x = 1 \quad y = 3 - 4$$

$$\begin{aligned} 11x - 21 &= 1 \\ 11x &= 22 \quad \boxed{x=2} \end{aligned}$$

$$\boxed{y=-1}$$

Solution (2, -1)

Ex. 2) Solve by substitution

$$\begin{aligned} x &= y + 2 \\ 3x - 3y &= 6 \end{aligned}$$

$$3(y+2) - 3y = 6$$

$$3y + 6 - 3y = 6$$

$$6 = 6 \quad \text{Hmm?}$$

infinitely many

Ex. 3) Solve by substitution:

$$\begin{aligned} 3x - y &= 5 \\ 2x + 5y &= -8 \end{aligned}$$

$$3x - y = 5$$

$$-y = \frac{5-3x}{-1}$$

$$y = -5 + 3x$$

$$17x = 17$$

$$x = 1$$

$$y = -5 + 3(1)$$

$$y = -2$$

Solution (1, -2)

You Try: Solve by substitution

$$\begin{aligned} 3x + y &= 4 \\ 6x + 2y &= 7 \end{aligned}$$

$$y = 4 - 3x$$

$$6x + 2(4 - 3x) = 7$$

$$6x + 8 - 6x = 7$$

$$8 \neq 7$$

NO SOLUTION

ELIMINATION

- 1) Make sure the equations are lined up with common variables and constants.
- 2) (If needed) Multiply an entire equation so that x or y has the same coefficient with opposite signs.
- 3) Add straight down and solve.
- 4) Substitute in the answer to either equation and solve for the other variable.
- 5) Write answer as a coordinate point (or infinitely many, or none)

Ex 1) Solve by elimination

$$\begin{array}{r} 11x + 2y = 17 \\ + 3x - 2y = -3 \\ \hline 14x = 14 \\ x = 1 \end{array}$$

Solution (1, 3)

$$\begin{array}{r} 3(1) - 2y = -3 \\ 3 - 2y = -3 \\ -3 \quad -3 \\ \hline -2y = -6 \\ y = 3 \end{array}$$

Ex 2) Solve by elimination

$$\begin{array}{r} 2x - 3y = 9 \\ + 3y + 4x = 3 \\ \hline -3y + 2x = 9 \\ 6x = 12 \\ x = 2 \end{array}$$

Solution (2, -5/3)

$$\begin{array}{r} 3y + 4(2) = 3 \\ 3y + 8 = 3 \\ 3y = -5 \\ y = -5/3 \end{array}$$

Ex 3) Solve by elimination

$$\begin{array}{r} 3x + 2y = 10 \\ 2(4x - y = 6) \\ 8x - 2y = 12 \end{array}$$

$$\begin{array}{r} 3x + 2y = 10 \\ + 8x - 2y = 12 \\ \hline 11x = 22 \quad x = 2 \end{array}$$

YOU TRY: Solve the following systems using the method of your choice.

1) $x = -2y + 1$
 $x = y - 5$
 $-2y + 1 = y - 5$
 Solution (-3, 2)

2) $2x + 4y = -6$
 $x - 3y = 7$

~~(1, -2)~~
 Solution (1, -2)

$$\begin{array}{r} 3(2) + 2y = 10 \\ 6 + 2y = 10 \\ 2y = 4 \\ y = 2 \end{array}$$

Solution (2, 2)

3) $3x + y = 10$
 $y = -3x + 4$

~~(-2, -2)~~

No solution
 same slope!

4) $5x - 3y = -4$
 $x + y = -4$

Solution (-2, -2)