

Solving Systems of Linear Equations

Grade 8 math · Lesson · Standards: 8.EE.C.8a, 8.EE.C.8b, 8.EE.C.8c

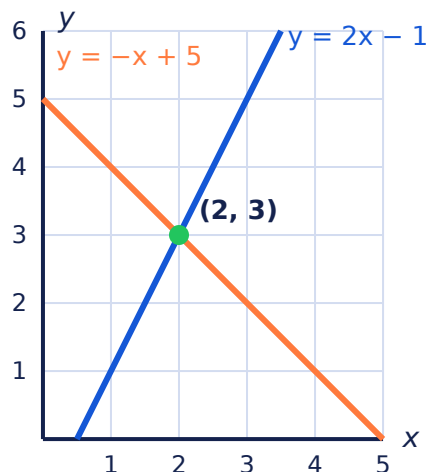
Quick answer: The solution of a system of two linear equations is the ordered pair that satisfies both, which is the point where their graphs cross. You can find it by graphing, by substitution, or by elimination. Parallel lines give no solution, and identical lines give infinitely many.

Standards: 8.EE.C.8a, 8.EE.C.8b, 8.EE.C.8c · **Level:** Grade 8

What is the solution of a system of linear equations?

System of equations

A system is two or more equations with the same variables. A **solution** is an ordered pair that makes every equation true. On a graph, it is the point where the lines intersect.



The lines cross at (2, 3), so (2, 3) is the solution of both equations.

How do you solve by substitution?

Method: substitution

1. Solve one equation for a variable.
2. Substitute that expression into the other equation.
3. Solve for the remaining variable.
4. Substitute back to find the second variable, then check in both equations.

Example

$$y = 3x - 4$$
$$2x + y = 16$$

Replace y : $2x + 3x - 4 = 16$, so $5x = 20$ and $x = 4$. Then $y = 3(4) - 4 = 8$. Solution: **(4, 8)**.

How do you solve by elimination?

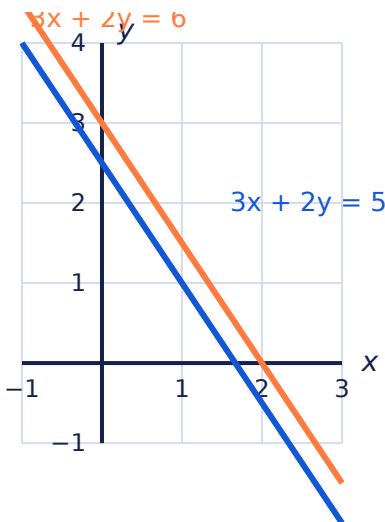
Add or subtract the equations so one variable cancels. When no variable cancels, first multiply one or both equations by a number.

$2x + y = 11$		add: the y terms cancel then $y = 11 - 2(4) = 3$
$x - y = 1$		
$3x = 12 \rightarrow x = 4$		

Adding the equations cancels y , leaving $3x = 12$.

How can you tell there is no solution or infinitely many?

Compare slopes and intercepts. Different slopes give one solution. The same slope with different intercepts gives parallel lines and no solution. The same slope and intercept gives one line and infinitely many solutions.



Same slope, different intercepts: parallel lines, so no solution.

Lines	Graph	Solutions
Different slopes	Cross once	One
Same slope, different intercepts	Parallel	None
Same slope, same intercept	Same line	Infinitely many

Common mistake

Finding x and stopping. A solution to a system is a pair, so always find y too and check the pair in both equations.

Mathbot's tip

Beep! If one equation already says $y = \text{something}$, use substitution. If both are in the form $Ax + By = C$, try elimination.

Key points to remember

- A solution is an ordered pair (x, y) that makes both equations true.
- Graphically, it is the intersection point of the two lines.
- Substitution: solve one equation for a variable and replace it in the other.
- Elimination: add or subtract equations so one variable cancels.
- Same slope, different intercept: no solution; same line: infinitely many.

Solving Systems of Linear Equations: frequently asked questions

What does the solution of a system mean on a graph?

It is the point where the two lines cross. Its coordinates satisfy both equations at once, so the pair (x, y) works in each equation.

When should you use substitution instead of elimination?

Use substitution when one equation already has a variable by itself, such as $y = 2x + 3$. Use elimination when both equations are written as $Ax + By = C$.

How can a system have no solution?

If both lines have the same slope but different y -intercepts they are parallel and never meet. Algebraically you reach a false statement such as $0 = 4$.

What does infinitely many solutions mean?

The two equations describe the same line, so every point on it solves both. Algebraically you reach a true statement such as $0 = 0$.

How do you check a solution to a system?

Substitute both coordinates into both original equations. The pair is a solution only if each equation becomes a true statement.