ALGEBRA / 01 UNDERSTAND

Systems of equations

An illustrated lesson ▪ Theory, reasoning and worked examples

Two conditions, one shared answer

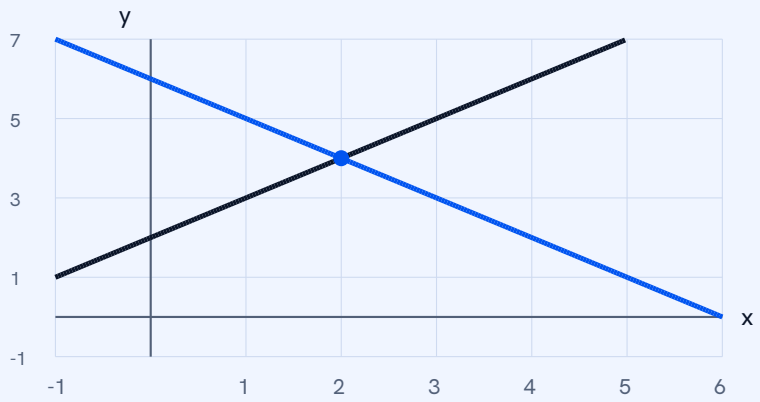
A system asks for values that make every equation true at the same time. Each linear equation in two variables describes a line. Their shared point, if there is one, is the solution. A pair that works in only one equation does not solve the system, even if the arithmetic for that equation is perfect.

The graph explains the possibilities

Two nonparallel lines meet once, giving one solution. Distinct parallel lines never meet, giving no solution. Two equations that describe the same line have infinitely many shared points. These are geometric descriptions of what substitution and elimination reveal algebraically.

Choose a method from the structure

Substitution is efficient when a variable is already isolated or has coefficient 1. Elimination is efficient when coefficients match or are easy to make opposites. Graphing can reveal the structure, but exact algebra avoids relying on a visual estimate when the intersection has fractional coordinates.



Two conditions

Blue: y = 6 - x

Navy: y = x + 2

Intersection: (2, 4)

Both equations hold.

Illustrative teaching diagram. Values and examples are explained in the lesson.

THE ESSENTIAL IDEA

A solution must satisfy both equations at the same time.

ALGEBRA / 02 BUILD THE METHOD

From idea to method

Substitution keeps an equivalent statement

If $y = 2x + 1$ and $x + y = 10$, replace y in the second equation with the entire expression $2x + 1$. This gives $x + (2x + 1) = 10$. Parentheses protect the expression when the substituted variable has a coefficient or a negative sign.

Eliminate one variable

Adding or subtracting whole equations can cancel a variable. If necessary, multiply every term of one equation by the same number first. For $2x + 3y = 12$ and $4x - 3y = 6$, addition removes y directly and gives $6x = 18$.

Read a cancelled system

After elimination, $0 = 0$ means the equations are dependent, provided both were valid equations. A contradiction such as $0 = 5$ means the lines are parallel and distinct. Do not divide by a coefficient that has become zero to force a numerical answer.

WORKED EXAMPLE / ELIMINATION WITH A FINAL EXPRESSION

If $2x + 3y = 12$ and $4x - 3y = 6$, find $x + y$.

01 Set up the reasoning

Add the equations: $6x = 18$, so $x = 3$.

02 Apply the relationship

Substitute into the first equation: $6 + 3y = 12$, giving $y = 2$.

03 Interpret and check

The requested value is $x + y = 5$. Check the second equation: $12 - 6 = 6$.

Keep these distinctions handy

One intersection	Different slopes give one shared ordered pair.
No intersection	Equal slopes and unequal intercepts: parallel lines.
Same line	Equivalent equations give infinitely many solutions.

ALGEBRA / 03 CONNECT & REMEMBER

See the deeper pattern

Sometimes the target is already in the system

If 3x + 3y = 24, then x + y = 8 without solving for x and y individually. A second equation might be unnecessary for that particular target. Look at the requested expression before choosing a method; equivalent combinations of equations can expose it immediately.

ONE MORE WORKED APPLICATION

If x + y = 24 and x - y = 6, what is x?

1. Add the equations: 2x = 30.

2. Divide by 2 to obtain 15.

3. Then y = 9; both original equations hold.

Answer: 15

Mistakes to recognize

- Multiply the constant as well as both variable terms when scaling an equation.
- Subtracting an equation reverses every sign in that equation.
- Report an ordered pair only if the question asks for the full solution.

A quick understanding check

What does a solution look like on the graph?

Explanation: A point lying on both lines simultaneously.

MORE PRACTICE IN YOUR DASHBOARD

Open prepvora.com/app/ and use the SAT question bank. Work on Algebra, then look for systems of equations questions. Solve independently before reviewing the explanation. Use this guide for the theory; use the dashboard for a longer practice session.

Open your dashboard → | Explore the resource library →

Original Prepvora explanations and examples. Scope: this topic, not the entire SAT syllabus. 2026-10-01 ▪ theory-v2