



Solving Systems of Linear Equations by Substitution (page 1)

When solving by graphing, you estimate the solution and then check that it works. **Substitution** is an algebraic way that we can use to find the exact solution for a system of linear equations. When both equations are written in slope-intercept form, you can set the equations equal to each other since both are equal to y . To use substitution (both equations in slope-intercept form):

- 1) If necessary, rewrite both equations in slope-intercept form.
- 2) Substitute y in one equation with the expression from the other equation. In other words, set the two x equations equal to each other.
- 3) Solve for x .
- 4) Replace x in one of the equations with the value found in Step 3 and solve for y .
- 5) Substitute the values for both variables into both equations to show they are correct.

Example: Solve the system algebraically using the substitution method. $\begin{cases} y = x - 3 \\ y = 2x \end{cases}$

Solution: Step 1) Both equations are written in slope-intercept form.

Step 2) Substitute $2x$ for y in the first equation.

Step 3) Solve for x .

Step 4) Since $x = -3$, then $y = 2x$

$$y = 2(-3)$$

$$y = -6 \quad \text{Solution is } (-3, -6)$$

$$y = x - 3$$



$$2x = x - 3$$

$$-x = -3$$

$$x = -3$$

Step 5) Check:

$$\begin{array}{ll} y = x - 3 & y = 2x \\ (-6) = (-3) - 3 & (-6) = 2(-3) \\ -6 = -6 \quad \checkmark & -6 = -6 \quad \checkmark \end{array}$$

Example: Solve the system algebraically using the substitution method. $\begin{cases} y = 2x + 3 \\ y = 6x - 5 \end{cases}$

Solution: 1) Both equations are in slope-intercept form.

2) Substitute $6x - 5$ for y in the first equation.

3) Solve for x .

4) Since $x = 2$, then $y = 2x + 3$

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

$$y = 7 \quad \text{Solution: } (2, 7)$$

$$y = 2x + 3$$



$$6x - 5 = 2x + 3$$

$$-2x = -2x$$

$$4x - 5 = 3$$

$$+5 = +5$$

$$4x = 8$$

$$\frac{4x}{4} = \frac{8}{4}$$

$$x = 2$$

5) Check: $y = 2x + 3$ $y = 6x - 5$

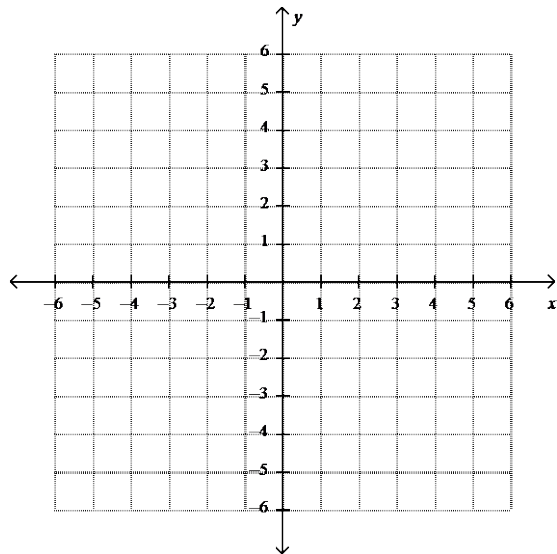
$$7 = 2(2) + 3 \quad 7 = 6(2) - 5$$

$$7 = 7 \quad \checkmark \quad 7 = 7 \quad \checkmark$$

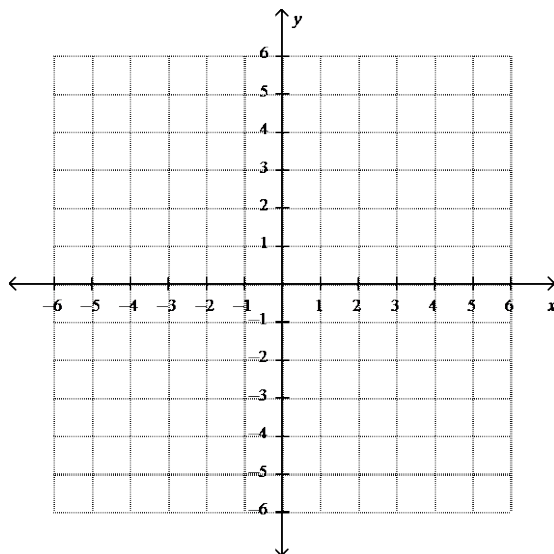
Solving Systems of Linear Equations by Substitution (page 2)

Solve the systems by graphing. Check by solving using substitution (see below).

1.
$$\begin{cases} y = -x + 3 \\ y = x + 5 \end{cases}$$



2.
$$\begin{cases} y = 2x + 6 \\ y = x + 3 \end{cases}$$



Solve the same systems (as above) by substitution.

1.
$$\begin{cases} y = -x + 3 \\ y = x + 5 \end{cases}$$

2.
$$\begin{cases} y = 2x + 6 \\ y = x + 3 \end{cases}$$

Solve the systems by substitution.

3.
$$\begin{cases} y = 3x - 30 \\ y = -x + 14 \end{cases}$$

4.
$$\begin{cases} y = 7x + 4 \\ y = 9x - 6 \end{cases}$$