



Simultaneous Equations (Substitution)

Substitution Method

Simultaneous equations involve more than one linear equation. When these two or more functions intersect, we can solve for the points of intersection. One method to achieve this is through substitution.

EXAMPLE: Solve $y = 3x - 5$ and $2x + y = 10$

STEP ONE: Label the equations

- (1) $y = 3x - 5$
(2) $2x + y = 10$

STEP TWO: Combine equations.

Substitute (1) into (2), or whichever is simpler, to isolate one variable.

$$\begin{aligned}2x + y &= 10 \\2x + (3x - 5) &= 10 \\5x - 5 &= 10 \\5x &= 10 + 5 \\5x &= 15 \\x &= 15/5 \\x &= 3\end{aligned}$$

STEP THREE: Solve for the second variable. From Step 2, substitute $x = 3$ into either (1) or (2) – use the simpler one.

Equation (1):

$$\begin{aligned}y &= 3x - 5 \\y &= 3(3) - 5 \\y &= 9 - 5 \\y &= 4\end{aligned}$$

The solution is (3, 4).

This is the intersection point between the two equations.

Verify by graphing.

Instructions: Solve the simultaneous equations below using substitution.

1

$$\begin{aligned}4x - 3y - 2 &= 0 \\y &= 4x + 2\end{aligned}$$



2

$$2x - 5y = 12$$
$$x = 6 - y$$

3

$$4x - 3y = 7$$
$$y = 4x - 3$$

4

$$3x - 8y = 12$$
$$2y = 4x - 3$$

5

$$4y + 11 = 3x - 5$$
$$y = 5x - 21$$



6

$$\frac{3x}{4} = -2y$$

$$y + 13 = -2x$$

7

$$\frac{x - 9y}{3} = 0$$

$$-56 = -3x - y$$

8

$$4y = 20$$

$$3x - 6y = 3$$

9

$$-y = \left(\frac{x}{2}\right) + 10$$

$$3x = 15 - y$$



10

$$2x - 5y = -5$$

$$\frac{y + 73}{-7} = x$$

11

$$5x = 2y + 10$$

$$2y = 6x - 15$$

12

$$\frac{y}{2} = 2x + 9$$

$$-6 - 3y = 18x$$

13

$$3(3x - 10) = -2y$$

$$-8y = x + 55$$



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1

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



2

$$2 - 3y = 2x$$

$$\frac{y}{4} = x + 6$$

3

$$3y - 7 = x$$

$$y - 17 = 4x$$

4

$$\frac{5y - x}{2} = 3y$$

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

5

$$y = -3\left(x - \frac{1}{2}\right)$$

$$5(2x - 1) = 2y$$



6

$$\frac{y - 3x}{3} = 11$$

$$12 - 2x = 5y$$

7

$$\frac{y - 4}{4} = 2x$$

$$2y = 3x - 5$$

8

$$y + 8 = 4x$$

$$2x = 21 - 8y$$

9

$$\frac{y}{3} = 3 - 2x$$

$$3(15x - 4y) = 9$$



10

$$\begin{aligned}5x + 8y &= -5 \\ 2y &= 18x + 95\end{aligned}$$

11

$$\begin{aligned}\frac{x}{3} + \frac{3y}{4} &= 8 \\ y - 5x &= -22\end{aligned}$$

12

$$\begin{aligned}\frac{7 - 3y}{4x} &= 5 \\ 4y &= x - 46\end{aligned}$$

13

$$\begin{aligned}\frac{2(2y - 3x)}{15} &= -4 \\ 2y + x &= 14\end{aligned}$$