

Solving linear simultaneous equations by substitution

A LEVEL LINKS

Scheme of work: Scheme of work: 1c. Equations – quadratic/linear simultaneous

Key points

- Two equations are simultaneous when they are both true at the same time.
- Solving simultaneous linear equations in two unknowns involves finding the value of each unknown which works for both equations.
- Make sure that the coefficient of one of the unknowns is the same in both equations.
- Eliminate this equal unknown by either subtracting or adding the two equations.
- The substitution method is the method most commonly used for A level. This is because it is the method used to solve linear and quadratic simultaneous equations.

Example 1 Solve the simultaneous equations $y = 2x + 1$ and $5x + 3y = 14$

$5x + 3(2x + 1) = 14$	1 Substitute $2x + 1$ for y into the second equation.
$5x + 6x + 3 = 14$	2 Expand the brackets and simplify.
$11x + 3 = 14$	3 Work out the value of x .
$11x = 11$	
So $x = 1$	
Using $y = 2x + 1$	4 To find the value of y , substitute $x = 1$ into one of the original equations.
$y = 2 \times 1 + 1$	
So $y = 3$	
Check:	5 Substitute the values of x and y into both equations to check your answers.
equation 1: $3 = 2 \times 1 + 1$ YES	
equation 2: $5 \times 1 + 3 \times 3 = 14$ YES	

Example 2 Solve $2x - y = 16$ and $4x + 3y = -3$ simultaneously.

$y = 2x - 16$ $4x + 3(2x - 16) = -3$ $4x + 6x - 48 = -3$ $10x - 48 = -3$ $10x = 45$ $\text{So } x = 4\frac{1}{2}$ <p>Using $y = 2x - 16$</p> $y = 2 \times 4\frac{1}{2} - 16$ $\text{So } y = -7$ <p>Check:</p> <p>equation 1: $2 \times 4\frac{1}{2} - (-7) = 16$ YES</p> <p>equation 2: $4 \times 4\frac{1}{2} + 3 \times (-7) = -3$ YES</p>	<ol style="list-style-type: none"> 1 Rearrange the first equation. 2 Substitute $2x - 16$ for y into the second equation. 3 Expand the brackets and simplify. 4 Work out the value of x. 5 To find the value of y, substitute $x = 4\frac{1}{2}$ into one of the original equations. 6 Substitute the values of x and y into both equations to check your answers.
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Practice questions

Solve these simultaneous equations.

1 $y = x - 4$
 $2x + 5y = 43$

2 $y = 2x - 3$
 $5x - 3y = 11$

3 $2y = 4x + 5$
 $9x + 5y = 22$

4 $2x = y - 2$
 $8x - 5y = -11$

5 $3x + 4y = 8$
 $2x - y = -13$

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

7 $3x = y - 1$
 $2y - 2x = 3$

8 $3x + 2y + 1 = 0$
 $4y = 8 - x$

9 Solve the simultaneous equations $3x + 5y - 20 = 0$ and $2(x + y) = \frac{3(y - x)}{4}$.

Answers

1 $x = 9, y = 5$

2 $x = -2, y = -7$

3 $x = \frac{1}{2}, y = 3\frac{1}{2}$

4 $x = \frac{1}{2}, y = 3$

5 $x = -4, y = 5$

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

7 $x = \frac{1}{4}, y = 1\frac{3}{4}$

8 $x = -2, y = 2\frac{1}{2}$

9 $x = -2\frac{1}{2}, y = 5\frac{1}{2}$