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Class Notes

Solving Systems Using Substitution

You can solve a system of equations by *substituting* an equivalent expression for one variable.

Problem

Solve and check the following system:

$$x + 2y = 4$$

$$2x - y = 3$$

Solution

$$x + 2y = 4$$

$$x = 4 - 2y$$

$$2(4 - 2y) - y = 3$$

$$8 - 4y - y = 3$$

$$8 - 5y = 3$$

$$8 - 8 - 5y = 3 - 8$$

$$-5y = -5$$

$$y = 1$$

$$x + 2(1) = 4$$

$$x + 2 - 2 = 4 - 2$$

$$x = 2$$

The first equation is easiest to solve in terms of one variable.

Get x to one side by subtracting $2y$.

Substitute $4 - 2y$ for x in the second equation.

Distribute.

Simplify.

Subtract 8 from both sides.

Divide both sides by 5.

You have the solution for y . Solve for x .

Substitute in 1 for y in the first equation.

Subtract 2 from both sides.

The solution is $(2, 1)$.

Check Substitute your solution into either (or both) of the given linear equations.

$$x + 2y = 4$$

$$2 + 2(1) \stackrel{?}{=} 4$$

$$4 = 4 \checkmark$$

Substitute $(2, 1)$ into the first equation.

You check the second equation.

Exercises

Solve each system using substitution. Check your answer.

1. $x + y = 3$

$$2x - y = 0$$

2. $x - 3y = -14$

$$x - y = -2$$

3. $2x - 2y = 10$

$$x - y = 5$$

4. $4x + y = 8$

$$x + 2y = 5$$

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Class Notes (continued)

Solving Systems Using Substitution

Problem

Solve and check the following system:

$$\frac{x}{2} - 3y = 10$$

$$3x + 4y = -6$$

Solve

$$\frac{x}{2} - 3y = 10$$

$$\frac{x}{2} = 10 + 3y$$

$$x = 20 + 6y$$

$$3x + 4y = -6$$

$$3(20 + 6y) + 4y = -6$$

$$60 + 22y = -6$$

$$22y = -66, y = -3$$

$$\frac{x}{2} - 3(-3) = 10$$

$$\frac{x}{2} + 9 = 10$$

$$x = 2$$

First, isolate x in the first equation.

Add 3y to both sides and simplify.

Multiply by 2 on both sides.

Substitute $20 + 6y$ for x in second equation.

Simplify.

Subtract 60 from both sides.

Divide by 22 to solve for y.

Substitute 23 in the first equation.

Simplify.

Solve for x.

The solution is $(2, -3)$.

Check $3(2) + 4(-3) \stackrel{?}{=} 26$

$$-6 = -6 \checkmark$$

Now you check the first equation.

Exercises

Solve each system using substitution. Check your answer.

5. $-2x + y = 8$

$$3x + y = -2$$

6. $3x - 4y = 8$

$$2x + y = 9$$

7. $3x + 2y = 25$

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

8. $6x - 5y = 3$

$$x - 9y = 25$$