

Bellwork:

Solve:

$$1) \frac{2x}{5} + \frac{3}{2} = 1 \qquad 2) \frac{3x+1}{3} = \frac{-x+2}{4}$$

Solve the System by Substitution:

$$3) \begin{cases} x = 3y \\ 2x - y = 40 \end{cases} \qquad 4) \begin{cases} 3x + y = 8 \\ -x + 5y = 8 \end{cases}$$

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Homework Questions???

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Chapter 5.3(a) Solving Systems by Elimination

Solve systems of linear equation in two variables by elimination.

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What are the two methods of solving a system of linear equations we have learned?

Graphing      Substitution

Today we are going to learn the last method for solving a system:

Elimination (sometimes called combination or addition)

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Elimination is a method that combines the systems leaving one equation with one variable (the second variable is eliminated).

$$\begin{array}{r} \begin{cases} 3x + 2y = 7 \\ x - 2y = -11 \end{cases} \\ + \\ \hline 4x = -4 \\ x = -1 \end{array}$$

Remember to keep the equations balanced.

Since 2y and -2y have opposite coefficients; y can be eliminated by adding the two equations.

$$\begin{array}{r} (-1) - 2y = -11 \\ + \\ -2y = -10 \quad y = 5 \end{array} \qquad (-1, 5)$$

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**Solving Systems of Equations by Elimination**

**Step 1:** Write both equations in standard form (Ax + By = C)

**Step 2:** Eliminate one of the variables and solve.

**Step 3:** Substitute the value of step 2 into one of the original equations and solve.

**Step 4:** Write the answers as an ordered pair (x, y) and check your answer.

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Example 1: Solve by Elimination

$$\begin{cases} 3x - 4y = 10 \\ x + 4y = -2 \end{cases} \quad (2, -1)$$

Step 1: (Ax + By = C)

$$\begin{array}{r} 3x - 4y = 10 \\ + \quad x + 4y = -2 \\ \hline 4x = 8 \end{array} \quad x=2$$

Step 2: Eliminate

$$\begin{array}{r} 2 + 4y = -2 \\ -2 + 4y = -2 \\ \hline 4y = -4 \\ y = -1 \end{array}$$

Step 3: Substitute Value in Original

Step 4: (x, y) and check

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Example 2: Solve by Elimination

$$\begin{cases} 2x + y = -5 \\ 2x - 5y = 13 \end{cases} \quad (-1, -3)$$

Step 1: (Ax + By = C)

$$\begin{array}{r} 2x + y = -5 \\ -2x - y = 5 \\ \hline -6y = 18 \\ y = -3 \end{array}$$

Step 2: Eliminate Variable

Step 3: Substitute Value in Original

$$\begin{array}{r} 2x + (-3) = -5 \\ +3 \quad +3 \\ \hline 2x = -2 \\ x = -1 \end{array} \quad \begin{array}{r} 2x - 5(-3) = 13 \\ -15 \quad -15 \\ \hline 2x = -2 \\ x = -1 \end{array}$$

Step 4: (x, y) and check

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Example 3: Solve by Elimination

$$\begin{cases} x + 3y = 7 \\ x - 4y = 14 \end{cases} \quad (10, -1)$$

Step 1: (Ax + By = C)

$$\begin{array}{r} x + 3y = 7 \\ -1(x - 4y = 14) \\ \hline 7y = -7 \\ y = -1 \end{array} \quad \begin{array}{r} x + 3(-1) = 7 \\ x - 3 = 7 \\ +3 \quad +3 \\ \hline x = 10 \end{array}$$

Step 2: Eliminate Variable

Step 3: Substitute Value in Original

Step 4: (x, y) and check

$$\begin{array}{r} (10) + 3(-1) = 7 \\ 10 - 3 = 7 \\ \checkmark \end{array} \quad \begin{array}{r} (10) - 4(-1) = 14 \\ 10 + 4 = 14 \\ \checkmark \end{array}$$

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Example 4: Solve by Elimination

$$\begin{cases} 2x + y = 25 \\ 3y = 2x - 13 \end{cases} \quad (11, 3)$$

Step 1: (Ax + By = C)

$$\begin{array}{r} 2x + y = 25 \\ -2x + 3y = -13 \\ \hline 4y = 12 \\ y = 3 \end{array} \quad \begin{array}{r} 2x + 3 = 25 \\ -3 \quad -3 \\ \hline 2x = 22 \\ x = 11 \end{array}$$

Step 2: Eliminate Variable

Step 3: Substitute Value in Original

Step 4: (x, y) and check

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Example 5: Solve by Elimination

$$\begin{cases} x + 2y = 11 \\ -3x + y = -5 \end{cases} \quad (3, 4)$$

Step 1: (Ax + By = C)

$$\begin{array}{r} x + 2y = 11 \\ -3x + y = -5 \\ \hline 7y = 28 \\ y = 4 \end{array} \quad \begin{array}{r} x + 2(4) = 11 \\ x + 8 = 11 \\ -8 \quad -8 \\ \hline x = 3 \end{array}$$

Step 2: Eliminate Variable

Step 3: Substitute Value in Original

Step 4: (x, y) and check

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Example 6: Solve by Elimination

$$\begin{cases} -2x + y = 9 \\ 3x + 2y = 12 \end{cases} \quad (3, 4)$$

Step 1: (Ax + By = C)

$$\begin{array}{r} -2x + y = 9 \\ 4x - 2y = -18 \\ \hline 3x + 2y = 12 \end{array}$$

Step 2: Eliminate Variable

Step 3: Substitute Value in Original

Step 4: (x, y) and check

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What kind of coefficients are needed before you can eliminate a variable?

Opposites

-3 & 3  
-5 & 5

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Homework

P. 347-348 #1-6, 11-16, 22 (all)

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2)  $\begin{cases} x+y=12 \\ x-y=2 \end{cases}$   $\begin{matrix} 7+y=12 \\ -7 \end{matrix}$   $\begin{matrix} 7-5=2 \\ 2=2 \checkmark \end{matrix}$   
 $\frac{2x+0=14}{x=7}$  (7, 5)

4)  $\begin{cases} (x-10y=60)-1 \\ x+14y=12 \end{cases}$   $\begin{matrix} -x+10y=-60 \\ x+14y=12 \\ 0+24y=-48 \\ y=-2 \end{matrix}$   $\begin{matrix} x-10(-2)=60 \\ x+20=60 \\ x=40 \end{matrix}$   
 (40, -2)

6)  $\begin{cases} (-5x+7y=11)-1 \\ -5x+3y=19 \end{cases}$   $\begin{matrix} 5x-7y=-11 \\ -5x+3y=19 \\ 0-4y=8 \\ -4y=8 \\ y=-2 \end{matrix}$   $\begin{matrix} -5x+3(-2)=19 \\ -5x-6=19 \\ -5x=25 \\ x=-5 \end{matrix}$   
 (-5, -2)

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12)  $\begin{cases} -2x+y=-20 \\ 2x+y=48 \end{cases}$   $\begin{matrix} -2x+(14)=-20 \\ -14 \end{matrix}$   $\begin{matrix} -2x+14=-20 \\ -14 \end{matrix}$   $\begin{matrix} 2(7)+(14)=48 \\ 34+14=48 \\ 48=48 \checkmark \end{matrix}$   
 $\frac{0+2y=28}{y=14}$  (17, 14)

14)  $\begin{cases} (x-y=4)-1 \\ x-2y=10 \end{cases}$   $\begin{matrix} -x+y=-4 \\ x-2y=10 \\ 0-y=6 \\ -y=6 \\ y=-6 \end{matrix}$   $\begin{matrix} x-(-6)=4 \\ x+6=4 \\ x=-2 \end{matrix}$   
 (-2, -6)

16)  $\begin{cases} (3x-2y=-1)-1 \\ 3x-4y=9 \end{cases}$   $\begin{matrix} -3x+2y=1 \\ 3x-4y=9 \\ 0-2y=10 \\ -2y=10 \\ y=-5 \end{matrix}$   $\begin{matrix} 3x-2(-5)=-1 \\ 3x+10=-1 \\ -10-10 \end{matrix}$   
 $\frac{3x}{3} = \frac{-11}{3}$   $x = -\frac{11}{3}$   
 $3(-\frac{11}{3}) - 4(-5) = 9$   
 $-11 + 20 = 9$   
 $9 = 9 \checkmark$

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22)

A)  $\begin{cases} x+y=-3 \\ 3x+y=3 \end{cases}$   $\begin{matrix} x+y=-3 \\ -(3x+y=3) \\ -2x=0 \\ x=0 \end{matrix}$   $\begin{matrix} x+y=-3 \\ -3x-y=3 \\ -2x=-6 \\ -2 \quad -2 \\ x=3 \end{matrix}$

B)  $\begin{cases} x+y=3 \\ 3x+y=3 \end{cases}$   $\begin{matrix} x+y=3 \\ -(3x+y=3) \\ -2x=-6 \\ x=3 \end{matrix}$  The correct answer is B; you have to multiply everything by negative 1!

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