

7.5 Using Elimination to Solve a linear System

Concept # 47 Solve a system algebraically using substitution and/or elimination verify the solutions

Example #1: Solve the following system using the method of elimination.

$$\begin{array}{r} (-1) \quad 3x + 5y = 12 \quad (-1) \\ 7x + 5y = 8 \\ \hline -3x - 5y = -12 \\ + \quad 7x + 5y = 8 \\ \hline 4x + 0y = -4 \\ \hline \text{Solve for "x"} \quad \frac{4x}{4} = \frac{-4}{4} \\ x = -1 \end{array}$$

Find "y" by substituting $x = -1$ into either equation

$$\begin{array}{r} 7(-1) + 5y = 8 \\ -7 + 5y = 8 + 7 \\ 5y = 15 \\ \frac{5y}{5} = \frac{15}{5} \\ y = 3 \end{array}$$

$\{(-1, 3)\}$

Steps To Doing The Method of Elimination

1. Write the two equations so that one is on top of the other and they are both in the same order. *or subtract*
2. You will add the two equations and you want one of the variables to *add or subtract* combine to zero. To make this possible you need to have the same number with different signs in front of either both x terms or both y terms. To make this possible, you may multiply each term in an equation all by the same number, or divide each term in an equation all by the same number.
3. Add the terms in the top equation to the terms in the bottom equation. Take what you get and solve for the variable (get it by itself).
4. Substitute your final answer to step 3 into one of the original equations to find the answer to the other variable.

Example #2: Solve the following system using the method of elimination.

$$\begin{array}{l} 4x + 3y = 9 \\ 2x - 7y = 13 \end{array}$$

$$\begin{array}{r} \textcircled{1} \quad 4x + 3y = 9 \\ (-2) \quad 2x - 7y = 13 \quad (-2) \\ \hline \textcircled{1} \quad 4x + 3y = 9 \\ + \quad -4x + 14y = -26 \\ \hline 0x + 17y = -17 \\ \frac{17y}{17} = \frac{-17}{17} \\ \boxed{y = -1} \end{array}$$

$$\begin{array}{r} 2x - 7(-1) = 13 \\ 2x + 7 = 13 + 7 \\ 2x = 6 \\ \frac{2x}{2} = \frac{6}{2} \\ \boxed{x = 3} \end{array}$$

$\{(3, -1)\}$

Example #3: Solve the following system using the method of elimination.

$$\begin{aligned} (-4) \quad 3x + 7y &= 3 \quad (-4) \\ (3) \quad 4x - 5y &= 42 \quad (3) \end{aligned}$$

$$\begin{aligned} -12x - 28y &= -12 \\ + 12x - 15y &= 126 \\ \hline 0x - 43y &= 114 \\ -43 & \quad -43 \\ \hline y &= -\frac{114}{43} \end{aligned}$$

$$\left\{ \left(\frac{309}{43}, -\frac{114}{43} \right) \right\}$$

$$3x + 7\left(\frac{-114}{43}\right) = 3$$

$$3x + \left(-\frac{798}{43}\right) = 3 + \frac{798}{43}$$

$$3x = \frac{3 \cdot 43}{1 \cdot 43} + \frac{798}{43}$$

$$3x = \frac{129}{43} + \frac{798}{43}$$

$$\frac{3x}{3} = \frac{927}{43} \div 3$$

$$x = \frac{309}{43}$$

Example #4: Solve the following system using the method of elimination or substitution.

$$\begin{aligned} (2) \quad \frac{x}{2} + \frac{y}{2} &= 7 \quad (2) \\ (1) \quad (-2)x + (-2)y &= 14 \quad (-2) \end{aligned}$$

$$(2) \quad 3x + 2y = 48$$

$$\begin{aligned} (1) \quad -2x + (-2y) &= -28 \\ + 3x + 2y &= 48 \\ \hline x + 0y &= 20 \end{aligned}$$

$$x = 20$$

$$\begin{aligned} 3(20) + 2y &= 48 \\ 60 - 60 + 2y &= 48 - 60 \\ 2y &= -12 \\ \frac{2y}{2} &= \frac{-12}{2} \\ y &= -6 \end{aligned}$$

$$\left\{ (20, -6) \right\}$$

Example #5: You decide to buy two different kinds of candy at the convenience store. In one bag, you put some ju-jubes and in the other licorice. The ju-jubes cost \$5.50 per kilogram and the licorice \$3.20 per kilogram. If a total of 1.5kg of candy was bought for \$6.18, how many kilograms of each did you buy?

Example #6: You won \$8000 in a lottery. You must invest part in an account earning %5 interest and part in an account earning 8% interest (both compounded annually). In one year the amount invested in the 8% account earns \$90 more than the amount earned in the 5% account. How much did you originally invest in each account?

(Solve by method of choice)

$$\textcircled{1} x + y = 8000$$

$$\textcircled{2} 0.08x = 0.05y + 90$$

$$\textcircled{1} y = -x + 8000$$

$$\textcircled{2} 0.08x = 0.05(-x + 8000) + 90$$

$$0.08x = -0.05x + 400 + 90$$

$$0.08x = -0.05x + 490$$

$$0.13x = 490$$

$$0.13 \quad 0.13$$

$$x = 3769.23$$

$$y = 4230.77$$

I originally invested \$3769.23 into the 8% account and \$4230.77 into the 5% account.

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AT LEAST TWO OF: 8, 9, 10, 11, 13, 14, 16,

AT LEAST ONE OF: 22, 24