

Solve by substitution or elimination

$$\begin{array}{r} \text{Ex: } 3(2x + 4y = 8) \quad 6x + 12y = 24 \\ \quad 2(3x + 6y = 18) \quad -6x - 12y = -36 \\ \hline \quad \quad \quad \quad \quad \quad \quad \quad 24 - 36 \end{array}$$

No Soln

$$\begin{array}{r} \text{Ex: } x + 2y = 11 \\ \quad x - 2y = -1 \\ \hline \quad 2x = 10 \\ \quad x = 5 \end{array}$$

$$\begin{array}{r} 5 + 2y = 11 \\ 2y = 6 \\ y = 3 \end{array}$$

(5, 3)

$$\begin{array}{r} \text{Ex: } 4(5x + 3y = 9) \quad 20x + 12y = 36 \\ \quad 3(2x - 4y = 14) \quad 6x - 12y = 42 \\ \hline \quad \quad \quad \quad \quad \quad \quad \quad 26x = 78 \\ \quad \quad \quad \quad \quad \quad \quad \quad x = 3 \\ \quad \quad \quad \quad \quad \quad \quad \quad (3, -2) \end{array}$$

$$\begin{array}{r} \text{Ex: } 2x - y = 1 \\ \quad 4x - 2y = 2 \\ \hline \quad \quad \quad \quad \quad \quad \quad \quad 0 = 0 \end{array}$$

Infinite Many Soln

$$\begin{array}{r} \text{Ex: } 2x - 3y = -7 \\ \quad 3(3x + y = -5) \quad 9x + 3y = -15 \\ \hline \quad \quad \quad \quad \quad \quad \quad \quad 11x = -22 \\ \quad \quad \quad \quad \quad \quad \quad \quad x = -2 \\ \quad \quad \quad \quad \quad \quad \quad \quad (-2, 1) \end{array}$$

$$\begin{array}{r} \text{Ex: } 2(x - 2y = 3) \quad 2x - 4y = 6 \\ \quad -2x + 4y = 1 \\ \hline \quad \quad \quad \quad \quad \quad \quad \quad 0 \neq 7 \\ \quad \quad \quad \quad \quad \quad \quad \quad \text{No Soln} \end{array}$$

If both variables are eliminated and you get a true statement, then it is "infinite solutions"
 If both variables are eliminated and you get a false statement, then it is "no solution"

Solve each system of equations by using substitution. State the solution.

1. $y = 3x$
 $x + 21 = -2y$

$y = 3(-3)$
 $y = -9$

$x + 21 = -2(3x)$
 $x + 21 = -6x$
 $21 = -7x$
 $-3 = x$

$(-3, -9)$

2. $4a + 3b = -4$
 $5a + b = 17$

$4a + 3(-5a + 17) = -4$
 $4a - 15a + 51 = -4$
 $-11a = -55$
 $a = 5$

$b = -5a + 17$
 $b = -5(5) + 17$
 $b = -25 + 17$
 $b = -8$

$(5, -8)$

Solve each system of equations by using elimination. State the solution.

3. $a + b = 5$
 $2a - b = 4$

$3 + b = 5$
 $b = 2$

$3a = 9$
 $a = 3$

$(3, 2)$

4. $3x - 5y = -13$
 $4x - 2y = 0$

$6x - 10y = -26$
 $-20x + 10y = 0$

$-14x = -26$
 $x = \frac{26}{14} = \frac{13}{7}$

$(\frac{13}{7}, \frac{26}{7})$

Solve each system of equations by using any method. State the solution.

5. $2x - 3y = 4$
 $x + 5y = 2$

$2x - 3y = 4$
 $-2x - 10y = -4$

$x + 5(0) = 2$
 $x + 0 = 2$
 $x = 2$

$-13y = 0$
 $y = 0$

$(2, 0)$

6. $x - 2y = -1$
 $2x + 3y = -16$

$3x - 6y = -3$
 $4x + 6y = -32$

$-5 - 2y = -1$
 $-2y = 4$
 $y = -2$

$7x = -35$
 $x = -5$

$(-5, -2)$

7. The length of a rectangular garden is 3 meters greater than twice the width. The perimeter of her garden is 48 meters. What are the dimensions of the garden?

width = 7m
length = 17m

$2w + 3$

$w + w + 2w + 3 + 2w + 3 = 48$
 $6w + 6 = 48$
 $6w = 42$
 $w = 7$

$2(7) + 3$
 $14 + 3 = 17$

8. Pascal has 20 coins in his pocket. He has only nickels and dimes that total \$1.35. How many of each coin does he have?

13 x = nickels
7 y = dimes

$x + y = 20$
 $.05x + .10y = 1.35$

$-.05x - .05y = -1.00$
 $.05x + .10y = 1.35$

$.05y = .35$
 $y = 7$

$x + y = 20$
 $x + 7 = 20$
 $x = 13$

Using Systems of Linear Equations to Solve Word Problems

- 1) Use two different variables (x and y) to represent the different unknown quantities in the problem.
- 2) Translate two relationships in the problem into two equations (making it a system).
- 3) Use one of the three methods to solve the system.
- 4) Check your answer using the original word problem.

Examples:

- 1) The sum of two numbers is 36. Their difference is 24. Find the two numbers.

$$\begin{aligned} x+y &= 36 \\ x-y &= 24 \\ \hline 2x &= 60 \\ x &= 30 \\ x+y &= 36 \\ y &= 6 \end{aligned}$$

- 2) The owner of a men's clothing store bought six belts and eight hats for \$140. A week later, at the same prices, he bought nine belts and six hats for \$132. Find the price of a belt and the price of a hat.

b = belt, h = hat

$$\begin{aligned} 3(6b + 8h) &= 140 & 18b + 24h &= 140 & 410 \\ 3(9b + 6h) &= 132 & 27b + 18h &= 132 & -12h = -264 \\ \hline & & 17h &= 150 & \end{aligned}$$

$$\begin{aligned} 6b + 8(13) &= 140 \\ 6b + 104 &= 140 \\ 6b &= 36 \\ b &= 6 \end{aligned}$$

- 3) If 5 times the smaller of two numbers is subtracted from twice the larger, the result is 16. If the larger is increased by 3 times the smaller, the result is 63. Find the numbers.

10 x = smaller, 33 y = larger

$$\begin{aligned} 2y - 5x &= 16 \\ 2(33) - 5x &= 16 \\ -5x &= -50 \\ x &= 10 \end{aligned}$$

$$\begin{aligned} 3(2x - 5x) &= 16 \\ 3(-3x) &= 16 \\ -9x &= 16 \\ 3x &= -16/3 \end{aligned}$$

$$\begin{aligned} 5l + 1x &= 31 \\ 5(11) + x &= 31 \\ 55 + x &= 31 \\ x &= -24 \end{aligned}$$

- 4) You are an ecologist studying the population of two types of fish in a lake. Type A currently has 5,750 fish and are decreasing at a rate of 250 fish per year. Type B currently has 3,500 fish and are increasing at a rate of 500 fish per year. Predict how many years it will take for the two types to have an equal number of fish.

3400 is

$$\begin{aligned} 5750 - 250x &= 3500 + 500x \\ 2250 &= 750x \\ 3 &= x \end{aligned}$$

- 5) Nico and his brother Noah each have a savings account for college. In April, Nico's account had a balance of \$2,000 and he plans to deposit an additional \$50 per month. At the same time, Noah's account had a balance of \$1,600 and he plans to deposit \$100 per month. Predict when the brothers will have the same amount in their college accounts.

8 months

$$\begin{aligned} 2000 + 50x &= 1600 + 100x \\ 400 &= 50x \\ x &= 8 \end{aligned}$$

- 6) You are the webmaster for the school's science and math clubs. You are analyzing the number of times each site is visited each year. The science club currently has 400 daily visits with an average increase of 25 daily visits per month. The math club currently has 200 daily visits with an average increase of 50 daily visits per month. Find when the number of visits at the two sites will be the same.

8 months

$$\begin{aligned} 400 + 25x &= 200 + 50x \\ 200 &= 25x \\ 8 &= x \end{aligned}$$

- 7) You plan to take boxing lessons at a local gym. Non-members pay \$4 per class while members pay \$2 per class plus a \$10 membership fee. After how many classes will the cost be the same? Should you become a member? Why or why not?

x = # classes, 5

If you take more than 5 classes a month.

$$\begin{aligned} 4x &= 2x + 10 \\ 2x &= 10 \\ x &= 5 \end{aligned}$$

- 8) You are selling tickets for a high school play. Student tickets cost \$4 and general admission tickets cost \$6. You sell 525 tickets and collect \$2,876. How many of each type of ticket did you sell?

137 x = student, 388 = general admission

$$\begin{aligned} -4(x+y) &= -2100 \\ 4x + 6y &= 2876 \\ \hline 2y &= 776 \\ y &= 388 \end{aligned}$$

$$\begin{aligned} x+y &= 525 \\ x &= 137 \end{aligned}$$

- 9) In one day a museum collected \$1,590 from 321 people admitted to the museum. The price of each adult admission is \$6 and price of each child admission is \$4. Estimate how many adults and how many children were admitted that day.

153 x adult = \$6, 168 y child = \$4

$$\begin{aligned} -4(x+y) &= -1284 \\ 6x + 4y &= 1590 \\ \hline 2x &= 306 \\ x &= 153 \end{aligned}$$

$$\begin{aligned} x+y &= 321 \\ x &= 153 \\ y &= 168 \end{aligned}$$

- 10) A store is selling compact discs for \$10.50 and \$8.50. You buy 10 discs and spend a total of \$93. How many compact discs did you buy that cost \$10.50? How many did you buy that cost \$8.50?

4 x = 10.50, 6 y = 8.50

$$\begin{aligned} x+y &= 10 \\ 10.50x + 8.50y &= 93 \\ 10.50(10-y) + 8.50y &= 93 \\ 105 - 10.50y + 8.50y &= 93 \end{aligned}$$

$$\begin{aligned} 105 - 2y &= 93 \\ -2y &= -12 \\ y &= 6 \end{aligned}$$

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