

## Lesson 5 – Solving Systems of Linear Equations by Substitution

THE IDEA: John wants to sell his car in a newspaper ad. The ad only allows up to 95 characters including spaces. Here is John's ad:

**Vehicle** on sale! 2001 black Honda prelude in mint condition for \$12000. Call John at 604-512-3456.

John's ad has 98 characters including spaces. Therefore, we can *substitute* the word Vehicle for car.

How to solve linear equations algebraically with the substitution method?

1. Isolate one of the variables from one of the given equations.
2. Plug in the results from step 1 into the remaining equation.
3. Now simplify and solve for the remaining variable.
4. Use the results in step 3 to find the solution of the variable that was isolated. (Don't forget to write your final answer as an ordered pair).

Examples:

$$\begin{aligned} 2x + y &= 7 & y &= -2x + 7 \\ x - 3y &= 14 & & \\ x - 3(-2x + 7) &= 14 & 2x + y &= 7 \\ x + 6x - 21 &= 14 & 2(5) + y &= 7 \\ \underline{\phantom{x} + 21} & \phantom{= 14} & 10 + y &= 7 \\ \phantom{x} & \phantom{= 14} & \underline{-10} & \phantom{= 7} \\ \frac{7x}{7} & \phantom{= 14} & \phantom{10 +} & \underline{-10} \\ x &= 5 & & y = -3 \\ \text{Solution } & (5, -3) & & \end{aligned}$$

$$\begin{aligned} 3x + y &= 3 & y &= -3x + 3 \\ 7x - 2y &= 20 & & \\ 7x - 2(-3x + 3) &= 20 & & \\ 7x + 6x - 6 &= 20 & & \\ 13x - 6 &= 20 & & \\ \phantom{13x} - 6 & \phantom{= 20} & & + 6 \\ \frac{1}{13} & \phantom{= 20} & & \frac{26}{13} \\ x &= 2 & & \\ \text{Sol'n} & (2, -3) & & \\ 3(2) + y &= 3 & & \\ 6 + y &= 3 & & \\ \underline{-6} & \phantom{= 3} & & \underline{-6} \\ y &= -3 & & \end{aligned}$$

$$\begin{aligned} 4x + 5y &= 26 \\ 3x &= y - 9 & y &= 3x + 9 \\ 4x + 5(3x + 9) &= 26 & & \\ 4x + 15x + 45 &= 26 & & \\ \underline{-45} & \phantom{= 26} & & \underline{-45} \\ 19x &= -19 & & \\ \frac{19x}{19} & \phantom{= -19} & & \frac{-19}{19} \\ x &= -1 & & \\ 4(-1) + 5y &= 26 & & \\ -4 + 5y &= 26 & & \\ \underline{+4} & \phantom{= 26} & & \underline{+4} \\ 5y &= 30 & & \\ \frac{5y}{5} & \phantom{= 30} & & \frac{30}{5} \\ y &= 6 & & \\ \text{Sol'n } & (-1, 6) & & \end{aligned}$$

How can you check your answer to see if it is correct?  
Substitute values into both eqn's & check LS=RS

Assignment: Pg. 137

~~WS 9.1~~

Textbook pg 424 - 428 # 1-9, 11, 12, 15, 18  
Pg. 137 notes too.

### Section 9.1 Extra Practice

1. Solve the following systems of linear equations by substitution. Verify your answers.

a)  $4x + y = 1$   
 $x = 2y - 20$   $(-2, 9)$

b)  $x - 3y = 4$   
 $5x - 7y = 4$   $(-2, -2)$   
 $x = 3y + 4$   
 sub in!

c)  $2x + 3y = 20$   
 $6x - y = 20$   $(4, 4)$   
 $y = 6x - 20$   
 sub in

d)  $\frac{x}{2} + \frac{y}{3} = 6$   $(8, 6)$   
 $3x - 2y = 12$   
 $2y = 3x - 12$   
 $y = \frac{3}{2}x - 6$   
 $\frac{8}{2} + \frac{y}{3} = 6$   
 $4 + \frac{y}{3} = 6$   
 $-\frac{y}{3} = 2$   
 $y = 6$   
 $3x + 2y = 36$   
 $3x + 2(\frac{3}{2}x - 6) = 36$   
 $3x + 3x - 12 = 36$   
 $6x - 12 = 36$   
 $+12 +12$   
 $6x = 48$   
 $x = 8$   
 Solution  $(8, 6)$

2. Maria has a total of 20 nickels and quarters. She has four times as many nickels as quarters. How much money does Maria have?

$n + q = 20$   
 $4q = n$

let  $n = \#$  nickels  
 $q = \#$  of quarters

$4q + q = 20$   
 $5q = 20$   
 $q = 4$

There are 4 quarters  
 & 16 nickels

3. A number is 12 less than one third of another number. Their sum is 56. What are the numbers?

$n = \frac{1}{3}m - 12$   
 $n + m = 56$

let  $n$  be any #  
 $m$  be the other #.  
 so a total of \$1.80

$\frac{1}{3}m - 12 + \frac{3}{3}m = 56$   
 $\frac{4}{3}m = 68$   
 $m = 51$

$n + 51 = 56$   
 $-51 -51$   
 $n = 5$

The two numbers are 51 and 5.