

2 equations...
Substitution:
 • isolate a variable & subst. into other eqn.
 • solve for the variable... & the other variable

4-2
 Solving Systems of Equations by Substitution
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MODEL & DISCUSS

Rochelle is conducting an experiment on cells of Elodea, a kind of water plant. To induce plasmolysis at the correct rate, she needs to use an 8% saline solution but she has only the solutions shown on hand.



A. If Rochelle mixes the two solutions to get 1,000 mL of an 8% saline solution, which will she use more of? Explain.

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B. How can Rochelle determine the amount of each solution she needs to make the 8% saline solution?

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C. **Use Appropriate Tools** Are there any methods for solving this problem other than the one you used in part (b)? Explain. **MP.5**

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HABITS OF MIND

Look for Relationships Next, Rochelle wants to make 1,000 mL of a 7% saline solution. Would the amount of 10% solution in the 7% saline solution be more or less than the amount in the 8% saline solution? Explain. **MP.7**

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EXAMPLE 1

- isolate a variable & subst into other eqn.
- solve for the variable -- (undo ops)

PE
MD
AS

Try It! Solve Systems of Equations Using Substitution

1. Use substitution to solve each system of equations.

a. $x = y + 6$
 $x + y = 10$

isolate

$x = (2) + 6$
 $x = 8$

$(y+6) + y = 10$
 $2y + 6 = 10$
 $-6 \quad -6$
 $2y = 4$
 $\frac{2y}{2} = \frac{4}{2}$
 $y = 2$

$\rightarrow (8, 2)$

b. $y = 2x - 1$
 $2x + 3y = -7$

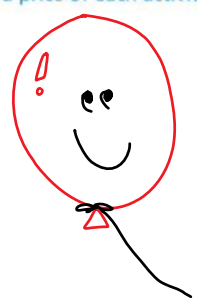
$2x + 3(2x - 1) = -7$
 $2x + 6x - 3 = -7$
 $8x - 3 = -7$
 $+3 \quad +3$
 $8x = -4$
 $\frac{8x}{8} = \frac{-4}{8}$
 $x = -\frac{1}{2}$

$y = 2(-\frac{1}{2}) - 1$
 $= -1 - 1$
 $y = -2$

$\therefore (-\frac{1}{2}, -2)$

EXAMPLE 2 Try It! Compare Graphing and Substitution Methods

2. On Saturday, the vacation resort offers a discount on water sports. To take a surfing lesson and go parasailing costs \$130. That day, 25 people take surfing lessons, and 30 people go parasailing. A total of \$3,650 is collected. What is the discounted price of each activity?



HABITS OF MIND

Generalize If you visit the vacation resort and find the cost of surfing lessons and parasailing by graphing the system of equations, what will you need to remember about the solution that you find? **MP.8**



EXAMPLE 3  **Try It!** Systems With Infinitely Many Solutions or No Solution

3. Solve each system of equations

a. $x + y = -4$
 $y = -x + 5$

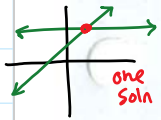
$x + (-x + 5) = -4$

$5 = -4$
 FALSE

 → **no solution**

b. $y = -2x + 5$
 $2x + y = 5$

$2x + (-2x + 5) = 5$
 $5 = 5$
 TRUE

 → **∞ solutions**


one soln



no soln

• False Statement


 ∞ soln

• True Statement

EXAMPLE 4  **Try It!** Model Using Systems of Equations

4. Funtime Amusement Park charges \$12.50 for admission and then \$0.75 per ride. River's Edge Park charges \$18.50 for admission and then \$0.50 per ride. For what number of rides is the cost the same at both parks?

HABITS OF MIND

Make Sense and Persevere Healthy Start gym charges \$32 for membership and then \$6 per cycling class. Fast Fitness charges \$29 for membership and then \$6 per cycling class. Does a number of cycling classes exist for which the cost is the same at both gyms?  **MP.1**

Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** How do you use substitution to solve a system of linear equations?

2. **Use Appropriate Tools** When is using a graph to solve a system of equations more useful than the substitution method? © MP.5

3. **Error Analysis** Simon solves a system of equations, in x and y , by substitution and gets an answer of $5 = 5$. He states that the solution to the system is all of the points (x, y) where x and y are real numbers. Describe Simon's error. © MP.3

4. **Use Structure** When solving a system of equations using substitution, how can you determine whether the system has one solution, no solution, or infinitely many solutions? © MP.7

Do You KNOW HOW?

Use substitution to solve each system of equations.

• Isolate a variable
 • subst into other eqn...
 • Solve for each variable

5. $y = 6 - x$
 $4x - 3y = -4$

$\rightarrow 4x - 3(6 - x) = -4$
 $\rightarrow 4x - 18 + 3x = -4$
 $7x - 18 = -4$
 $+18 \quad +18$
 $7x = 14$
 $\frac{7x}{7} = \frac{14}{7}$
 $x = 2$
 $y = 6 - (2)$
 $y = 4$... $\rightarrow (2, 4)$

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

$3(-y + 3) - 2y = -1$
 $-3y + 9 - 2y = -1$
 $-5y + 9 = -1$
 $-9 \quad -9$
 $-5y = -10$
 $\frac{-5y}{-5} = \frac{-10}{-5}$
 $y = 2$
 $x = -(2) + 3$
 $x = -2 + 3$
 $x = 1$ $\rightarrow (1, 2)$

7. $-3x - y = 7$
 $x + 2y = 6$

$x = 6 - 2y$
 $-3(6 - 2y) - y = 7$
 $-18 + 6y - y = 7$
 $-18 + 5y = 7$
 $+18 \quad +18$
 $5y = 25$
 $\frac{5y}{5} = \frac{25}{5}$
 $y = 5$
 $x = 6 - 2(5)$
 $= 6 - 10 = -4$ $\rightarrow (-4, 5)$

8. $6x - 3y = -6$
 $y = 2x + 2$

$6x - 3(2x + 2) = -6$
 $6x - 6x - 6 = -6$
 $-6 = -6$
 TRUE Statement $\rightarrow \infty$ solutions

9. A sports store sells a total of 70 soccer balls in one month, and collects a total of \$2,400. Write and solve a system of equations to determine how many of each type of soccer ball were sold.

Limited Edition soccer ball
\$65.00



Pro NSL soccer ball
\$15.00

