

Name: \_\_\_\_\_ Core: \_\_\_\_\_

### Solving Systems of Equations through Substitution

Directions: Solve each system using substitution. Write no solution or infinitely many solutions where applicable. Show all your work to receive credit.

1.  $y = x - 9$

$$2x + 5y = 4$$

2.  $4x + 2y = 0$

$$y = \frac{1}{2}x - 5$$

3.  $y = 2x - 4$

$$7x - 2y = 5$$

4.  $-4x + y = 3$

$$5x - 2y = -9$$

5.  $y = 4x - 2$

$$y = 4x + 1$$

6.  $y = x + 3$

$$y = 5x - 5$$

# 5.2 Puzzle Time

## Where Do High Jumpers Store Their Valuables?

Write the letter of each answer in the box containing the exercise number.

Solve the system of linear equations by substitution.

- |   |  |
|---|--|
| 1. $y = x$<br>$y = 2x - 1$                | 2. $y = -x$<br>$y = 3x - 4$                          |
| 3. $y = 5x - 6$<br>$y = 4x - 2$           | 4. $x + y = 7$<br>$7x + y = 1$                       |
| 5. $-8x + y = 9$<br>$5x - y = 3$          | 6. $x - y = 0$<br>$9x + y = 0$                       |
| 7. $x + y = 5$<br>$3x - y = 7$            | 8. $3x - 2y = 12$<br>$4x + 2y = 16$                  |
| 9. $\frac{1}{2}x + y = 2$<br>$-x + y = 2$ | 10. $\frac{1}{2}x + \frac{1}{4}y = 2$<br>$x + y = 1$ |
| 11. $6x - y = 24$<br>$6x + y = -12$       |  |

12. There are a total of 52 students on the soccer team and the field hockey team. The field hockey team has 12 more students than the soccer team. Write a system of linear equations that fits this situation. How many students are on the soccer team  $x$  and the field hockey team  $y$ ?

- Answers**

  - P. (20, 32)
  - V. (0, 0)
  - L. (7, -6)
  - I. (-1, 8)
  - T. (4, 0)
  - U. (4, 14)
  - A. (1, -18)
  - N. (1, -1)
  - E. (-4, -23)
  - O. (0, 2)
  - A. (3, 2)
  - L. (1, 1)

4	2		11		12	9	1	5		6	7	3	10	8
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# Problem Solving with Systems of Equations

1. Angelica solves the system 
$$\begin{cases} 3x - y = 0 \\ \frac{1}{4}x + \frac{3}{4}y = \frac{5}{2} \end{cases}$$

and finds the solution (1, 3). Use substitution to explain why Angelica's solution is correct.

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Angelo bought apples and bananas at the fruit stand. He bought 20 pieces of fruit and spent \$11.50. Apples cost \$0.50 and bananas cost \$0.75 each. Use this information for Exercises 2–5.

2. Write an equation to represent the number of pieces of fruit.

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3. Write an equation to represent the money spent on the fruit.

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4. Solve the system algebraically.

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5. How many apples and bananas did Angelo buy?

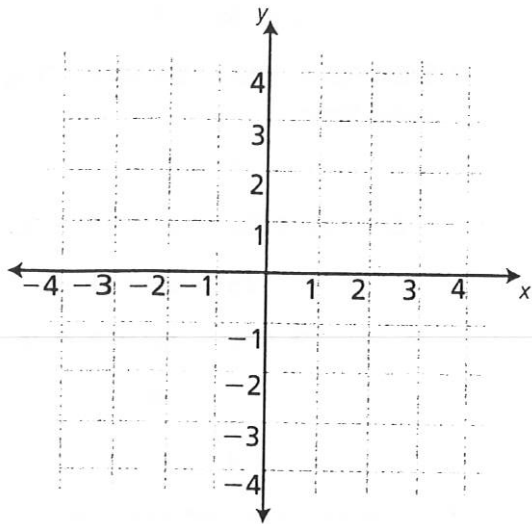
\_\_\_\_\_ apples; \_\_\_\_\_ bananas

## Graphing Systems of Equations

6 Graph the following system of equations.

$$y + \frac{3}{2}x - 3 = 0$$

$$y - x + 2 = 0$$



Which point is the solution of the system of equations?

- Ⓐ  $(-2, 0)$                       Ⓒ  $(4, 2)$   
 Ⓑ  $(2, 0)$                         Ⓓ  $(4, -3)$

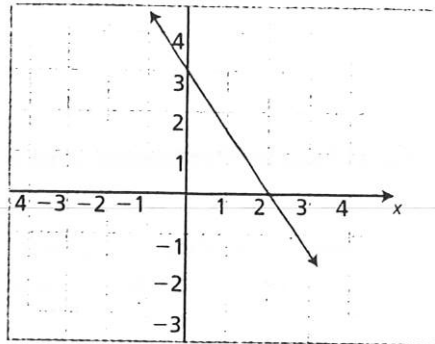
## Step-By-Step

Follow these steps to answer **example 6**.

- 1 Graph the equations on the same grid. First solve for  $y$ , then use the slope-intercept form to graph each equation.

$$y + \frac{3}{2}x - 3 = 0$$

$$y = -\frac{3}{2}x + 3$$



- 2 The grid above shows the graph of the first equation. Now graph  $y - x + 2 = 0$ . First solve for  $y$ .

$$y - x + 2 = 0$$

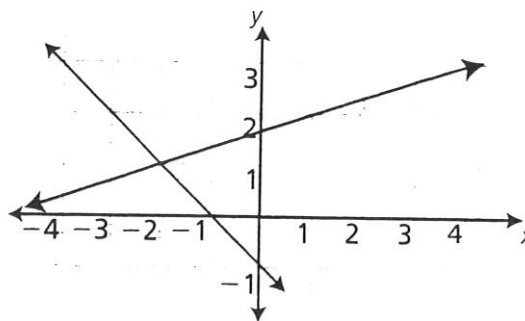
$$y = x - 2$$

- 3 Use the slope of 1 and the  $y$ -intercept of  $-2$  to graph the second line.  
 4 The point where the two lines intersect, the **point of intersection**, is the solution to the system.

## Systems of Equations

A **system of equations** is two or more related linear equations. The solution set of a system of equations is all the ordered pairs that make both equations true. For example, the solution to the system on the right is the **point of intersection**  $(-2, 1)$ .

There are several ways to solve systems of equations, including *graphing*, the *substitution method*, and the *elimination method*.



GO ON

## Solving Systems of Equations

- 7 What is the solution of this system of equations? Solve using substitution.

$$y = 6x - 4$$

$$y = -2x + 28$$

- (A) (4, 10)                      (C) (10, 8)  
(B) (4, 20)                      (D) (20, 4)

## Real-World Problems and Systems

- 8 Choose the system of equations that represents the problem situation below.

Lucinda paid \$28 for 3 lbs of cherries and 2 lbs of apples. Her sister paid \$17 for 2 lbs of cherries and 1 lb of apples. Which system can be solved to find the price per pound of each fruit?

- (A)  $(2 + 3)a = 28$                       (C)  $3c + 2a = 28$   
       $(2 + 1)c = 17$                        $2c + a = 17$   
(B)  $3(c + a) = 28$                       (D)  $2c + a = 28$   
       $2(c + a) = 17$                        $3c + 2a = 17$

## Step-By-Step

Use substitution to solve the system of equations in **example 7**.

- 1 Start with one of the equations.

$$y = 6x - 4$$

- 2 Substitute  $-2x + 28$  for  $y$ . Then solve for  $x$ .

$$-2x + 28 = 6x - 4$$

$$-2x + 28 + 2x = 6x - 4 + 2x$$

$$28 = 8x - 4$$

$$28 + 4 = 8x - 4 + 4$$

$$32 = 8x$$

$$4 = x$$

- 3 Solve for the other variable in either equation.

$$y = -2(4) + 28$$

$$y = -8 + 28$$

$$y = 20$$

- 4 The solution is (      ,      ).

## Step-By-Step

The first equation in **example 8** represents what Lucinda spent on cherries and apples. The second equation represents what her sister spent on cherries and apples.

- 1 Complete this expression for the amount Lucinda spends.

$$3c + \quad \times a$$

- 2 Complete the equation for Lucinda.

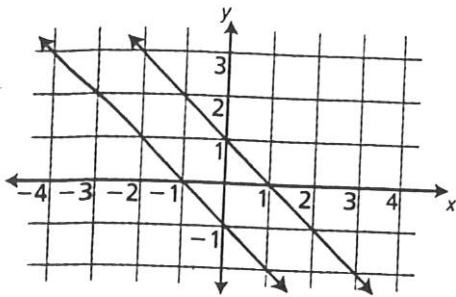
$$3c + 2a =$$

- 3 Complete the equation for her sister.

$$2c + a =$$

Try It

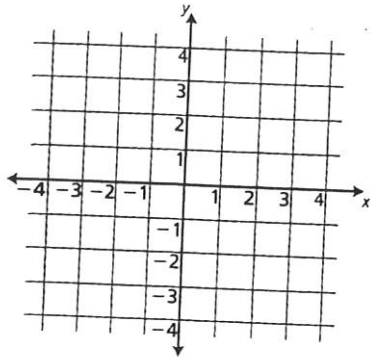
7 What is the solution of this system?



- Ⓐ (1, 0)                      Ⓒ (-1, 1)  
 Ⓑ (-1, 0)                    Ⓓ {∅}

8 Solve by graphing.

$$y + 4x = 2 \quad y + 3 = x$$



Answer: \_\_\_\_\_

Questions 9–12: Solve using the substitution method.

9  $y = 4x - 8$

$y = 2x + 10$

Answer: \_\_\_\_\_

10  $3x - 6y = 30$

$y = -6x + 34$

- Ⓐ (6, -2)                      Ⓒ (-2, 6)  
 Ⓑ (3, 1)                        Ⓓ (0, 6)

11  $y = 5x + 8$

$y = -10x + 3$

Answer: \_\_\_\_\_

12  $x - 1.2y = -3$

$0.2y + 0.6x = 12$

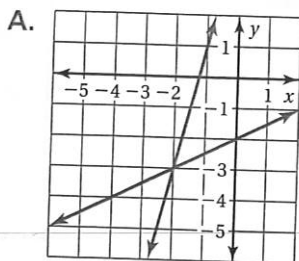
Answer: \_\_\_\_\_

# 4.1–4.2 Quiz

Match the system of linear equations with the corresponding graph. Use the graph to estimate the solution. Check your solution. (Section 4.1)

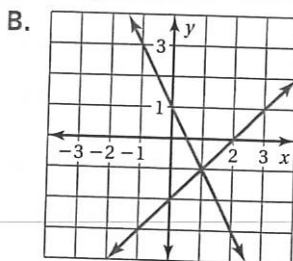
1.  $y = x - 2$

$y = -2x + 1$



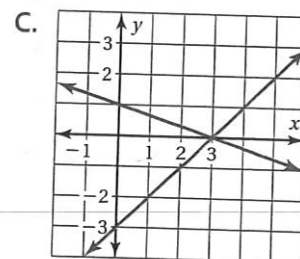
2.  $y = x - 3$

$y = -\frac{1}{3}x + 1$



3.  $y = \frac{1}{2}x - 2$

$y = 4x + 5$



Solve the system of linear equations by graphing. (Section 4.1)

4.  $y = 2x - 3$

$y = -x + 9$

5.  $6x + y = -2$

$y = -3x + 1$

6.  $4x + 2y = 2$

$3x = 4 - y$

Solve the system of linear equations by substitution. Check your solution. (Section 4.2)

7.  $y = x - 8$

$y = 2x - 14$

8.  $x = 2y + 2$

$2x - 5y = 1$

9.  $x - 5y = 1$

$-2x + 9y = -1$

10. **MOVIE CLUB** Members of a movie rental club pay a \$15 annual membership fee and \$2 for new release movies. Nonmembers pay \$3 for new release movies. (Section 4.1)

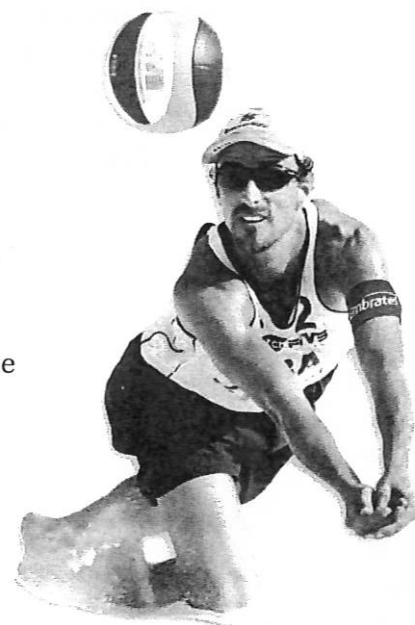
a. Write a system of linear equations that represents this situation.

b. When is it beneficial to have a membership?

11. **NUMBER SENSE** The sum of two numbers is 38. The greater number is 8 more than the other number. Find each number. Use a system of linear equations to justify your answer. (Section 4.1)

12. **VOLLEYBALL** The length of a sand volleyball court is twice its width. The perimeter is 180 feet. Find the length and width of the sand volleyball court. (Section 4.2)

13. **MEDICAL STAFF** A hospital employs a total of 77 nurses and doctors. The ratio of nurses to doctors is 9 : 2. How many nurses are employed at the hospital? How many doctors are employed at the hospital? (Section 4.2)



# Practice 7-1

## Solving Systems by Graphing

Solve by graphing. Write *no solution* or *infinitely many solutions* where appropriate.

- |   |  |   |   |
|---|--|---|---|
| 1. $y = 3x - 1$<br>$y = -2x + 4$          | 2. $y = x - 1$<br>$y = -x + 7$             | 3. $y = \frac{3}{4}x + 2$<br>$\frac{3}{4}x - y = 4$ | 4. $y = 4x + 7$<br>$y = -3x$                    |
| 5. $y = x - 3$<br>$y = \frac{1}{7}x + 3$  | 6. $y = -3x - 4$<br>$3x + y = -4$          | 7. $y = -x - 3$<br>$y = -2x - 8$                    | 8. $y = -x + 2$<br>$3x + 3y = 12$               |
| 9. $y = x$<br>$y = 3x + 2$                | 10. $y = 4x - 3$<br>$y = -3x - 3$          | 11. $y = \frac{5}{3}x - 4$<br>$y = 2x - 6$          | 12. $y = 3x + 2$<br>$2x + y = -8$               |
| 13. $x = y + 4$<br>$y = x + 4$            | 14. $x + y = 2$<br>$y = -2x - 1$           | 15. $2x - y = 3$<br>$y = x + 4$                     | 16. $3x - 6y = 12$<br>$2x - 4y = 8$             |
| 17. $x - y = 1$<br>$y = \frac{3}{4}x + 1$ | 18. $y = x$<br>$x = 2y + 2$                | 19. $3x - y = 9$<br>$y = x + 1$                     | 20. $2x + y = 0$<br>$y = 2x - 4$                |
| 21. $y = 2x - 6$<br>$x + y = 9$           | 22. $y = -x$<br>$y = 3x + 12$              | 23. $4x + y = 6$<br>$y = -4x - 1$                   | 24. $y = 4x$<br>$y = -3x$                       |
| 25. $y = x$<br>$2x + y = \frac{3}{2}$     | 26. $3x + y = 6$<br>$2x - y = \frac{3}{2}$ | 27. $x + 4y = -\frac{1}{2}$<br>$-2x - 3y = 1$       | 28. $x - y = -\frac{3}{2}$<br>$-2x + 5y = -4.5$ |

Solve each system by using a graphing calculator. Write *no solution* or *infinitely many solutions* where appropriate.

- |   |  |   |
|---|--|---|
| 29. $y = x + 6$<br>$y = 2x - 7$                       | 30. $y = \frac{7}{2}x - 6$<br>$y = 3x - 2$         | 31. $y = 2x - 20$<br>$y = -x + 34$      |
| 32. $y = \frac{2}{3}x + 4$<br>$2x - 3y = 3$           | 33. $y = -x - 5$<br>$y = 3x - 105$                 | 34. $x + y = -10$<br>$2x + 3y = -30$    |
| 35. $3x - 4y = 0$<br>$2x + y = 110$                   | 36. $y = \frac{1}{7}x + 10$<br>$x - 2y = 0$        | 37. $2x + y = 6$<br>$3y = -6x + 9$      |
| 38. $y = \frac{5}{6}x + 12$<br>$y = \frac{4}{3}x - 6$ | 39. $2x - y = 8$<br>$3x - 2y = 0$                  | 40. $x + 2y = 2$<br>$3x + 4y = 22$      |
| 41. $y = 2x + 0.75$<br>$y = -4x - 8.25$               | 42. $1.25x + 3.25y = -5.75$<br>$0.5x - 1.5y = 0.5$ | 43. $x = -2y - 3.5$<br>$-5x + 3y = -15$ |



# Practice 7-2

## Solving Systems Using Substitution

Solve each system using substitution. Write *no solution* or *infinitely many solutions* where appropriate.

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

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

3.  $y = 3x - 10$   
 $y = 2x - 5$

4.  $x = -2y + 1$   
 $x = y - 5$

5.  $y = 5x + 5$   
 $y = 15x - 1$

6.  $y = x - 3$   
 $y = -3x + 25$

7.  $y = x - 7$   
 $2x + y = 8$

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

9.  $x + 2y = 200$   
 $x = y + 50$

10.  $3x + y = 10$   
 $y = -3x + 4$

11.  $y = 2x + 7$   
 $y = 5x + 4$

12.  $3x - 2y = 0$   
 $x + y = -5$

13.  $4x + 2y = 8$   
 $y = -2x + 4$

14.  $6x - 3y = 6$   
 $y = 2x + 5$

15.  $2x + 4y = -6$   
 $x - 3y = 7$

16.  $5x - 3y = -4$   
 $x + y = -4$

17.  $y = -\frac{2}{3}x + 4$   
 $2x + 3y = -6$

18.  $2x + 3y = 8$   
 $\frac{3}{2}y = 4 - x$

19.  $3x - y = 4$   
 $2x + y = 16$

20.  $x + y = 0$   
 $x = y + 4$

21.  $5x + 2y = 6$   
 $y = -\frac{5}{2}x + 1$

22.  $2x + 5y = -6$   
 $4x + y = -12$

23.  $4x + 3y = -3$   
 $2x + y = -1$

24.  $y = -\frac{2}{3}x + 1$   
 $4x + 6y = 6$

25.  $5x - 6y = 19$   
 $4x + 3y = 10$

26.  $2x + y = 6.6$   
 $5x - 2y = 0.3$

27.  $2x - 4y = 3.8$   
 $3x - y = 17.7$

28.  $3x + 4y = 8$   
 $4.5x + 6y = 12$

29.  $3x - 4y = -5$   
 $x = y + 2$

30.  $y = \frac{1}{3}x + 10$   
 $x = 3y + 6$

31.  $2x + 5y = 62$   
 $3x - y = 23.3$

32.  $-5x + y = 6$   
 $2x - 3y = 60$

33.  $x = \frac{3}{4}y - 6$   
 $y = \frac{4}{3}x + 8$

34.  $5x + 6y = -76$   
 $x + 2y = -44$

35.  $3x - 2y = 10$   
 $y = \frac{3}{2}x - 1$

36.  $-3x + 2y = -6$   
 $-2x + y = 6$

37. At an ice cream parlor, ice cream cones cost \$1.10 and sundaes cost \$2.35. One day, the receipts for a total of 172 cones and sundaes were \$294.20. How many cones were sold?

38. You purchase 8 gal of paint and 3 brushes for \$152.50. The next day, you purchase 6 gal of paint and 2 brushes for \$113.00. How much does each gallon of paint and each brush cost?

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