

# Solving Systems by Substitution

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

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## Q Quick Review

**Substitution method:** when one equation is already solved (or easily solvable) for one variable, substitute that expression into the other equation. Steps: **(1)** solve one equation for one variable; **(2)** substitute into the other equation to get a one-variable equation; **(3)** solve; **(4)** substitute back to find the other variable. Substitution is best when a variable has a coefficient of  $\pm 1$  — isolating it is easy. **Special outcomes:** if the variables cancel and you get a *true* statement, infinitely many solutions; if you get a *false* statement, no solution.

## PRACTICE

Solve each system by substitution.

1.  $y = x + 3, 2x + y = 12$  \_\_\_\_\_

2.  $y = -x, 3x + 2y = 4$  \_\_\_\_\_

3.  $x = 2y, x + 3y = 10$  \_\_\_\_\_

4.  $y = 2x - 1, x + y = 8$  \_\_\_\_\_

5.  $y = 3, 2x - y = 5$  \_\_\_\_\_

6.  $y = x + 5, y = 2x + 3$  \_\_\_\_\_

7.  $x = y + 1, 2x - 3y = 0$  \_\_\_\_\_

8.  $y = 4x, 5x - y = 3$  \_\_\_\_\_

9.  $y = -2x + 6, 4x + y = 8$  \_\_\_\_\_

10.  $x + y = 10, x - y = 4$  \_\_\_\_\_

11.  $y = x, y = -x + 8$  \_\_\_\_\_

12.  $y = 2x, y = 2x + 5$  \_\_\_\_\_

13.  $y = x + 1, 3y = 3x + 3$  \_\_\_\_\_

14.  $x = 3y + 2, 2x - 6y = 4$  \_\_\_\_\_

15.  $y = 5, x = 2y - 1$  \_\_\_\_\_

16.  $x = 4, 3x + 2y = 20$  \_\_\_\_\_

17.  $y = \frac{1}{2}x, 4x - y = 14$  \_\_\_\_\_

18.  $x + 2y = 7, x = y + 1$  \_\_\_\_\_

19.  $y = 3x - 2, y = -x + 6$  \_\_\_\_\_

20.  $y = -x + 1, 2x + y = -3$  \_\_\_\_\_

## ◆ Word Problems

21. Two numbers sum to 20 and one is 3 times the other. Find them.

\_\_\_\_\_

22. At a fair, adult tickets cost \$8 and child tickets \$5. Total tickets sold: 25. Total revenue: \$170. How many adult tickets?

\_\_\_\_\_

23. A rectangle's length is 3 more than its width. Its perimeter is 26 cm. Find dimensions.

\_\_\_\_\_

24. A coin jar has \$3.10 in nickels and dimes. Total coins: 40. How many nickels?

\_\_\_\_\_



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## Answer Keys

- |   |  |
|---|--|
| <p>1. (3, 6)</p> <p>2. (4, -4)</p> <p>3. (4, 2)</p> <p>4. (3, 5)</p> <p>5. (4, 3)</p> <p>6. (2, 7)</p> <p>7. (3, 2)</p> <p>8. (3, 12)</p> <p>9. (1, 4)</p> <p>10. (7, 3)</p> <p>11. (4, 4)</p> <p>12. no solution</p> | <p>13. infinitely many</p> <p>14. infinitely many</p> <p>15. (9, 5)</p> <p>16. (4, 4)</p> <p>17. (4, 2)</p> <p>18. (3, 2)</p> <p>19. (2, 4)</p> <p>20. (-4, 5)</p> <p>21. 5 and 15</p> <p>22. 15</p> <p>23. <math>w = 5, \ell = 8</math></p> <p>24. 18</p> |
|---|--|

### Step-by-Step Tutor Notes

1. For a table question, slow down and locate the exact row, column, or cell before calculating.  $2x + (x + 3) = 12 \Rightarrow 3x = 9 \Rightarrow x = 3, y = 6$ . This gives (3, 6).
2. For a table question, slow down and locate the exact row, column, or cell before calculating.  $3x + 2(-x) = 4 \Rightarrow x = 4, y = -4$ . This gives (4, -4).
3. For a table question, slow down and locate the exact row, column, or cell before calculating.  $2y + 3y = 10 \Rightarrow 5y = 10 \Rightarrow y = 2, x = 4$ . This gives (4, 2).
4. For a table question, slow down and locate the exact row, column, or cell before calculating.  $x + (2x - 1) = 8 \Rightarrow 3x = 9 \Rightarrow x = 3, y = 5$ . This gives (3, 5).
5. Use the labels on the display first; they tell you which count or total belongs in the answer.  $2x - 3 = 5 \Rightarrow x = 4$ . This gives (4, 3).
6. Use the labels on the display first; they tell you which count or total belongs in the answer.  $x + 5 = 2x + 3 \Rightarrow x = 2, y = 7$ . This gives (2, 7).
7. Use the labels on the display first; they tell you which count or total belongs in the answer.  $2(y + 1) - 3y = 0 \Rightarrow -y + 2 = 0 \Rightarrow y = 2, x = 3$ . This gives (3, 2).
8. Use the labels on the display first; they tell you which count or total belongs in the answer.  $5x - 4x = 3 \Rightarrow x = 3, y = 12$ . This gives (3, 12).
9. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $4x + (-2x + 6) = 8 \Rightarrow 2x = 2 \Rightarrow x = 1, y = 4$ . This gives (1, 4).
10. For a table question, slow down and locate the exact row, column, or cell before calculating. First gives  $x = 10 - y$ . Sub:  $10 - y - y = 4 \Rightarrow y = 3, x = 7$ . This gives (7, 3).
11. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $x = -x + 8 \Rightarrow x = 4, y = 4$ . This gives (4, 4).
12. For a table question, slow down and locate the exact row, column, or cell before calculating.  $2x = 2x + 5 \Rightarrow 0 = 5$ . False — no solution. This gives no solution.
13. Move carefully through the arithmetic; one clean operation usually unlocks the next one. Divide second by 3:  $y = x + 1$ . Same line. After simplifying, the answer is infinitely many.
14. Use the labels on the display first; they tell you which count or total belongs in the answer. Sub:  $2(3y + 2) - 6y = 4 \Rightarrow 4 = 4$ . True for any  $y$ . This gives infinitely many.
15. Take it one clear step at a time and keep the original question in mind.  $x = 2(5) - 1 = 9$ . So the answer is (9, 5).
16. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $12 + 2y = 20 \Rightarrow y = 4$ . This gives (4, 4).
17. For a table question, slow down and locate the exact row, column, or cell before calculating.  $4x - \frac{1}{2}x = 14 \Rightarrow \frac{7}{2}x = 14 \Rightarrow x = 4, y = 2$ . This gives (4, 2).
18. For a table question, slow down and locate the exact row, column, or cell before calculating.  $(y + 1) + 2y = 7 \Rightarrow 3y = 6 \Rightarrow y = 2, x = 3$ . This gives (3, 2).
19. Read the table by matching the correct row and column first, then use the count or total that fits the question.  $3x - 2 = -x + 6 \Rightarrow 4x = 8 \Rightarrow x = 2, y = 4$ . This gives (2, 4).
20. For a table question, slow down and locate the exact row, column, or cell before calculating.  $2x + (-x + 1) = -3 \Rightarrow x = -4, y = 5$ . This gives (-4, 5).
21. Read the table by matching the correct row and column first, then use the count or total that fits the question. Let  $x + y = 20$  and  $y = 3x$ . Sub:  $x + 3x = 20 \Rightarrow x = 5, y = 15$ . This gives 5 and 15.
22.  $a + c = 25, 8a + 5c = 170$ . From first:  $c = 25 - a$ . Sub:  $8a + 5(25 - a) = 170 \Rightarrow 3a = 45 \Rightarrow a = 15$ .
23. Use the labels on the display first; they tell you which count or total belongs in the answer.  $\ell = w + 3$ . Perimeter:  $2(\ell + w) = 26 \Rightarrow \ell + w = 13 \Rightarrow (w + 3) + w = 13 \Rightarrow w = 5, \ell = 8$ . This gives  $w = 5, \ell = 8$ .
24.  $n + d = 40, 0.05n + 0.10d = 3.10$ . From first:  $d = 40 - n$ . Sub:  $0.05n + 0.10(40 - n) = 3.10 \Rightarrow -0.05n = -0.90 \Rightarrow n = 18$ .



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