

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 ± 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. $y = x + 3, 2x + y = 12$ | _____ | 11. $y = x, y = -x + 8$ | _____ |
| 2. $y = -x, 3x + 2y = 4$ | _____ | 12. $y = 2x, y = 2x + 5$ | _____ |
| 3. $x = 2y, x + 3y = 10$ | _____ | 13. $y = x + 1, 3y = 3x + 3$ | _____ |
| 4. $y = 2x - 1, x + y = 8$ | _____ | 14. $x = 3y + 2, 2x - 6y = 4$ | _____ |
| 5. $y = 3, 2x - y = 5$ | _____ | 15. $y = 5, x = 2y - 1$ | _____ |
| 6. $y = x + 5, y = 2x + 3$ | _____ | 16. $x = 4, 3x + 2y = 20$ | _____ |
| 7. $x = y + 1, 2x - 3y = 0$ | _____ | 17. $y = \frac{1}{2}x, 4x - y = 14$ | _____ |
| 8. $y = 4x, 5x - y = 3$ | _____ | 18. $x + 2y = 7, x = y + 1$ | _____ |
| 9. $y = -2x + 6, 4x + y = 8$ | _____ | 19. $y = 3x - 2, y = -x + 6$ | _____ |
| 10. $x + y = 10, x - y = 4$ | _____ | 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

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

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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