

Solving Real Problems with Systems

Name: _____ Date: _____ Score: _____ / 24

Q Quick Review

Many real-world problems hide a **system of equations** inside the words. The trick is to *translate* carefully: pick two variables, then write one equation for each piece of information — often one for a **total count** and one for a **total value** or cost. Once you have the system, solve it with substitution or elimination, just like before. Finally, *answer the question in words* and check that your numbers make sense in the original story.

◊ **Example:** A box has 15 coins, all nickels and dimes, worth \$1.05. How many of each?
 ⇒ Let's name our unknowns: n is the number of nickels and d is the number of dimes. One fact is about the *count*: $n + d = 15$. The other is about *value*, in cents: a nickel is 5 and a dime is 10, and the total is 105 cents, so $5n + 10d = 105$. From the first equation, $n = 15 - d$. Substitute: $5(15 - d) + 10d = 105$, which simplifies to $75 + 5d = 105$, so $5d = 30$ and $d = 6$. Then $n = 15 - 6 = 9$. Nine nickels and six dimes — that's $45 + 60 = 105$ cents. It checks!

Answer: 9 nickels, 6 dimes

PRACTICE

Set up and solve a system for each problem.

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|----------------------------------|-------|----------------------------------|-------|
| 1. $x + y = 14, x - y = 2$ | _____ | 11. $3a + b = 17, a + b = 9$ | _____ |
| 2. $x + y = 25, x - y = 5$ | _____ | 12. $x + y = 50, x - y = 10$ | _____ |
| 3. $a + b = 30, 2a + b = 44$ | _____ | 13. $5x + 2y = 24, x + 2y = 12$ | _____ |
| 4. $x + y = 18, 5x + 10y = 130$ | _____ | 14. $x + y = 100, x = 4y$ | _____ |
| 5. $p + q = 20, 25p + 10q = 350$ | _____ | 15. $2x + y = 13, 3x - y = 12$ | _____ |
| 6. $x + y = 12, 3x + 5y = 50$ | _____ | 16. $a + b = 21, 2a + 4b = 62$ | _____ |
| 7. $a + b = 40, a = 3b$ | _____ | 17. $x + y = 7, 10x + 25y = 130$ | _____ |
| 8. $x + y = 16, x = y + 4$ | _____ | 18. $x + y = 35, x - y = 7$ | _____ |
| 9. $2x + 3y = 31, x + y = 12$ | _____ | 19. $3x + 2y = 18, x = 2$ | _____ |
| 10. $x + y = 9, 4x + 2y = 26$ | _____ | 20. $x + y = 60, x = 2y$ | _____ |

◆ Word Problems

21. A class of 28 students went to a museum. Tickets were \$5 for students who took the bus and \$8 for those who walked, for a total of \$179. How many took the bus? _____
22. A jar holds 40 marbles, red and blue. There are 8 more red marbles than blue. How many of each color are there? _____
23. A store sells small and large notebooks. A small costs \$2 and a large costs \$5. A customer bought 9 notebooks for \$33. How many large notebooks did they buy? _____
24. Two friends biked a total of 54 miles. One biked twice as far as the other. How far did each bike? _____



Answer Keys

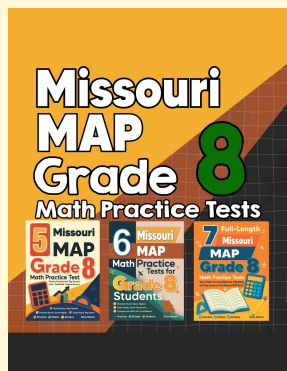
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| <ol style="list-style-type: none"> 1. (8, 6) 2. (15, 10) 3. (14, 16) 4. (10, 8) 5. (10, 10) 6. (5, 7) 7. (30, 10) 8. (10, 6) 9. (5, 7) 10. (4, 5) 11. (4, 5) 12. (30, 20) | <ol style="list-style-type: none"> 13. $(3, \frac{9}{2})$ 14. (80, 20) 15. (5, 3) 16. (11, 10) 17. (3, 4) 18. (21, 14) 19. (2, 6) 20. (40, 20) 21. 15 students took the bus 22. 24 red, 16 blue 23. 5 large notebooks 24. 36 miles and 18 miles |
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Step-by-Step Explanations

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| <ol style="list-style-type: none"> 1. Add the equations: $2x = 16$, so $x = 8$ and $y = 6$. 2. Add: $2x = 30$, so $x = 15$ and $y = 10$. 3. Subtract the first from the second: $a = 14$, then $b = 16$. 4. From $x = 18 - y$: $5(18 - y) + 10y = 130$, so $5y = 40$, $y = 8$, $x = 10$. 5. Substitute $p = 20 - q$: $25(20 - q) + 10q = 350$, so $-15q = -150$, $q = 10$. 6. From $x = 12 - y$: $3(12 - y) + 5y = 50$, so $2y = 14$, $y = 7$, $x = 5$. 7. Substitute $a = 3b$: $3b + b = 40$, so $b = 10$ and $a = 30$. 8. Substitute: $(y + 4) + y = 16$, so $2y = 12$, $y = 6$, $x = 10$. 9. From $x = 12 - y$: $2(12 - y) + 3y = 31$, so $y = 7$, $x = 5$. 10. From $y = 9 - x$: $4x + 2(9 - x) = 26$, so $2x = 8$, $x = 4$, $y = 5$. 11. Subtract: $2a = 8$, so $a = 4$ and $b = 5$. 12. Add: $2x = 60$, so $x = 30$ and $y = 20$. 13. Subtract: $4x = 12$, so $x = 3$, then $2y = 9$, $y = \frac{9}{2}$. | <ol style="list-style-type: none"> 14. Substitute $x = 4y$: $4y + y = 100$, so $y = 20$ and $x = 80$. 15. Add: $5x = 25$, so $x = 5$, then $y = 3$. 16. From $a = 21 - b$: $2(21 - b) + 4b = 62$, so $2b = 20$, $b = 10$, $a = 11$. 17. From $x = 7 - y$: $10(7 - y) + 25y = 130$, so $15y = 60$, $y = 4$, $x = 3$. 18. Add: $2x = 42$, so $x = 21$ and $y = 14$. 19. Substitute $x = 2$: $6 + 2y = 18$, so $2y = 12$, $y = 6$. 20. Substitute $x = 2y$: $2y + y = 60$, so $y = 20$ and $x = 40$. 21. With $b + w = 28$ and $5b + 8w = 179$, substitute $w = 28 - b$: $5b + 8(28 - b) = 179$, so $-3b = -45$ and $b = 15$. 22. With $r + b = 40$ and $r = b + 8$, substitute: $(b + 8) + b = 40$, so $2b = 32$, $b = 16$, $r = 24$. 23. With $s + l = 9$ and $2s + 5l = 33$, substitute $s = 9 - l$: $2(9 - l) + 5l = 33$, so $3l = 15$ and $l = 5$. 24. With $x + y = 54$ and $x = 2y$, substitute: $2y + y = 54$, so $y = 18$ and $x = 36$. |
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