

# 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.

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

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