

# Systems of Equations

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Score: \_\_\_\_\_ / 18

## Quick Review and Helpful Hints

A system is two equations with two variables; the solution is the  $(x, y)$  pair that makes *both* true. Solve by *elimination* (add or subtract the equations to cancel a variable) or *substitution* (replace one variable using the other equation). Then back-substitute to find the second variable.

▷ **Example:** Solve  $x + y = 10$  and  $x - y = 2$ . **Work:** Add the two equations to cancel  $y$ :  $2x = 12$ , so  $x = 6$ . Put  $x = 6$  into  $x + y = 10$ :  $6 + y = 10$ , so  $y = 4$ .  
 ★ **Answer:**  $(6, 4)$



The lines cross at the solution.

### ◆ Practice Problems

Solve each system. Write the answer as  $(x, y)$ .

- |  |  |
|--|--|
| <p>1. <math>x + y = 5, x - y = 1</math> _____</p> <p>2. <math>x + y = 8, x - y = 2</math> _____</p> <p>3. <math>x + y = 10, x - y = 4</math> _____</p> <p>4. <math>x + y = 9, x - y = 3</math> _____</p> <p>5. <math>x + y = 7, x - y = -1</math> _____</p> <p>6. <math>y = x + 1, x + y = 7</math> _____</p> <p>7. <math>y = 2x, x + y = 9</math> _____</p> | <p>8. <math>x + y = 12, x - y = 2</math> _____</p> <p>9. <math>y = x - 2, x + y = 10</math> _____</p> <p>10. <math>2x + y = 10, x - y = 2</math> _____</p> <p>11. <math>x + 2y = 11, x - y = 2</math> _____</p> <p>12. <math>x + y = 6, 2x + y = 8</math> _____</p> <p>13. <math>x - y = 5, x + y = 11</math> _____</p> <p>14. <math>3x + y = 10, x + y = 4</math> _____</p> |
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### ◆ Word Problems

15. Two numbers add up to 20 and differ by 4. Find the two numbers. \_\_\_\_\_
16. A pen and a pencil together cost \$5. The pen costs \$3 more than the pencil. Find each price. \_\_\_\_\_
17. The sum of two numbers is 15 and their difference is 3. Find the numbers. \_\_\_\_\_
18. A student buys  $x$  notebooks and  $y$  pens for a total of 7 items. The number of pens is 1 more than twice the notebooks. Solve the system  $x + y = 7$  and  $y = 2x + 1$ . \_\_\_\_\_



## Answer Keys

- |           |            |                 |
|-----------|------------|-----------------|
| 1. (3, 2) | 7. (3, 6)  | 13. (8, 3)      |
| 2. (5, 3) | 8. (7, 5)  | 14. (3, 1)      |
| 3. (7, 3) | 9. (6, 4)  | 15. (12, 8)     |
| 4. (6, 3) | 10. (4, 2) | 16. \$4 and \$1 |
| 5. (3, 4) | 11. (5, 3) | 17. (9, 6)      |
| 6. (3, 4) | 12. (2, 4) | 18. (2, 5)      |

### Step-by-Step Explanations

1. Add the two equations so  $y$  cancels:  $(x + y) + (x - y) = 5 + 1$  gives  $2x = 6$ , so  $x = 3$ . Put  $x = 3$  into  $x + y = 5$  to get  $y = 2$ . The solution is  $(3, 2)$ .
2. A good way to think about this is: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Add to cancel  $y$ :  $2x = 10$ , so  $x = 5$ . Then  $5 + y = 8$  gives  $y = 3$ . So the final answer is  $(5, 3)$ .
3. Step by step: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Add:  $2x = 14$ , so  $x = 7$ . Then  $7 + y = 10$  gives  $y = 3$ . So the final answer is  $(7, 3)$ .
4. Take it one move at a time: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Add:  $2x = 12$ , so  $x = 6$ . Then  $6 + y = 9$  gives  $y = 3$ . So the final answer is  $(6, 3)$ .
5. Start by naming the process: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Add:  $2x = 6$ , so  $x = 3$ . Then  $3 + y = 7$  gives  $y = 4$ . So the final answer is  $(3, 4)$ .
6. A good way to think about this is: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Substitute  $y = x + 1$  into  $x + y = 7$ :  $x + (x + 1) = 7$ , so  $2x = 6$ ,  $x = 3$ . Then  $y = 3 + 1 = 4$ . So the final answer is  $(3, 4)$ .
7. Step by step: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Substitute  $y = 2x$ :  $x + 2x = 9$ , so  $3x = 9$ ,  $x = 3$ . Then  $y = 2(3) = 6$ . So the final answer is  $(3, 6)$ .
8. Take it one move at a time: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Add:  $2x = 14$ , so  $x = 7$ . Then  $7 + y = 12$  gives  $y = 5$ . So the final answer is  $(7, 5)$ .
9. Start by naming the process: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Substitute  $y = x - 2$ :  $x + (x - 2) = 10$ , so  $2x = 12$ ,  $x = 6$ . Then  $y = 6 - 2 = 4$ . So the final answer is  $(6, 4)$ .
10. A good way to think about this is: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Add the equations so  $y$  cancels:  $3x = 12$ , so  $x = 4$ . Then  $4 - y = 2$  gives  $y = 2$ . So the final answer is  $(4, 2)$ .
11. Step by step: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Subtract the second from the first so  $x$  cancels:  $3y = 9$ , so  $y = 3$ . Then  $x - 3 = 2$  gives  $x = 5$ . So the final answer is  $(5, 3)$ .
12. Take it one move at a time: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Subtract the first from the second so  $y$  cancels:  $x = 2$ . Then  $2 + y = 6$  gives  $y = 4$ . So the final answer is  $(2, 4)$ .
13. Start by naming the process: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Add:  $2x = 16$ , so  $x = 8$ . Then  $8 + y = 11$  gives  $y = 3$ . So the final answer is  $(8, 3)$ .
14. A good way to think about this is: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Subtract the second from the first so  $y$  cancels:  $2x = 6$ , so  $x = 3$ . Then  $3 + y = 4$  gives  $y = 1$ . So the final answer is  $(3, 1)$ .
15. Step by step: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Write  $x + y = 20$  and  $x - y = 4$ . Add them:  $2x = 24$ , so  $x = 12$ , then  $y = 8$ . The numbers are 12 and 8. So the final answer is  $(12, 8)$ .
16. Take it one move at a time: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Write  $p + c = 5$  and  $p - c = 3$ . Add them:  $2p = 8$ , so the pen is  $p = \$4$  and the pencil is  $c = \$1$ . So the final answer is \$4 and \$1.
17. Start by naming the process: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Write  $x + y = 15$  and  $x - y = 3$ . Add:  $2x = 18$ , so  $x = 9$ , then  $y = 6$ . So the final answer is  $(9, 6)$ .
18. A good way to think about this is: Read what the problem is asking, choose the matching rule, write the setup, and then simplify one step at a time. The setup/work is Substitute  $y = 2x + 1$  into  $x + y = 7$ :  $x + (2x + 1) = 7$ , so  $3x = 6$ ,  $x = 2$ . Then  $y = 5$ . The solution is  $(2, 5)$ . So the final answer is  $(2, 5)$ .



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