

# Equations with Variables on Both Sides

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

Date: \_\_\_\_\_

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## Quick Review and Helpful Hints

When the variable appears on *both* sides, first move all the variable terms to one side (subtract the smaller one from both sides) and the constants to the other side. Then solve the two-step equation that remains.

▷ **Example:** Solve  $5x + 3 = 2x + 18$ . **Work:** Subtract  $2x$  from both sides:  $3x + 3 = 18$ . Subtract 3:  $3x = 15$ . Divide by 3:  $x = 5$ .

★ **Answer:**  $x = 5$

$$\begin{array}{ccc} 5x+3 & & 2x+18 \\ | & & | \\ \hline & \triangle & \\ | & & | \end{array}$$

Move variables to one side first.

## ◆ Practice Problems

Solve each equation.

1.  $5x + 3 = 2x + 18$

8.  $8x - 3 = 3x + 12$

2.  $4x + 1 = 2x + 9$

9.  $10x + 1 = 6x + 9$

3.  $7x - 2 = 3x + 10$

10.  $4x + 6 = x + 18$

4.  $6x + 5 = 4x + 13$

11.  $5x - 7 = 2x + 5$

5.  $3x + 8 = x + 14$

12.  $6x + 2 = 2x + 10$

6.  $9x - 4 = 5x + 8$

13.  $7x + 4 = 4x + 19$

7.  $2x + 7 = 5x - 2$

14.  $3x + 15 = 8x$

## ◆ Word Problems

15. Plan A costs \$30 plus \$2 per item; Plan B costs \$10 plus \$4 per item. For how many items do they cost the same?

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16. A number plus 12 equals four times the number. Find the number.

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17. One tree is 8 ft tall and grows 2 ft per year; another is 2 ft tall and grows 4 ft per year. After how many years are they the same height?

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18. Two repair companies quote  $5x - 8$  dollars and  $3x + 2$  dollars for the same job. For what value of  $x$  are the quotes equal?

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## Answer Keys

- |            |             |              |
|------------|-------------|--------------|
| 1. $x = 5$ | 7. $x = 3$  | 13. $x = 5$  |
| 2. $x = 4$ | 8. $x = 3$  | 14. $x = 3$  |
| 3. $x = 3$ | 9. $x = 2$  | 15. 10 items |
| 4. $x = 4$ | 10. $x = 4$ | 16. 4        |
| 5. $x = 3$ | 11. $x = 4$ | 17. 3 years  |
| 6. $x = 3$ | 12. $x = 2$ | 18. $x = 5$  |

### Step-by-Step Explanations

**1.** 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 Subtract  $2x$ :  $3x + 3 = 18$ . Subtract 3:  $3x = 15$ , so  $x = 5$ . So the final answer is  $x = 5$ .

**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 Subtract  $2x$ :  $2x + 1 = 9$ . Subtract 1:  $2x = 8$ , so  $x = 4$ . So the final answer is  $x = 4$ .

**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 Subtract  $3x$ :  $4x - 2 = 10$ . Add 2:  $4x = 12$ , so  $x = 3$ . So the final answer is  $x = 3$ .

**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 Subtract  $4x$ :  $2x + 5 = 13$ . Subtract 5:  $2x = 8$ , so  $x = 4$ . So the final answer is  $x = 4$ .

**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 Subtract  $x$ :  $2x + 8 = 14$ . Subtract 8:  $2x = 6$ , so  $x = 3$ . So the final answer is  $x = 3$ .

**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 Subtract  $5x$ :  $4x - 4 = 8$ . Add 4:  $4x = 12$ , so  $x = 3$ . So the final answer is  $x = 3$ .

**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 Subtract  $2x$ :  $7 = 3x - 2$ . Add 2:  $9 = 3x$ , so  $x = 3$ . So the final answer is  $x = 3$ .

**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 Subtract  $3x$ :  $5x - 3 = 12$ . Add 3:  $5x = 15$ , so  $x = 3$ . So the final answer is  $x = 3$ .

**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 Subtract  $6x$ :  $4x + 1 = 9$ . Subtract 1:  $4x = 8$ , so  $x = 2$ . So the final answer is  $x = 2$ .

**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 Subtract  $x$ :  $3x + 6 = 18$ . Subtract 6:  $3x = 12$ , so  $x = 4$ . So the final answer is  $x = 4$ .

**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  $2x$ :  $3x - 7 = 5$ . Add 7:  $3x = 12$ , so  $x = 4$ . So the final answer is  $x = 4$ .

**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  $2x$ :  $4x + 2 = 10$ . Subtract 2:  $4x = 8$ , so  $x = 2$ . So the final answer is  $x = 2$ .

**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 Subtract  $4x$ :  $3x + 4 = 19$ . Subtract 4:  $3x = 15$ , so  $x = 5$ . So the final answer is  $x = 5$ .

**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  $3x$ :  $15 = 5x$ . Divide by 5:  $x = 3$ . So the final answer is  $x = 3$ .

**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 Set  $30 + 2x = 10 + 4x$ . Subtract  $2x$ :  $30 = 10 + 2x$ ; then  $20 = 2x$ , so  $x = 10$  items. So the final answer is 10 items.

**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 Set  $x + 12 = 4x$ . Subtract  $x$ :  $12 = 3x$ , so  $x = 4$ . So the final answer is 4.

**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 Set  $8 + 2t = 2 + 4t$ . Subtract  $2t$ :  $8 = 2 + 2t$ ; then  $6 = 2t$ , so  $t = 3$  years. So the final answer is 3 years.

**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 Subtract  $3x$ :  $2x - 8 = 2$ . Add 8:  $2x = 10$ , so  $x = 5$ . So the final answer is  $x = 5$ .



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