

# Introduction to Equations and Solutions

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

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

Score: \_\_\_\_\_ / 24

## Q Quick Review

An **equation** is a mathematical sentence that uses an equals sign to say two expressions have the same value. The equation  $2x + 3 = 11$  reads “two times a number, plus three, equals eleven.” A **solution** is a value that makes the equation true when you substitute it. To **check** if a value is a solution, substitute it for the variable and simplify both sides. If the two sides come out equal, you’ve found a solution; if not, you haven’t. When **translating words to equations**, certain phrases are reliable signals: “sum,” “more than,” or “increased by”  $\rightarrow +$ ; “difference,” “less than,” or “decreased by”  $\rightarrow -$  (and watch out — “less than” *reverses* the order!); “product” or “times”  $\rightarrow \times$ ; “quotient” or “divided by”  $\rightarrow \div$ ; and “is” or “equals”  $\rightarrow =$ .

## PRACTICE

Determine if the value is a solution (Yes/No), or translate.

- |                                   |       |   |       |
|-----------------------------------|-------|---|-------|
| 1. $x + 9 = 14$ ; $x = 5$ ?       | _____ | 11. $2(x + 3) = 14$ ; $x = 4$ ?             | _____ |
| 2. $2x - 3 = 7$ ; $x = 5$ ?       | _____ | 12. “Half a number is 9”                    | _____ |
| 3. $4a + 1 = 17$ ; $a = 3$ ?      | _____ | 13. $6x = 24$ ; $x = 4$ ?                   | _____ |
| 4. $5n - 10 = 0$ ; $n = 2$ ?      | _____ | 14. $x^2 - 9 = 0$ ; $x = 3$ ?               | _____ |
| 5. $\frac{x}{3} = 6$ ; $x = 18$ ? | _____ | 15. $5x + 2 = 22$ ; $x = 4$ ?               | _____ |
| 6. $3(y - 2) = 12$ ; $y = 6$ ?    | _____ | 16. $\frac{x - 1}{2} = 3$ ; $x = 7$ ?       | _____ |
| 7. “A number plus 8 is 15”        | _____ | 17. “Twice a number, increased by 5, is 13” | _____ |
| 8. “Three times a number is 21”   | _____ | 18. “Five less than a number is 12”         | _____ |
| 9. “A number minus 4 equals 10”   | _____ | 19. “The quotient of a number and 4 is 7”   | _____ |
| 10. $7 - x = 3$ ; $x = 4$ ?       | _____ | 20. $3x + 1 = 10$ ; $x = 3$ ?               | _____ |

## ◆ Word Problems

21. A gym charges a one-time fee of \$25 plus \$10 per month. After  $m$  months Carlos has paid \$75. Write an equation and find the number of months.

\_\_\_\_\_

22. Priya is checking homework and says  $x = 3$  is a solution of  $2x + 4 = 12$ . Test her claim carefully and decide whether  $x = 3$  really makes the equation true.

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23. A book costs \$3 less than twice the price of a magazine. If a book costs \$15, write an equation and find the price of the magazine.

\_\_\_\_\_

24. Aisha is thinking of a number. When she triples it and adds 7, she gets 25. Write an equation and find her number.

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## Answer Keys

- |   |   |
|---|---|
| <p>1. <input type="text" value="Yes"/></p> <p>2. <input type="text" value="Yes"/></p> <p>3. <input type="text" value="No"/></p> <p>4. <input type="text" value="Yes"/></p> <p>5. <input type="text" value="Yes"/></p> <p>6. <input type="text" value="Yes"/></p> <p>7. <input type="text" value="x + 8 = 15"/></p> <p>8. <input type="text" value="3x = 21"/></p> <p>9. <input type="text" value="x - 4 = 10"/></p> <p>10. <input type="text" value="Yes"/></p> <p>11. <input type="text" value="Yes"/></p> <p>12. <input type="text" value="1/2 x = 9"/></p> | <p>13. <input type="text" value="Yes"/></p> <p>14. <input type="text" value="Yes"/></p> <p>15. <input type="text" value="Yes"/></p> <p>16. <input type="text" value="Yes"/></p> <p>17. <input type="text" value="2x + 5 = 13"/></p> <p>18. <input type="text" value="x - 5 = 12"/></p> <p>19. <input type="text" value="x/4 = 7"/></p> <p>20. <input type="text" value="Yes"/></p> <p>21. <input type="text" value="m = 5"/></p> <p>22. <input type="text" value="No"/></p> <p>23. <input type="text" value="\$9"/></p> <p>24. <input type="text" value="x = 6"/></p> |
|---|---|

### Step-by-Step Tutor Notes

- Check the proposed value by substituting 5 for  $x$ :  $5 + 9 = 14$ . The left side equals the right side, so  $x = 5$  is a solution.
- Put the given value into the expression first, then simplify from the inside out. Substitute:  $2(5) - 3 = 10 - 3 = 7$ . Equals the right side, so yes. That confirms the final answer is Yes.
- Substitute:  $4(3) + 1 = 12 + 1 = 13$ . But the right side is 17, and  $13 \neq 17$ . So no. (The actual solution would be  $a = 4$ , since  $4(4) + 1 = 17$ .)
- Put the given value into the expression first, then simplify from the inside out. Substitute:  $5(2) - 10 = 10 - 10 = 0$ . Both sides are 0, so yes. That confirms the final answer is Yes.
- Put the given value into the expression first, then simplify from the inside out. Substitute:  $\frac{18}{3} = 6$ . Match, so yes. That confirms the final answer is Yes.
- Put the given value into the expression first, then simplify from the inside out. Substitute:  $3(6 - 2) = 3(4) = 12$ . Match, so yes. That confirms the final answer is Yes.
- "Plus" is +, "is" is =. Pick a letter —  $x$  is traditional — and you've got  $x + 8 = 15$ .
- Move carefully through the arithmetic; one clean operation usually unlocks the next one. "Times" means multiply. Three times the unknown is  $3x$ , and "is" equates:  $3x = 21$ . After simplifying, the answer is  $3x = 21$ .
- Focus on the main idea of the problem, then simplify carefully. Pretty direct: "minus" is -, "equals" is =. Result:  $x - 4 = 10$ . So the answer is  $x - 4 = 10$ .
- The safest move is to replace the variable, keep the arithmetic organized, and simplify one step at a time. Substitute:  $7 - 4 = 3$ . Match, so yes. That confirms the final answer is Yes.
- Put the given value into the expression first, then simplify from the inside out. Substitute:  $2(4 + 3) = 2(7) = 14$ . Match, so yes. That confirms the final answer is Yes.
- "Half a number" is the same as  $\frac{1}{2}$  times the number. Equation:  $\frac{1}{2}x = 9$  (or equivalently  $\frac{x}{2} = 9$ ).
- Put the given value into the expression first, then simplify from the inside out. Substitute:  $6(4) = 24$ . Match, so yes. That confirms the final answer is Yes.
- Substitute:  $(3)^2 - 9 = 9 - 9 = 0$ . Match, so yes. (Fun fact:  $x = -3$  also works here, because  $(-3)^2 = 9$  too. Squared equations often have two solutions.)
- Put the given value into the expression first, then simplify from the inside out. Substitute:  $5(4) + 2 = 20 + 2 = 22$ . Match, so yes. That confirms the final answer is Yes.
- Start by substituting the given value or values carefully, using parentheses when a value is negative. Substitute:  $\frac{7-1}{2} = \frac{6}{2} = 3$ . Match, so yes. That confirms the final answer is Yes.
- "Twice a number" is  $2x$ . "Increased by 5" adds 5. "Is 13" makes it equal 13. Put it together:  $2x + 5 = 13$ .
- Here's the tricky one. "Less than" reverses the order — "five less than a number" means "a number minus five," not "five minus a number." So  $x - 5 = 12$ .
- "Quotient" means division. "A number divided by 4" is  $\frac{x}{4}$ . "Is 7" makes it equal 7. So  $\frac{x}{4} = 7$ .
- Start by substituting the given value or values carefully, using parentheses when a value is negative. Substitute:  $3(3) + 1 = 9 + 1 = 10$ . Match, so yes. That confirms the final answer is Yes.
- Total paid is the one-time fee plus monthly fees:  $10m + 25 = 75$ . To solve, peel off the 25 first — subtract 25 from both sides:  $10m = 50$ . Then divide both sides by 10:  $m = 5$ . Carlos has been a member for 5 months.
- Substitute  $x = 3$  into the left side:  $2(3) + 4 = 6 + 4 = 10$ . But the right side is 12, and  $10 \neq 12$ , so  $x = 3$  is not a solution. (For reference, the real solution is  $x = 4$ :  $2(4) + 4 = 12$ , checked.)
- Let  $m$  be the magazine price. "Twice the price of a magazine" is  $2m$ , and "three dollars less than that" subtracts 3:  $2m - 3$ . That equals the book price of 15, so the equation is  $2m - 3 = 15$ . Add 3 to both sides:  $2m = 18$ . Divide by 2:  $m = 9$ . The magazine costs \$9.
- Let her number be  $x$ . "Triple it and add 7" gives  $3x + 7$ , and the result is 25, so the equation is  $3x + 7 = 25$ . Subtract 7 first:  $3x = 18$ . Divide by 3:  $x = 6$ . Aisha was thinking of 6.



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