

# Absolute Value Equations

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

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

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

## Q Quick Review

Absolute value measures **distance from zero**. To solve  $|A| = c$ , first make sure the absolute value is isolated. If  $c < 0$ , there is no solution because distance cannot be negative. If  $c \geq 0$ , split into two equations:  $A = c$  or  $A = -c$ . Then solve both and check for any extraneous answers if the equation had extra steps before the split.

## PRACTICE

Solve each absolute value equation.

- |                       |       |                        |       |
|-----------------------|-------|------------------------|-------|
| 1. $ x  = 9$          | _____ | 11. $ 4x + 1  = 9$     | _____ |
| 2. $ x - 4  = 6$      | _____ | 12. $ x/3  = 5$        | _____ |
| 3. $ n + 3  = 5$      | _____ | 13. $ 2x - 7  = 1$     | _____ |
| 4. $ 2x  = 14$        | _____ | 14. $ x + 2  - 4 = 0$  | _____ |
| 5. $ 3x - 6  = 12$    | _____ | 15. $3 x - 8  = 0$     | _____ |
| 6. $ x + 7  = 0$      | _____ | 16. $ 6 - 2x  = 10$    | _____ |
| 7. $ x  = -4$         | _____ | 17. $ x + 1  =  5 $    | _____ |
| 8. $ x - 1  + 3 = 10$ | _____ | 18. $ x - 10  = 2.5$   | _____ |
| 9. $2 x + 5  = 18$    | _____ | 19. $ 0.5x  = 3$       | _____ |
| 10. $5 -  x  = 1$     | _____ | 20. $ x + 4  + 2 = -1$ | _____ |

## ◆ Word Problems

21. A target value is 50. A measurement is exactly 7 units away from the target. Write and solve an absolute value equation.

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22. A student's score is exactly 4 points from 86. What are the possible scores?

\_\_\_\_\_

23. A machine part should be 12 cm long. One part is exactly 0.3 cm from the target length. Find the possible lengths.

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24. A city block is centered at avenue 0. A store is exactly 5 blocks from the center. What avenue numbers are possible?

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## Answer Keys

- |  |   |
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| <p>1. <math>x = 9</math> or <math>x = -9</math></p> <p>2. <math>x = 10</math> or <math>x = -2</math></p> <p>3. <math>n = 2</math> or <math>n = -8</math></p> <p>4. <math>x = 7</math> or <math>x = -7</math></p> <p>5. <math>x = 6</math> or <math>x = -2</math></p> <p>6. <math>x = -7</math></p> <p>7. no solution</p> <p>8. <math>x = 8</math> or <math>x = -6</math></p> <p>9. <math>x = 4</math> or <math>x = -14</math></p> <p>10. <math>x = 4</math> or <math>x = -4</math></p> <p>11. <math>x = 2</math> or <math>x = -\frac{5}{2}</math></p> <p>12. <math>x = 15</math> or <math>x = -15</math></p> | <p>13. <math>x = 4</math> or <math>x = 3</math></p> <p>14. <math>x = 2</math> or <math>x = -6</math></p> <p>15. <math>x = 8</math></p> <p>16. <math>x = -2</math> or <math>x = 8</math></p> <p>17. <math>x = 4</math> or <math>x = -6</math></p> <p>18. <math>x = 12.5</math> or <math>x = 7.5</math></p> <p>19. <math>x = 6</math> or <math>x = -6</math></p> <p>20. no solution</p> <p>21. <math> m - 50  = 7</math>; <math>m = 57</math> or <math>43</math></p> <p>22. 82 or 90</p> <p>23. 11.7 cm or 12.3 cm</p> <p>24. <math>-5</math> or <math>5</math></p> |
|--|---|

### Step-by-Step Tutor Notes

1. Absolute value is distance from 0. The numbers 9 units from 0 are 9 and  $-9$ .
2. The expression  $x - 4$  must be 6 or  $-6$ . Solving  $x - 4 = 6$  gives  $x = 10$ ; solving  $x - 4 = -6$  gives  $x = -2$ .
3. Split the distance equation:  $n + 3 = 5$  or  $n + 3 = -5$ . That gives  $n = 2$  or  $n = -8$ .
4. The inside can equal 14 or  $-14$ . So  $2x = 14$  gives  $x = 7$ , and  $2x = -14$  gives  $x = -7$ .
5. Make two linear equations:  $3x - 6 = 12$  and  $3x - 6 = -12$ . They solve to  $x = 6$  and  $x = -2$ .
6. An absolute value is 0 only when the inside is exactly 0. Solve  $x + 7 = 0$  to get  $x = -7$ .
7. Use the clue in the question first, then let the arithmetic finish the job. Distance can never be negative, so no real value of  $x$  can make  $|x| = -4$ . So the answer is no solution.
8. Isolate the absolute value first:  $|x - 1| = 7$ . Then solve  $x - 1 = 7$  or  $x - 1 = -7$ , giving  $x = 8$  or  $x = -6$ .
9. Divide by 2 before splitting:  $|x + 5| = 9$ . Then  $x + 5 = 9$  or  $x + 5 = -9$ , so  $x = 4$  or  $x = -14$ .
10. Subtract 5 to get  $-|x| = -4$ , then multiply by  $-1$ :  $|x| = 4$ . The solutions are  $x = 4$  and  $x = -4$ .
11. Solve both cases.  $4x + 1 = 9$  gives  $x = 2$ ;  $4x + 1 = -9$  gives  $4x = -10$ , so  $x = -\frac{5}{2}$ .
12. The quantity  $\frac{x}{3}$  is 5 units from 0, so  $\frac{x}{3} = 5$  or  $\frac{x}{3} = -5$ . Multiply by 3.
13. Set the inside equal to 1 and  $-1$ . The equations  $2x - 7 = 1$  and  $2x - 7 = -1$  give  $x = 4$  and  $x = 3$ .
14. Add 4 first:  $|x + 2| = 4$ . Then  $x + 2 = 4$  or  $x + 2 = -4$ , so  $x = 2$  or  $x = -6$ .
15. Divide by 3 to get  $|x - 8| = 0$ . The inside must be 0, so  $x - 8 = 0$  and  $x = 8$ .
16. Use  $6 - 2x = 10$  or  $6 - 2x = -10$ . The first gives  $x = -2$ ; the second gives  $x = 8$ .
17. First simplify the right side:  $|5| = 5$ . Now solve  $|x + 1| = 5$ , so  $x + 1 = 5$  or  $x + 1 = -5$ .
18. The value is 2.5 units from 10. Move 2.5 to the right and left of 10: 12.5 and 7.5.
19. Split into  $0.5x = 3$  and  $0.5x = -3$ . Dividing by 0.5 gives  $x = 6$  or  $x = -6$ .
20. Subtracting 2 would require  $|x + 4| = -3$ . Since absolute value cannot be negative, there is no solution.
21. Distance from 50 is modeled by  $|m - 50|$ . A distance of 7 gives  $m = 50 + 7$  or  $m = 50 - 7$ .
22. Name the quantities first so the model is easy to read. Use  $|s - 86| = 4$ . The two scores are  $86 - 4 = 82$  and  $86 + 4 = 90$ .
23. Set up the model from the story, then calculate carefully. The equation is  $|L - 12| = 0.3$ . Move 0.3 below and above 12.
24. Distance from 0 is  $|a|$ . The equation  $|a| = 5$  has two solutions:  $a = -5$  and  $a = 5$ .



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