

Absolute Value Equations

Name: _____

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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.

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.

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

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