

# Solving Equations Involving Absolute Value

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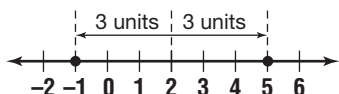
Equations that involve absolute value can be solved by using a number line or by writing them as compound sentences and solving them. When an equation has more than one solution, the solutions are often written as a set  $\{a, b\}$ . When an equation has no solution, the solution set is called the **empty set** and is symbolized by  $\{\}$  or  $\emptyset$ . For example,  $|x| = -2$  is never true because the absolute value of a number is always positive or zero. Since there is no replacement for  $x$  that will make the sentence true, the solution set is  $\emptyset$ .

## EXAMPLES

**Solve each equation. Check your solution.**

**A**  $|b - 2| = 3$

You can find  $b$  on the number line. Start at 2 and move 3 units in either direction.



Does  $b$  replaced by  $-1$  and  $5$  check? Yes. The solution set is  $\{-1, 5\}$ .

**B**  $|x - 2| + 4 = 9$

Simplify, then write as a compound sentence and solve.

$$\begin{aligned} |x - 2| + 4 &= 9 \\ |x - 2| &= 5 \\ x - 2 &= 5 \quad \text{or} \quad x - 2 = -5 \\ x &= 7 \qquad \qquad \qquad x = -3 \end{aligned}$$

Does  $x$  replaced by  $7$  and  $-3$  check? Yes. The solution set is  $\{-3, 7\}$ .

### Try These Together

1. Solve  $|a - 4| = 7$ .

HINT: There will be two solutions.

2. Solve  $|g| + 3 = 1$ .

HINT: This sentence can never be true.

## PRACTICE

**Solve each equation. Check your solution.**

3.  $|w| - 7 = 2$

4.  $|d| + 4 = 5$

5.  $|s - 5| = 6$

6.  $|a + 3| = 9$

7.  $|g - 1| = 4$

8.  $|-2 + y| = -1$

9.  $|f + (-5)| = 5$

10.  $|q - (-3)| = 11$

11.  $|k + 7| + 6 = 10$

12.  $|j - 6| + 8 = 15$

13.  $12 = |4 + h| + 1$

14.  $|-9 + m| + 5 = 17$

15. How many solutions exist for  $5 = |p + 4| + 6$ ?

16. **Standardized Test Practice** Solve  $|x - 5| + 3 = 7$ .

**A**  $\{-9, -1\}$

**B**  $\{-1, 9\}$

**C**  $\{-9, 1\}$

**D**  $\{1, 9\}$

Answers: 1.  $\{-3, 11\}$  2.  $\emptyset$  3.  $\{-9, 9\}$  4.  $\{-1, 1\}$  5.  $\{-1, 11\}$  6.  $\{-12, 6\}$  7.  $\{-3, 5\}$  8.  $\emptyset$  9.  $\{0, 10\}$  10.  $\{-14, 8\}$  11.  $\{-11, -3\}$  12.  $\{-1, 13\}$  13.  $\{-15, 7\}$  14.  $\{-3, 21\}$  15. None 16. D