Absolute Value

I. Definition

A. **The absolute value of a number is its *distance from zero***.

B. What do absolute values do to ***positive*** numbers?

1. **NOTHING**
2. Examples
   a. $|8| = 8$
   b. $|2.5| = 2.5$

C. What do absolute values do to ***zero***?

1. **NOTHING**
2. Example
   a. $|0| = 0$

D. What do absolute values do to ***negative*** numbers?

1. **MAKE THEM POSITIVE**
2. Examples
   b. $|-9| = 9$
   c. $|-3.8| = 3.8$

II. Solving equations involving absolute value.

1) Isolate the **absolute value** on one side of the equation.

2) Clear the **absolute value bars** and **split** the equation **into 2** possible **cases**, **one positive** and **one negative**.

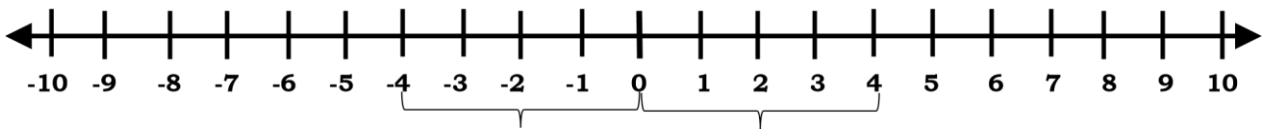
3) Solve for the unknown in each equation. **4) Check** your answers.

Example 1:

$$|x| = 4$$

x = 4 and **x = - 4** **Step 3**

Solution: $\{-4, 4\}$



4 units **4 units**

Example 2:

$$|x| = -8$$

No solution. Absolute value cannot be negative.

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Example 3:

$$3|x| = 15$$

$3x = 15$ and $3x = -15$ **Step 2**

$\frac{3x}{3} = \frac{15}{3}$ and $\frac{3x}{3} = \frac{-15}{3}$ **Step 3**

x = 5 and **x = - 5** **Step 3**

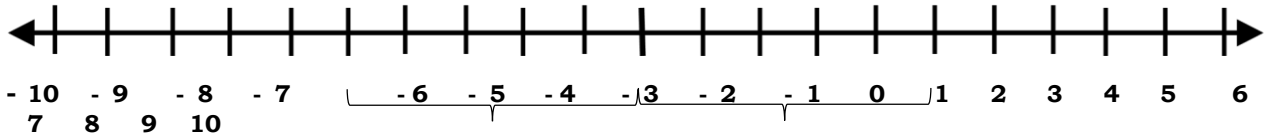
Check:

$3|5| = 15$ $3|-5| = 15$ **Step 4**

3(5) = 15 3(5) = 15 15 = 15

15 = 15

Solution: $\{-5,5\}$



5 units **5 units**

Example 4:

$$|x| - 10 = -2$$

$+10 \quad +10$

$$|x| = 8$$ **Step 1**

x = **8** and **x = - 8** **Step 2**

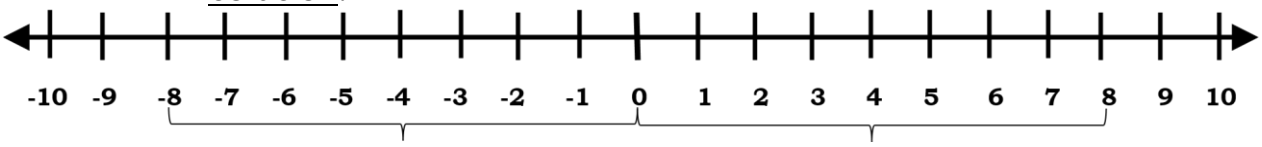
Check:

$|8| - 10 = -2$ $|-8| - 10 = 2$ **Step 4**

8 – 10 = - 2 8 – 10 = -2

- 2 = - 2 - 2 = - 2

Solution: $\{-8,8\}$



8 units **8 units**

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Example 5:

$$|x + 2| = 4$$

x **+ 2 = 4** and **x + 2 = - 4** **Step 2** - 2 - 2 and - 2 - 2 **Step 3**

x = 2 and **x = - 6** **Step 3**

Check:

$|2 + 2| = 4$ $|-6 + 2| = 4$

Step 4 $|4| = 4$

$|-4| = 4$

$4 = 4$ $4 = 4$

Solution: $\{-6,2\}$

Example 6:

$$|2x - 10| = 8 - 4x$$

$2x - 10 = 8 - 4x$ and $2x - 10 = -(8 - 4x)$ **Step 2**

$2x - 10 = 8 - 4x$ and $2x - 10 = -8 + 4x$ **Step 3**

+4x +4x - 2x - 2x

$6x - 10 = 8$ and $-10 = -8 + 2x$ **Step 3**

+10 +10 +8 +8 6x = 18 and - 2 = 2x **Step 3**

6 6 2 2

x = 3 and **- 1 = x** **Step 3**

Check:

$|2 \cdot 3 - 10| = 8 - 4 \cdot 3$ $|2 \cdot -1 - 10| = 8 - 4 \cdot -1$ **Step 4**

$|6 - 10| = 8 - 12$ $|-2 - 10| = 8 + 4$

$|-4| = -4$ $|-12| = 12$

$4 \neq -4$ $12 = 12$

Solution: $\{-1\}$

Example 7:

$$|2x + 4| < 10$$

$-10 < 2x + 4 < 10$ **Step 2**

- 4 - 4 - 4 **Step 3**

$\frac{-14}{2} < \frac{2x}{2} < \frac{6}{2}$ **Step 3**

-7 < x < 3 **Step 3**

Solution: (-7, 3)

Example 8:

$$|3x - 5| + 2 \geq x + 7$$

- 2 - 2

$|3x - 5| \geq x + 5$ **Step 1**

$3x - 5 \leq -(x + 5)$ or $3x - 5 \geq x + 5$ **Step 2**

$3x - 5 \leq -x - 5$ or $3x - 5 \geq x + 5$ **Step 3**

+x +x -x -x

$4x - 5 \leq -5$ or $2x - 5 \geq 5$ **Step 3**

+5 +5 +5 +5

$\frac{4x}{4} \leq \frac{0}{4}$ or $\frac{2x}{2} \geq \frac{10}{2}$ **Step 3**

$x \leq 0$ **or** $x \geq 5$ **Step 3**

Solution: $(-\infty, 0] \cup [5, \infty)$

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