Warm Up

M3-25

Evaluate each expression.

1. $|9 + (-4)|$

2. $|-1 - 5|$

3. $|4 \times (-6)|$

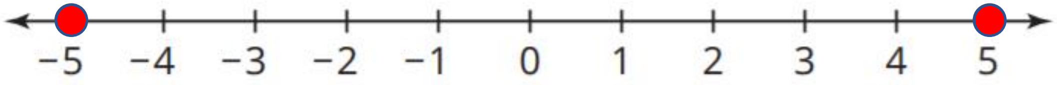
4. $|0 \div (-2)|$

Opposites Attract? Absolutely!

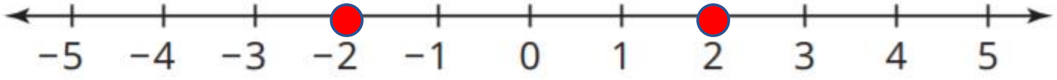
You can solve many absolute value equations using inspection.

1. Graph the solution set of each equation on the number line given.

a. $|x| = 5$

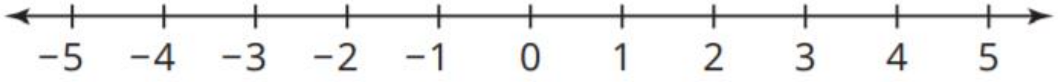


b. $|x| = 2$

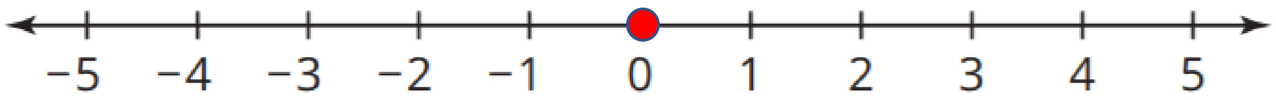


No Solution, absolute value can not be negative

c. $|x| = -3$



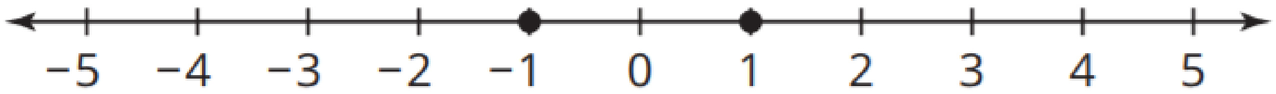
d. $|x| = 0$



One Solution

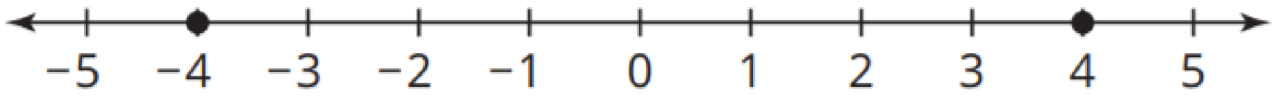
2. Write the absolute value equation for each solution set graphed.

a.



$|x| = 1$

b.

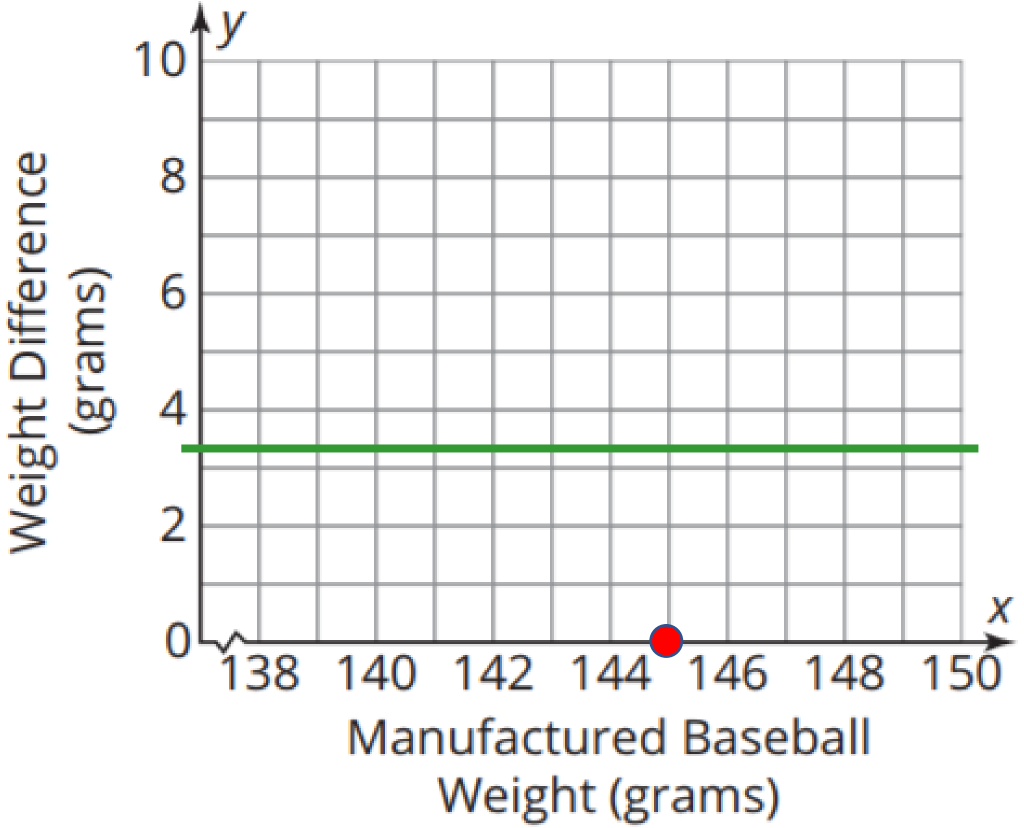


$|x| = 4$

The official rules of baseball state that all baseballs used during professional games must be within a specified range of weights. The baseball manufacturer sets the target weight of the balls at 145.045 grams on its machines. M3-27

1. Sketch a graph that models the relationship between a manufactured baseball's weight, *x*, and its distance from the target weight, *y*. Explain how you constructed your sketch. Then write an absolute value equation to represent the situation and the graph.

$$d(x) = |x - 145.045|$$



2. The specified weight allows for a difference of 3.295 grams in the actual weight of a ball and the target weight. Since the weight must be within a distance of 3.295 grams from the target weight, $y = 3.295$.

   a. Graph the equation $y = 3.295$ on the coordinate plane in Question 1.

   b. What two equations can you write, without absolute values, to show the least acceptable weight and the greatest acceptable weight of a baseball? Explain your reasoning.

$$x - 145.045 = 3.295 \qquad x - 145.045 = -3.295$$

$$x = 148.34 \qquad x = 141.75$$

   c. Use the graph to write the solutions to the equations you wrote in part (b). Show your work.

The two equations you wrote can be represented by the **linear absolute value equation** $|w - 145.045| = 3.295$. To solve any absolute value equation, recall the definition of absolute value.

Worked Example

Consider this linear absolute value equation.

$$|a| = 6$$

There are two points that are 6 units away from zero on the number line: one to the right of zero, and one to the left of zero.

$$+(a) = 6 \qquad \text{or} \qquad -(a) = 6$$

$$a = 6 \qquad \text{or} \qquad a = -6$$

Now consider the case where $a = x - 1$.

$$|x - 1| = 6$$

If you know that $|a| = 6$ can be written as two separate equations, you can rewrite any absolute value equation.

$$+(a) = 6 \qquad \text{or} \qquad -(a) = 6$$

$$+(x - 1) = 6 \qquad \text{or} \qquad -(x - 1) = 6$$

2. Martina and Bob continued to solve the linear absolute value equation $|x - 1| = 6$ in different ways. Compare their strategies and then determine the solutions to the equation.

Martina

$(x - 1) = 6$ or $(x - 1) = -6$

Bob

$x - 1 = 6$ or $-x + 1 = 6$

3. Solve each linear absolute value equation. Show your work.

a. $|x + 7| = 3$

$x + 7 = 3$ $\quad$ $x + 7 = -3$

$x = -4$ $\quad$ $x = -10$

b. $|x - 9| = 12$

$x - 9 = 12$ $\quad$ $x - 9 = -12$

$x = 21$ $\quad$ $x = -3$

c. $|3x + 7| = -8$

No Solution

d. $|2x + 3| = 0$

One Solution

$$2x + 3 = 0$$

$$2x = -3$$

$$x = -\frac{3}{2}$$

Ask yourself:

Before you solve each equation, think about the number of solutions each equation may have. You may be able to save yourself some work—and time!

4. Artie, Donald, Cho, and Steve each solved the equation $|x| - 4 = 5$.

Artie

$$|x| - 4 = 5$$

$$(x) - 4 = 5 \qquad -(x) - 4 = 5$$
$$(x) = 9 \qquad -x = 9$$
$$x = -9$$

Donald

$$|x| - 4 = 5$$
$$|x| = 9$$

$$(x) = 9 \qquad -(x) = 9$$
$$x = -9$$

Cho

$$|x| - 4 = 5$$

$$(x) - 4 = 5 \qquad -[(x) - 4] = 5$$
$$x - 4 = 5 \qquad -x + 4 = 5$$
$$x = 9 \qquad -x = 1$$
$$x = -1$$

Steve

$$|x| - 4 = 5$$

$$(x) - 4 = 5 \qquad -(x) - 4 = -5$$
$$x = 9 \qquad -x - 4 = -5$$
$$-x = -1$$
$$x = 1$$

5. Solve each linear absolute value equation.

a. $|x| + 16 = 32$

$$|x| = 16$$

$$x = 16 \text{ or } -16$$

b. $23 = |x - 8| + 6$

$$17 = |x - 8|$$

$$x - 8 = 17 \qquad x - 8 = -17$$

$$x = 25 \qquad x = -9$$

c. $3|x - 2| = 12$

$$|x-2| = 4$$

$$x-2=4 \qquad x-2=-4$$

$$x=6 \qquad x=-2$$

d. $35 = 5|x + 6| - 10$

$$45 = 5|x+6|$$

$$9 = |x+6|$$

$$x+6=9 \qquad x+6=-9$$

$$x=3 \qquad x=-15$$