

3-7: Absolute Value Equations Notes

Lesson Objective: To solve equations that have absolute values in them.

What do absolute value symbols determine?

How far a # is away from 0.

TRY

Simplify the following:

1.  $|15| = 15$

2.  $|-3| = 3$

3.  $|18-12|$   
 $|6| = 6$

4.  $-|-7|$

5.  $|12 - 12|$

6.  $|-10+8|$

$-1 \cdot |-7|$   
 $-1 \cdot 7$   
 $-7$

$|24|$   
 $24$

$|-2|$   
 $2$

Complete with  $>$ ,  $=$ , or  $<$

7.  $|3-7| \square 4$   
 $| -4 | \square 4$   
 $4 \square 4$

8.  $|-5|+2 \square 6$   
 $5+2 \square 6$   
 $7 \square 6$

9.  $|7|-1 \square 8$   
 $7-1 \square 8$   
 $6 \square 8$

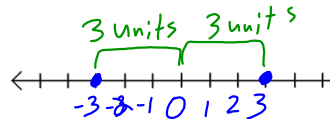
10.  $|6-2\frac{1}{4}| \square 3\frac{5}{8}$   
 $|3\frac{3}{4}| \square 3\frac{5}{8}$   
 $|3\frac{6}{8}| \square 3\frac{5}{8}$   
 $3\frac{6}{8} > 3\frac{5}{8}$

EXAMPLE

Solve  $|x|=3$

$x = \pm 3$  since  
 $+3$  and  $-3$  are  
3 units away from 0.

Graph the solution



Checks:

$|3| = 3 \checkmark$

$|-3| = 3 \checkmark$

EXAMPLE      ① Isolate the  $|x|$   
                   ② Give the two answers.

$$|x| + 5 = 11$$

$$|x| = 6$$

$$x = \pm 6$$

TRY

$$3|w| - 2 = 4$$

$$3|w| = 6$$

$$|w| = 2$$

$$w = \pm 2$$

$$\text{LCD} = 8$$

$$4 - 8 \left( \frac{3}{2}|w| \right) - \frac{1}{4} = \frac{1}{8}$$

$$12|w| - 2 = 1$$

$$12|w| = 3$$

$$|w| = \frac{1}{4}$$

$$w = \pm \frac{1}{4}$$

### SOLVING ABSOLUTE VALUE EQUATIONS

$|x| = n$ , where  $n > 0$ , then

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

solve:  $x = -n$

$$|x| = n$$

$$x = \pm n$$

- ① Isolate the absolute value
- ② Then, set what's in the absolute value equal to both the positive and negative version of the number it equals.

EXAMPLE

$$|x-3|=5$$

↑  
The absolute value is already isolated.

$$x-3 = \pm 5$$

$$x-3 = 5$$

$$+3 \quad +3$$

$$x = 8$$

$$x-3 = -5$$

$$+3 \quad +3$$

$$x = -2$$

$$\frac{-3|2w|}{-3} = \frac{-12}{-3}$$

$$|2w| = 4$$

$$2w = \pm 4$$

$$\frac{2w}{2} = \frac{4}{2}$$

$$w = 2$$

$$\frac{2w}{2} = \frac{-4}{2}$$

$$w = -2$$

or

$$w = \pm 2$$

TRY

$$|3c-6|=9$$

$$3c-6 = \pm 9$$

$$3c-6 = 9$$

$$+6 \quad +6$$

$$3c = 15$$

$$\frac{3c}{3} = \frac{15}{3}$$

$$c = 5$$

$$3c-6 = -9$$

$$+6 \quad +6$$

$$3c = -3$$

$$\frac{3c}{3} = \frac{-3}{3}$$

$$c = -1$$

or

$$\frac{2|d+4|}{2} = \frac{8}{2}$$

$$|d+4| = 4$$

$$d+4 = \pm 4$$

$$d+4 = 4$$

$$-4 \quad -4$$

$$d = 0$$

$$d+4 = -4$$

$$-4 \quad -4$$

$$d = -8$$

Example:

$$3|x + 2| + 4 = 13$$

~~-4~~ -4

~~$$3|x + 2| = \frac{9}{3}$$~~

$$|x + 2| = 3$$

$$x + 2 = \pm 3$$

$x + 2 = 3$ $\begin{array}{r} -2 \\ -2 \end{array}$ $x = 1$	$x + 2 = -3$ $\begin{array}{r} -2 \\ -2 \end{array}$ $x = -5$
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$$|-3n| - 2 = 4$$

~~+2~~ +2

$$|-3n| = 6$$

$$-3n = \pm 6$$

$\frac{-3n = 6}{-3 \quad -3}$ $n = -2$	$\frac{-3n = -6}{-3 \quad -3}$ $n = 2$
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$n = \pm 2$

Example:

$$-3|3c - 6| - 18 = 9$$

~~+18~~ +18

~~$$-3|3c - 6| = \frac{27}{-3}$$~~

$$|3c - 6| = -9$$

TRY

$$-5.5 = |t + 2|$$

No solutions

No solution because the absolute value of a # is always positive.

• Only say there are no solutions if the isolated absolute value equals a negative.

TRY

$|x+3| = -1+5x$  *already isolated*

$x+3 = \pm 1(-1+5x)$

$x+3 = -1+5x$   
 $-x$   
 $3 = -1+4x$   
 $+1$   
 $4 = 4x$   
 $\frac{4}{4} = \frac{4x}{4}$   
 $1 = x$

$x+3 = 1-5x$   
 $-x$   
 $3 = 1-6x$   
 $-1$   
 $2 = -6x$   
 $\frac{2}{-6} = \frac{-6x}{-6}$   
 $-\frac{1}{3} = x$

**HOMEWORK**  
Pages 210-212: 9-31 odd

Solve each equation. Graph and check your solutions.

See Probl

- |                        |                 |                   |                   |
|------------------------|-----------------|-------------------|-------------------|
| 9. $ b  = \frac{1}{2}$ | 10. $4 =  y $   | 11. $ n  + 3 = 7$ | 12. $7 =  s  - 3$ |
| 13. $ x  - 10 = -2$    | 14. $5 d  = 20$ | 15. $-3 m  = -9$  | 16. $ y  + 3 = 3$ |

*odds*

Solve each equation. If there is no solution, write *no solution*.

See Problems 2

- |                        |                          |                        |
|------------------------|--------------------------|------------------------|
| 17. $ r - 8  = 5$      | 18. $ c + 4  = 6$        | 19. $2 =  g + 3 $      |
| 20. $3 =  m + 2 $      | 21. $-2 7d  = 14$        | 22. $-3 2w  = -12$     |
| 23. $3 v - 3  = 9$     | 24. $2 d + 4  = 8$       | 25. $ 4f + 1  - 2 = 5$ |
| 26. $ 3t - 2  + 6 = 2$ | 27. $4 2y - 3  - 1 = 11$ | 28. $ x + 2  + 4 = 13$ |
| 29. $-4 k  = 12$       | 30. $ -3n  - 2 = 4$      | 31. $-4 k + 1  = 16$   |

*all odds and 28*  
*9-31*