

LESSON

12

Absolute Value Equations

LEARNING OBJECTIVES

- ▶ Today I am: reviewing the meaning of absolute value.
- ▶ So that I can: solve and graph absolute value equations.
- ▶ I'll know I have it when I can: determine how many solutions an equation like $|x - 2| = 3$ has.

Warm-Up Exercise

1. Watch the absolute value video on YouTube *Math Shorts Episode 10* and then answer the questions below.

<https://www.youtube.com/watch?v=wrof6Dw63Es>



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A. $|-3| = \underline{3}$

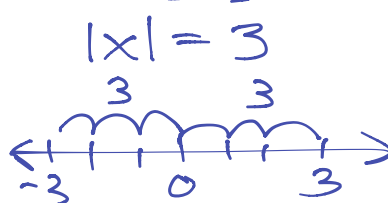
B. $|4.75| = \underline{4.75}$

C. $|-10| + |-4| = \underline{14}$
 $10 + 4$

D. $|-11| - |-21| = \underline{-10}$
 $11 - 21$

E. If $|x| = 4.5$, then $x = \underline{4.5}$ or $\underline{-4.5}$.
The distance that x is away from zero = 4.5

F. If $|x| + 3 = 6$, then $x = \underline{3}$ or $\underline{-3}$.



The distance that x is


The distance that x is away from zero is 3.

Exploratory Exercise

First, let's look at absolute value equations, like we saw in Exercise 1E and 1F.

2. For each absolute value equation below, think about any values of x that will make the equation true. Are there two solutions for each one?

A. $|x| - 2 = 4$
 $+2 +2$
 $|x| = 6$
 The distance between x and zero is six.
 $x = 6$ or -6

B. $|x - 2| = 4$

 The distance that x is away from 2 is 4.

C. $2|x| = 4$
 $\div 2 \div 2$
 $|x| = 2$
 $x = 2$ or -2

D. $|x| = -4$
 No solution.

3. A. Kyle wrote the following steps to solve absolute value equations. Use Kyle's steps to solve $|x + 1| - 2 = 7$.

Steps	Example: $ x + 1 - 2 = 7$
1. Get the absolute value term alone. You can add, subtract, multiply or divide to get it alone.	$+2 +2$ $ x + 1 = 9$
2. You have to make two equations. Take what is in the absolute value symbol and make it equal to the number on the other side of the equal sign and also take that same inside part and set it equal to the opposite of the number on the other side of the equal sign.	$x + 1 = 9$ $x + 1 = -9$ $-1 -1$ $-1 -1$
3. Solve each equation.	$x = 8$ $x = -10$
4. Check your work.	$x = 8$ $x = -10$ $ 8 + 1 - 2 = 7$ $ -10 + 1 - 2 = 7$ $ 9 - 2 = 7$ $ -9 - 2 = 7$ $9 - 2 = 7 \checkmark$ $9 - 2 = 7 \checkmark$

B. Look at the problems on the next page. What other steps should be added to Kyle's steps to cover all absolute value situations?

Practice Exercises

4. $ k + 9 = 2$	5. $ k - 9 = 2$	6. $ k + 9 = -2$ No solution
7. $ 2x = 12$	8. $ 2x - 4 = 14$ $\quad +4 \quad +4$ $ 2x = 18$ $\swarrow \quad \searrow$ $2x = 18 \quad 2x = -18$ $x = 9 \quad x = -9$	9. $ n + 1 = 7$
10. $ -2 + x = 1$	11. $ 10 - 10n = 50$	12. $ a - 6 = -7$ No solution

<p>13. $-3x = 48$</p>	<p>14. $n \div 4 = 3$</p>	<p>15. $5y - 10 = 15$</p> <p style="text-align: center;"> \swarrow \searrow $5y - 10 = 15$ $5y - 10 = -15$ or $5y = 25$ $5y = -5$ $y = 5$ $y = -1$ </p>
<p>16. $2 -3x = 24$</p> <p style="padding-left: 20px;">$-3x = 12$</p> <p style="text-align: center;"> \swarrow \searrow $-3x = 12$ or $-3x = -12$ $x = -4$ or $x = 4$ </p>	<p>17. $2x + 10 = 14$</p>	<p>18. $\frac{ n + 1 }{2} = 14$</p>
<p>19. $\left \frac{x}{7}\right - 8 = -7$</p> <p style="padding-left: 20px;">$+8$ $+8$</p>	<p>20. $\frac{3 -9 + v }{8} = 3 \cdot 8$</p> <p style="padding-left: 20px;">$\frac{3 -9 + v }{3} = \frac{24}{3}$</p> <p style="padding-left: 20px;">$-9 + v = 8$</p> <p style="text-align: center;"> \swarrow \searrow $-9 + v = 8$ or $-9 + v = -8$ $v = 17$ or $v = 1$ </p>	<p>21. $\frac{ a - 5 }{8} = 5$</p>

22. Play *Who Wants to Win a Million?* and record your work and answers below. The questions below are mixed up so you'll have to look carefully for the one that is being played on the video. <http://www.crctlessons.com/absolute-value-equations-game.html>



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A. Find the solution(s) of the equation $ 3y = 24$	B. Find the solution(s) of the equation $ 5y - 10 = 35$	C. How many solution does the equation $ m + 3 = 9$ have?
D. Find the solution(s) of the equation $ -2k = 26$	E. Find the solution(s) of the equation $ \frac{m}{5} = 20$	F. Find the solution(s) of the equation $ 7f - 14 = -21$
G. Find the solution(s) of the equation $ \frac{4f + 8}{3} = 0$	H. $- -35 =$	I. How many solutions does the equation $ -5m = 0$ have ?
J. $3 - 2 - 9 =$	K. Find the solution(s) of the equation $ 3a - 12 = 3$	L. Find the solution(s) of the equation $ x - 2 = -3$

Lesson Summary

$$2|4a + 5| = 6$$

Get the absolute value term alone.

$$|4a + 5| = 3$$

Split into two equations.

$$4a + 5 = 3$$

$$4a + 5 = -3$$

Solve each equation.

$$a = -\frac{1}{2}$$

$$a = -2$$

23. Finish solving the equations in the Lesson Summary.

NAME: _____ PERIOD: _____ DATE: _____

Homework Problem Set

Solve each absolute value equation.

1. $|k - 6| = 10$

2. $|a| + 6 = 13$

3. $|n - 10| = 4$

4. $|-3r| = 27$

5. $\frac{|n|}{4} = 2$

6. $|6 - 7r| + 4 = 38$

7. $-8 10 + p - 6 = -22$	8. $10 + 3 -2r = 22$
9. $2 + 8 7k - 2 = 42$	10. $7 3n + 5 - 7 = 0$

11. Lindsey is making some home-made toffee. The recipe says that she must bring the mixture to a boil at 285 degrees. If she is 7 degrees above or below, the toffee should turn out fine.

Write and solve an absolute value equation to model the minimum and maximum temperatures that would still create yummy toffee.



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Spiral REVIEW—True and False Statements

For Problems 12–17, let $x = -3$ and $y = \frac{2}{3}$. Determine whether the following equations are true, false, or neither true nor false.

12. $xy = -2$

13. $x + 3y = -1$

14. $x + z = 4$

15. $9y = -2x$

16. $\frac{y}{x} = -2$

17. $\frac{-\frac{2}{x}}{y} = -1$

Spiral REVIEW—Solving Equations

For Problems 18–21, which values of x will make the equation a true statement?

18. $x + 2 = 9$

19. $x + 2^2 = -9$

20. $-12t = 12$

21. $12t = 24$

REVIEW—Translate

For each description, match the expression, equation or inequality.

- | | |
|---|--------------------|
| 22. Four is less than a number | A. $n + 4 = 6$ |
| 23. Four more than a number is 6 | B. $4 \leq n$ |
| 24. Four is greater than or equal to a number minus three | C. $4 \cdot n = 3$ |
| 25. Four multiplied by a number is equal to three | D. $3 + 4 = n$ |
| 26. Four is less than or equal to a number | E. $4 < n$ |
| 27. Four is equal to three less a number | F. $4 = n - 3$ |
| 28. Four more than three is equal to a number | G. $4 > n \cdot 3$ |
| 29. Four is greater than a number multiplied by three | H. $4 \geq n - 3$ |