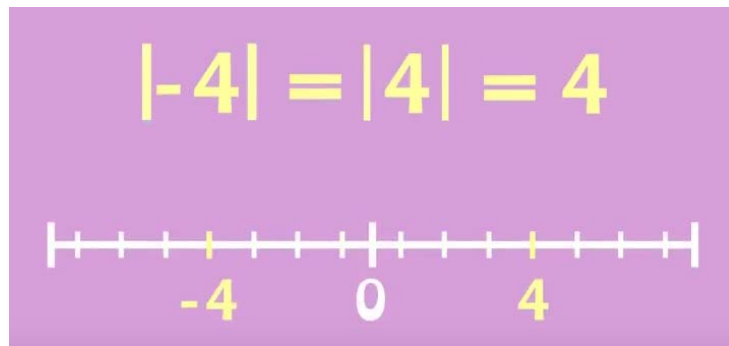


## Lesson 8: Absolute Value Equations

### 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>



A.  $|-1.3| = \underline{1.3}$

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  $\underline{-4.5}$ .

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

### 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.  $|x| - 2 = 4$   
 $+2 +2$   
 $|x| = 6$   
 $x = 6$   $x = -6$

B.  $|x - 2| = 4$   
 $x = 6$  or  $x = -2$

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

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

3. Kyle wrote the following steps to solve absolute value equations.

1. Get the absolute value term alone. You can add, subtract, multiply or divide to get it alone.
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.
3. Solve each equation.
4. Check your work.

A. Use Kyle's steps to solve  $|x+1|-2=7$ .

$$\begin{array}{r} |x+1|-2=7 \\ +2 \quad +2 \\ |x+1|=9 \end{array}$$

$$\begin{array}{r} x+1=9 \quad x+1=-9 \\ -1 \quad -1 \quad -1 \quad -1 \\ \hline x=8 \quad x=-10 \end{array}$$

$$\begin{array}{r} |x-2|=4 \\ x-2=4 \quad x-2=-4 \\ +2 \quad +2 \quad +2 \quad +2 \\ x=6 \quad x=-2 \end{array}$$

B. What other steps should be added to Kyle's steps to cover all absolute value situations?

## Practice Problems

$$4. |k+9|=2$$

$$k+9=2 \quad k+9=-2$$

$$\boxed{k=-7} \quad \boxed{k=-11}$$

$$5. |k-9|=2$$

$$k-9=2 \quad k-9=-2$$

$$\boxed{k=11} \quad \boxed{k=7}$$

$$6. |k+9|=-2$$

No  
Solution

$$7. |2x|=12$$

$$2x=12 \quad 2x=-12$$

$$\boxed{x=6} \quad \boxed{x=-6}$$

$$8. |2x|-4=14$$

$$2x=18 \quad 2x=-18$$

$$\boxed{x=9} \quad \boxed{x=-9}$$

$$9. |n+1|=7$$

$$n+1=7 \quad n+1=-7$$

$$\boxed{n=6} \quad \boxed{n=-8}$$

$$10. |-2+x|=1$$

$$-2+x=1 \quad -2+x=-1$$

$$\boxed{x=3} \quad \boxed{x=1}$$

$$11. |10-10n|=50$$

$$10-10n=50 \quad 10-10n=-50$$

$$-10n=40 \quad -10n=-60$$

$$\boxed{n=-4} \quad \boxed{n=6}$$

$$12. |a-6|=-7$$

No  
Solution

$$13. |-3x|=48$$

$$-3x=48 \quad -3x=-48$$

$$\boxed{x=-16} \quad \boxed{x=16}$$

$$14. |n \div 4|=3$$

$$\frac{n}{4}=3 \quad \frac{n}{4}=-3$$

$$\boxed{n=12} \quad \boxed{n=-12}$$

$$15. |5y-10|=15$$

$$5y-10=15 \quad 5y-10=-15$$

$$5y=25 \quad 5y=-5$$

$$\boxed{y=5} \quad \boxed{y=-1}$$

$$16. 2|-3x|=24$$

$$-3x=12 \quad -3x=-12$$

$$\boxed{x=-4} \quad \boxed{x=4}$$

$$17. |2x+10|=14$$

$$2x+10=14 \quad 2x+10=-14$$

$$2x=4 \quad 2x=-24$$

$$\boxed{x=2} \quad \boxed{x=-12}$$

$$18. \frac{|n+1|}{2}=14$$

$$n+1=28 \quad n+1=-28$$

$$\boxed{n=27} \quad \boxed{n=-29}$$

19. Play the *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>

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

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

$a = -2$

20. Finish solving the equations in the Lesson Summary.

## 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.

**Spiral Review**

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

For Problems 18 – 21, assign a value to the variable,  $x$ , to make the equation a true statement.

18.  $x + 2 = 9$

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

20.  $-12t = 12$

21.  $12t = 24$