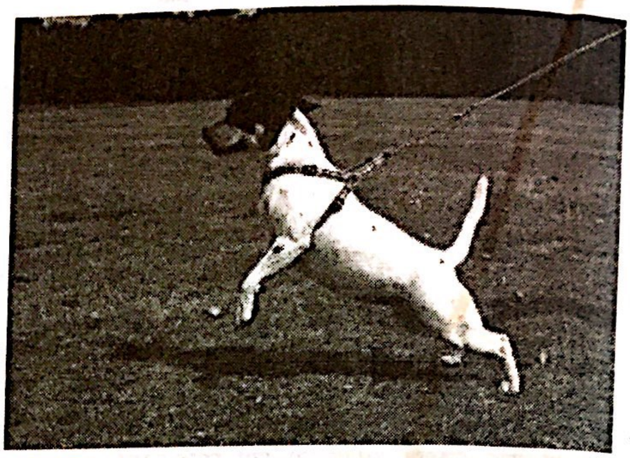
EQ: how do we solve Eq + Ineq w/ absolute Value

Lesson 4: A Dog's Life

A Solidify Understanding Task

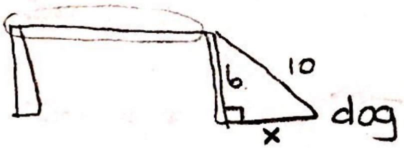


https://yourdogsfriend.org/help/pulling-on-leash/

Lily has a rat terrier named Mo. He's a feisty little dog, and boy, can he run! She has a big backyard but it does not have a fence, and she cannot afford to buy one at this time. She is trying to come up with a way of letting him run in the back yard without getting loose.

Lily is thinking about using a dog run which is a cable suspended above the ground between two poles. The dog's leash is attached to the cable, allowing the dog to run up and down and from side to side of the line of the cable.

1. If the cable is 6 ft off of the ground and the leash is 10 ft long, how far out can Mo run on either side of the cable line?



$10^2 = 6^2 + x^2$

$x = 8$

8 feet both Ways

2. Lily visualizes the cable as zero on a number line. What numbers on this number line can Mo run between? Write this interval as an inequality.

$-8 \le x \le 8$

$[-8, 8]$

Lily knows this is the distance that Mo can run from the cable on either side. In math class she has been learning about absolute value and that it represents the distance of a number away from zero.

3. Represent the distance Mo can be away from the cable using absolute value.

$|x| \le 8$

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4. For problem #3, which relationship symbol did you use to compare the two expressions (=, <, >, ≥, ≤)? Explain your reasoning.

≤ distance is less than = to 8

5. Lily decides she doesn't like having negative numbers when she is thinking about distances in her backyard. She wants to change the cable from being at 0 on the number line to being at 10 to represent the fact that it is 10 feet away from her house.

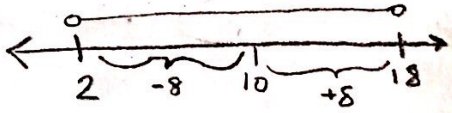
   a. How could you modify your absolute value inequality from #3 to show this change?

$|x-10| \leq 8$

distance is 8 feet
left or right? both?

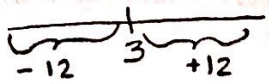
   b. What would be the numbers that Mo could run between now? Write this interval as an inequality.

$2 \leq x \leq 18$



6. Lily is starting to see how what she has been learning about absolute value fits with her situation with Mo. Because his distance from the cable is LESS THAN a certain amount, he is held in between two values. She wants to see if this works for all absolute value equations.

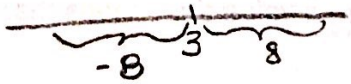
   a. What does it mean for the value(s) of x if $|x - 3| \leq 12$?



$-9 \leq x \leq 15$

   b. What does it mean for the value(s) of x if $|x - 3| + 4 < 12$? How is this inequality different from part a?

$|x-3| < 8$



$-5 < x < 11$

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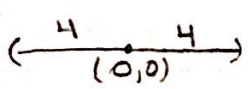
7. Lily's Mom has a very special flower bed in the middle of the backyard that she does not want Mo to get into and mess up. To keep Mo out she has buried an invisible fence sensor in the middle of the bed that will keep Mo from getting within 4 feet of it.
   a. If Lily thinks of the middle of the flower bed as zero, where can Mo be on the number line? Write this interval as an inequality.



$x < -4$ or $x > 4$

$(-\infty, -4) \cup (4, \infty)$

   b. Lily realizes we are still talking about a fixed distance away from something, so we are still talking about absolute value. How could you write his distance from the invisible fence sensor as an absolute value?

$|x| > 4$

11. For number ten, what kind of relationship symbol did you use to compare the two expressions? Explain your reasoning.

Lily did not like having negative numbers for distances in her backyard. She wanted to move the sensor from 0 to 8.

12. How could you change the absolute value from #10 to show this change?

13. What would be the numbers that Mo could run on now? How would you write this interval as an inequality?

Lily starts to see that this also applies to absolute value. If the absolute value is GREATER than a value this means that the solutions CANNOT be between two

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numbers, but is outside of those two numbers. She wonders if this is the same for other situations.

14. What values of x are solutions to $|x - 3| \geq 12$?

$x \leq -9$ or $x \geq 15$
$(-\infty, -9] \cup [15, \infty)$

15. What values of x are solutions to $|x - 3| + 4 > 12$? How is this different?

$|x-3| > 8$

$x < -5$ or $x > 11$
$(-\infty, -5) \cup (11, \infty)$

16. This also got Lily thinking about other situations. What would these situations mean? Explain your reasoning and make your thinking visible!

a. $|x + 4| < 0$ not possible $\emptyset$

b. $\frac{-2|x - 5|}{-2} \leq \frac{6}{-2}$ | | is always positive
$|x-5| > -3$ $\mathbb{R}$

c. $|2x - 5| + 6 > 4$ $\mathbb{R}$
$|2x-5| > -2$

d. $|4x + 5| - 3 = 8$ $x = -4$ not a range of #'s
$|4x+5| = 11$ $x = 3/2$ =

e. $2|x - 6| + 8 = 6$ $\emptyset$
$|x-6| = -1$

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Unit 1 - Lesson 4

READY, SET, GO!

Name Period Date

READY

Topic: Solving absolute value equations.
Solve for x. (You will have two answers.)

1. $|x| = 7$
   $x = \pm 7$
2. $|x - 6| = 3$
   $x = 3, 9$
3. $|w + 4| = 11$
   $w = 7, -15$
4. $-9|m| = -63$
   $m = \pm 7$
5. $|3d| = 15$
   $d = \pm 5$
6. $|3x - 5| = 11$
   $x = 16/3, -2$
7. $-|m + 3| = -13$
   $m = 10, -16$
8. $|-4m| = 64$
   $m = \pm 16$
9. $2|x + 1| - 7 = -3$
   $m = 1, -3$
10. $5|c + 3| - 1 = 9$
    $c = -1, -5$
11. $-2|2p - 3| - 1 = -11$
    $p = 4, -1$
12. **Explain why the equation $|m| = -3$ has no solution.**

SET

11 means distance / distance never neg.

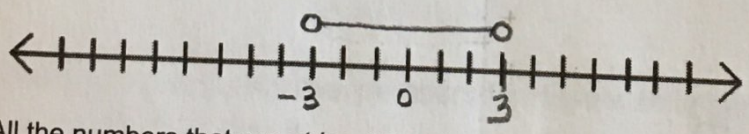
Which of these is a solution to the given inequality? Justify your answer.

1. $|4x + 1| \leq 11$
   a. $x = 3$ **Yes** or **No**
   b. $x = -1$ **Yes** or **No**
   c. $x = 2.5$ **Yes** or **No**
2. $3|7 - 2x| + 5 > 14$
   a. $x = 3$ **Yes** or **No**
   b. $x = -1$ **Yes** or **No**
   c. $x = 2.5$ **Yes** or **No**

Absolute Value Ineq

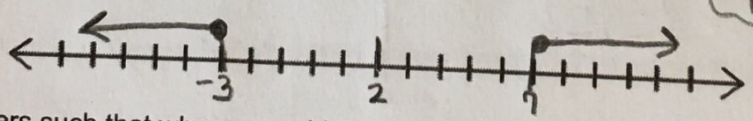
Show the solution for each inequality on the number line provided.

3. All the numbers that are less than 3 units from 0



$|x| < 3$ $x > -3$ $x < 3$

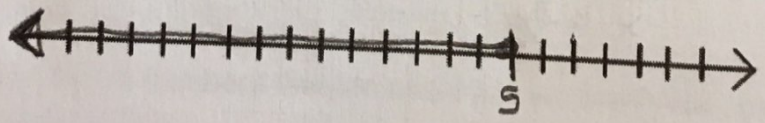
4. All the numbers that are *at least* 5 units away from 2.



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

5. All numbers such that when you add 3, the result is no more than 8.

$5+3=8$



$x \leq 5$

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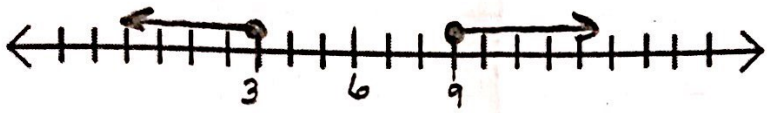
6. All values of x for which $|x-6| \geq 3$

$x \leq 3$ or $x \geq 9$

or

$x-6 \geq 3$ or $x-6 \leq -3$

$x \geq 9$ or $x \leq 3$



Solve each inequality algebraically.

7. $|3-x| > 10$

$x < -7$ or $x > 13$

8. $|2x+5| \leq 21$

$-13 \leq x \leq 8$

9. $22 \geq |12+x|$

$-34 \leq x \leq 10$

10. $-4|4x-3| > -28$

$-1 < x < 5/2$

11. $|7-x|+4 < 10$

$1 < x < 13$

12. $5|3x+11|-29 \leq -4$

$-16/3 \leq x \leq -2$

13. As Lily thought about her learning, she wondered how her work would apply to a specific distance, not just "closer than" or "further than". Describe how you would find the number(s) Mo could stand on to be *exactly* 9 feet from the sensor in the flower bed.

GO

Graph each function. Be sure to label your work.

$f(x) = (x-3)^2 - 1$

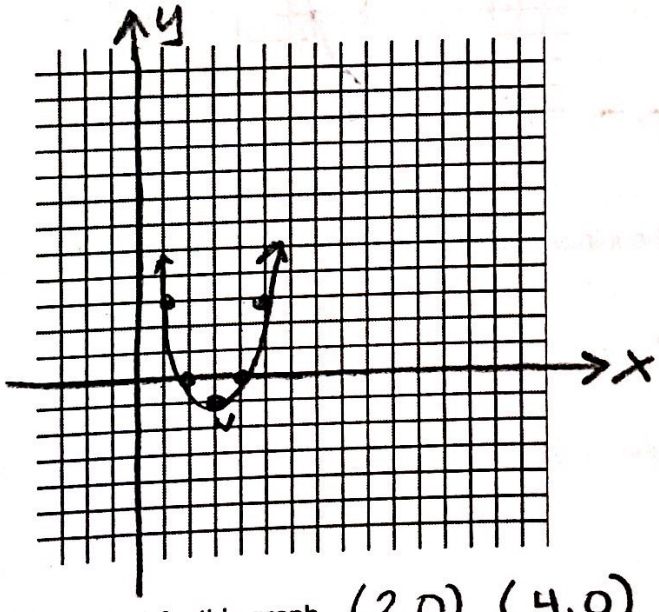
Vertex form

$f(x) = (x-h)^2 + k$

$V(h, k)$

Parabola

$V(3, -1)$



a. Identify the x-intercept(s) for this graph. (2,0) (4,0)

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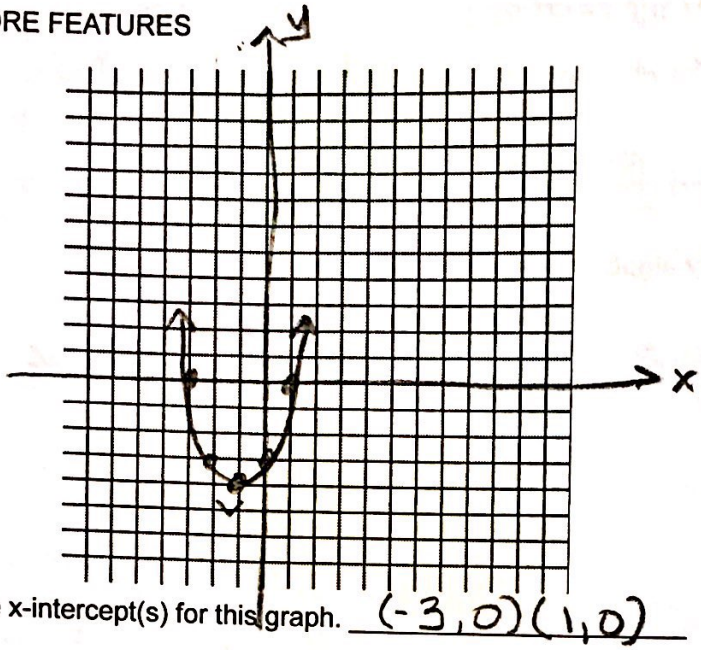
14. $f(x) = (x+1)^2 - 4$

V(-1, -4)

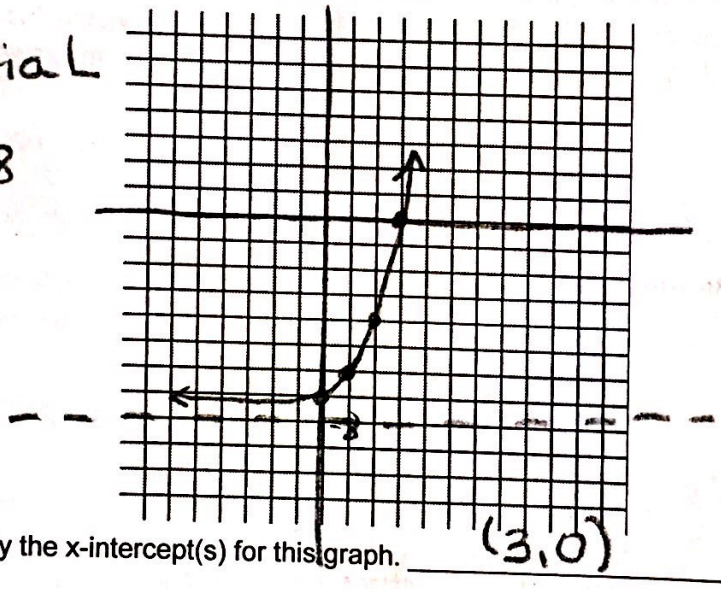


a. Identify the x-intercept(s) for this graph. (-3, 0) (1, 0)

15. $f(x) = 2^x - 8$

Exponential

H.A y = -8



a. Identify the x-intercept(s) for this graph. (3, 0)

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