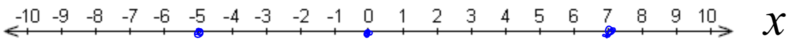
1.2 Absolute Value Notation and Interval Notation

Math Learning Target:
"I can graph transformations of the absolute value function, and state several properties. I can express a solution for an equation and inequality in set notation, absolute value notation and interval notation. I can graph all solutions for equations and inequalities on the number line."

absolute value The **absolute value** of a number x on an axis is its distance to the axis' origin. The notation used is $|x|$. This axis is traditionally referred to as the **number line**.

$|-3-4|$
$=|-7|$
$=7$



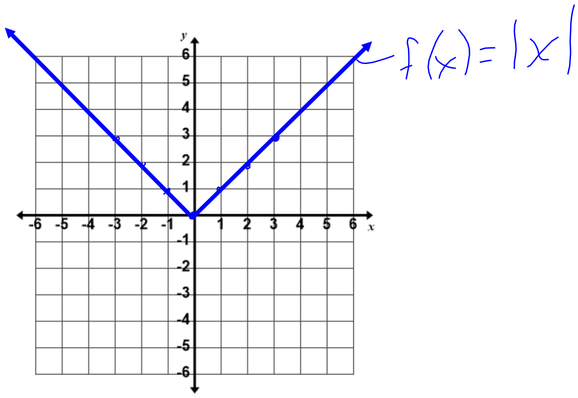
$|-5| = 5$ $\quad |0| = 0$ $\quad |7| = 7$

Since each element x on an axis has one, and only one, absolute value, the absolute value of x can be described as a function.

Graph $f(x) = |x|$

$|(-3)(4)|$
$=|-3|\cdot|-4|$
$=3\cdot 4$
$=12$

x	y
3	$\lvert 3\rvert=3$
2	2
1	1
0	0
-1	$\lvert -1\rvert=1$
-2	$\lvert -2\rvert=2$
-3	$\lvert -3\rvert=3$



Important Properties: (Characteristics)

Read p.15

Graph is comprised of 2 linear functions

$$f(x)=\begin{cases} x, & \text{if } x\geq 0 \\ -x, & \text{if } x<0 \end{cases}$$

* no overlap

Set Notation

$D: \{x\in\mathbb{R}\}$

$R: \{y\in\mathbb{R} \mid y\geq 0\}$

Interval Notation

$x\in(-\infty,\infty)$

$y\in[0,\infty)$

Increasing: $\{x\in\mathbb{R} / x\geq 0\}$

Decreasing: $\{x\in\mathbb{R} / x<0\}$

End Behaviours

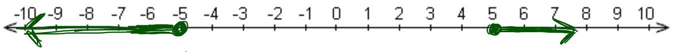
as $x\to\infty$, $y\to\infty$

as $x\to-\infty$, $y\to\infty$

Examples

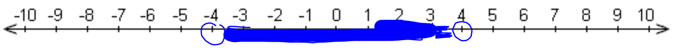
1. Express using absolute value notation: $\{x \in R \mid x \leq -5 \text{ or } x \geq 5\}$ ∪

$\hookrightarrow \{x \in \mathbb{R} \mid |x| \geq 5\}$



closed

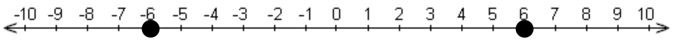
2. Graph on the real number line: $\{x \in R \mid |x| < 4\}$



open

$x \in [-6,-6] \cup [6,6]$

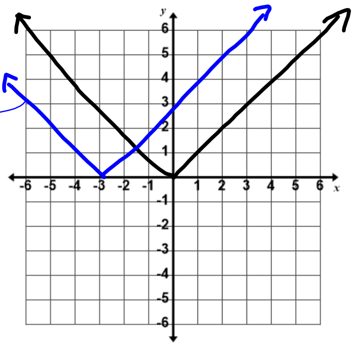
3. Express using absolute value notation: $\{x \in \mathbb{R} \mid |x| = 6\}$



4. Without a table of values, graph:

$g(x) = |x+3|$

$g(x)$



5. Express in interval notation:

a) $\{x \in R \mid x > 6\}$ $\mathbb{R}$ $x \in (6, \infty)$

b) $\{x \in R \mid -3 \leq x \leq 5\}$ $\mathbb{R}$ $x \in [-3, 5]$

c) $\{x \in R \mid |x| < 2\}$ $\mathbb{R}$ $x \in (-2, 2)$

If #5 was difficult, study video lessons 1, 2 and 3:

http://courseware.cemc.uwaterloo.ca/8/assignments/75/0

On any assessment in this course, you must be prepared to present your solution in set notation, interval notation and absolute value notation.

And finally... what is $\sqrt{x^2}$ simplified? Hint: Make a Table for $y = \sqrt{x^2}$

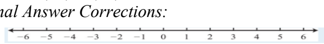
x	$y = \sqrt{x^2}$
3	$\sqrt{(3)^2} = \sqrt{9} = 3$
2	$\sqrt{(2)^2} = \sqrt{4} = 2$
1	1
0	0
-1	$\sqrt{(-1)^2} = \sqrt{1} = 1$
-2	2
-3	$\sqrt{(-3)^2} = \sqrt{9} = 3$

$y = |x|$

Today's entertainment...

pg. 16 #2, 3, 4*, 5, 7.

**Final Answer Corrections:*

4c:  i.e. no solution (so no "shading")

4d:  i.e. entire number line (entire line is "shaded")

Now do these two quick quizzes: http://courseware.cemc.uwaterloo.ca/8/assignments/75/3

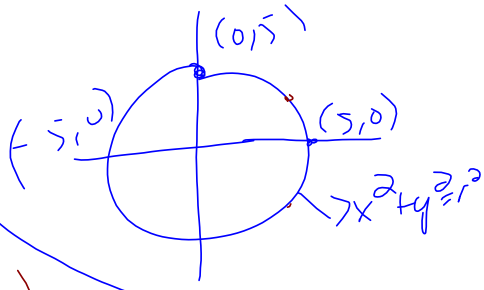
http://courseware.cemc.uwaterloo.ca/8/assignments/75/4 pg. 11 10c 11a 14

10. Consider the relation between x and y that consists of all points (x, y) such that the distance from (x, y) to the origin is 5.

a) Is (4, 3) in the relation? Explain.

b) Is (1, 5) in the relation? Explain.

c) Is the relation a function? Explain.



$LS = x^2 + y^2$ $\quad RS = 5^2$

$= (4)^2 + (3)^2$ $\quad = 25$

$= 16 + 9$

$= 25$

$\because LS = RS$

$\therefore$ (4,3) is in the relation.

(1,5)

$LS = (1)^2 + (5)^2$ $\quad RS = 25$

$= 1 + 25$

$= 26$

$\because LS > RS$

$\therefore$ (1,5) is outside the circle

c) No, For all x values there are 2 corresponding y values.

11. The table below lists all the ordered pairs that belong to the function $g(x)$.

x	0	1	2	3	4	5
$g(x)$	3	4	7	12	19	28

1 3 5 7 9

$g(x) = x^2 + 3$

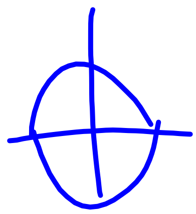
a) Determine an equation for $g(x)$.

b) Does $g(3) - g(2) = g(3 - 2)$? Explain.

Extending

14. Consider the relations $x^2 + y^2 = 25$ and $y = \sqrt{25 - x^2}$. Draw the graphs of these relations, and determine whether each relation is a function. State the domain and range of each relation.

$y = -\sqrt{25 - x^2}$



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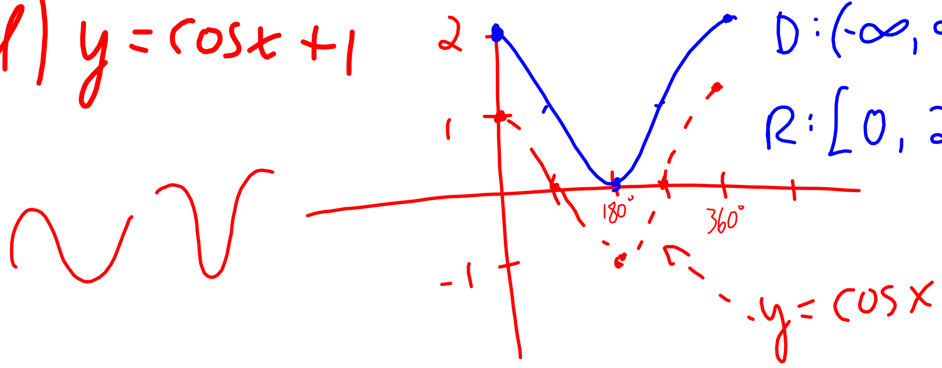
2d) $y = \cos x + 1$



D: $(-\infty, \infty)$

R: $[0, 2]$