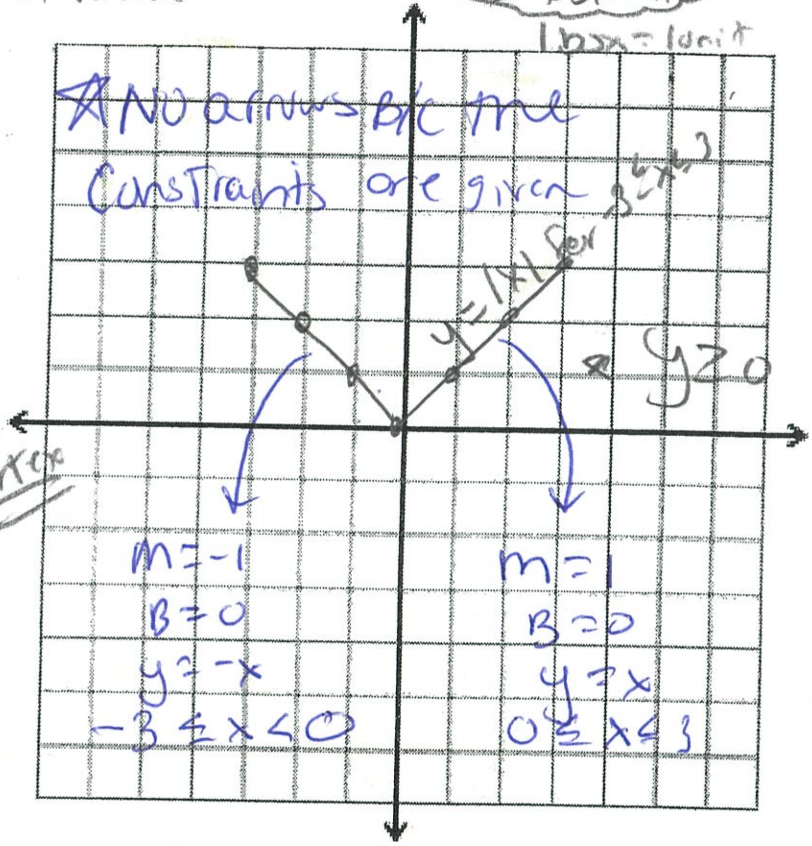
Name Key   Date 23-24
8A; Algebra 1   Period ______

Absolute Value

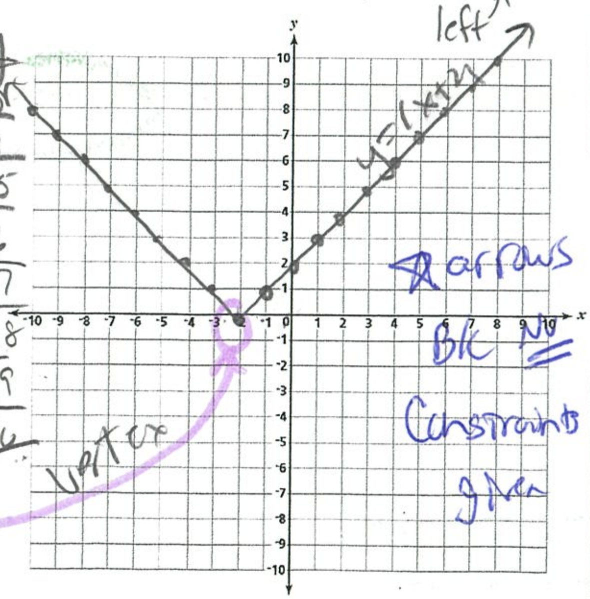
Draw the graph of the equation y = |x| from $-3 \le x \le 3$

X		Y	
-3		3	
-2		2	
-1		1	
0		0	
1		1	
2		2	
3		3	

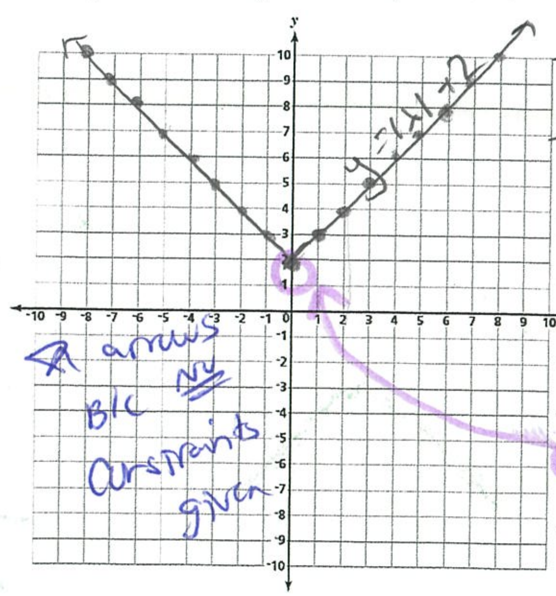


Copy all the coordinates you can plot from $-10 \le x \le 10$

Graph the equation y = |x + 2|



Graph the equation y = |x| + 2



X	y
-8	10
-7	9
-6	8
-5	7
-4	6
-3	5
-2	4
-1	3
0	2
1	3
2	4
3	5

Name ______________________ Date ______________

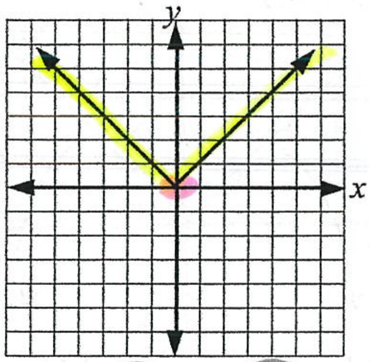
8A: Algebra 1 Period ____________

Graphing Absolute Value

- Remember: Absolute value is the amount of units the number is away from 0.
- Symbol: $|x|$

I. Absolute value function:

- $f(x) = |x|$ (called parent function)
- It is a V shaped graph whose vertex (minimum) is the origin (0,0). → lowest point
- Is it symmetric to the y-axis.
- Domain: Real numbers . Range: y ≥ 0. (pos. y-values)
- This function is also considered a piecewise-defined function: $f(x) = \begin{cases} -x & x < 0 \\ x & x \geq 0 \end{cases}$



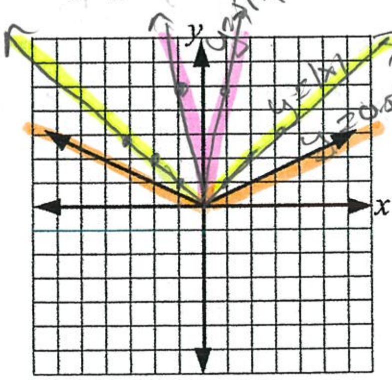
$y = |x|$ *or* $f(x) = |x|$

The vertex is at (0, 0).

Note: The graph of $y = |-x|$ is the same as this one.

x	y
-3	3
-2	2
-1	1
0	0
1	1
2	2
3	3

- Changing the coefficient of x will make the V wider or more narrow



$y = 0.5|x|$ *or* $f(x) = 0.5|x|$

The coefficient here is 0.5.

This graph is wider than the first one, the vertex is still (0, 0).

Note: A coefficient of 5, $y = 5|x|$, would make the graph narrow.

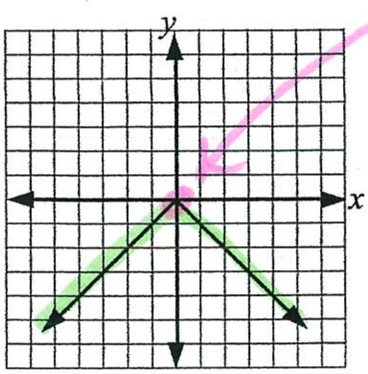
y = 0.5|x|

x	y
-2	1
-1	.5
0	0
1	.5
2	1

y = 5|x|

x	y
-2	10
-1	5
0	0
1	5
2	10

- A negative coefficient outside the absolute value symbol will make the graph an upside down V. Therefore the vertex will now be a maximum point at the origin. highest point



$y = -|x|$ *or* $f(x) = -|x|$

This function has –1 outside the | | which makes the graph look "upside down" when compared with the original $f(x)$.

↓ Reflection over the x-axis

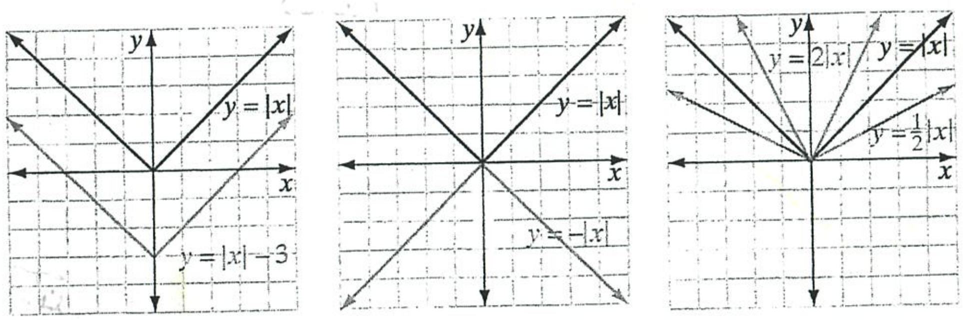
y = -|x|

x	y
-3	-3
-2	-2
-1	-1
0	0
1	-1
2	-2
3	-3

Translating, Reflecting, and Scaling Graphs of Absolute Value Functions

Just as linear functions can be translated, reflected, or scaled, graphs of absolute value functions can also be manipulated by working with the graph of the absolute value function $y = |x|$.

For instance, the graph of $y = |x| - 5$ is the graph of $y = |x|$ shifted 5 units down. The graph of $y = -|x|$ is the graph of $y = |x|$ reflected in the x-axis. The graph of $y = 2|x|$ is the graph of $y = |x|$ stretched vertically by a factor of 2, while the graph of $y = \frac{1}{2}|x|$ is the graph of $y = |x|$ compressed vertically by a factor of $\frac{1}{2}$.



Translation Rules for Absolute Value Functions

If c is *positive*:

affects y-value
- The graph of $y = |x| + c$ is the graph of $y = |x|$ shifted c units up.
- The graph of $y = |x| - c$ is the graph of $y = |x|$ shifted c units down.

Translation = Slide

For absolute value functions, there are two additional translations that can be done to the graph of $y = |x|$, *horizontal* shifting to left or to the right.

If c is positive:

affects x-value
- The graph of $y = |x + c|$ is the graph of $y = |x|$ shifted c units to the left.
- The graph of $y = |x - c|$ is the graph of $y = |x|$ shifted c units to the right.

Translation = slide

Reflection Rule for Absolute Value Functions

- The graph of $y = -|x|$ is the graph of $y = |x|$ reflected across the x-axis.

Turned upside down (Rotation of 180°)

Scaling Rules for Absolute Value Functions

- When $c > 1$, the graph of $y = c|x|$ is the graph of $y = |x|$ stretched vertically by a factor of c. narrower (whole #)
- When $0 < c < 1$, the graph of $y = c|x|$ is the graph of $y = |x|$ compressed vertically by a factor of c. wider (decimal

☆ stretched vertically: is also called a horizontal compression

☆ compressed vertically: is also called a horizontal stretch

1) What will be the equation of the resulting graph if the graph of $y = |x|$ is shifted 4 units down?

A) $y = |x| + 4$ C) $y = |x - 4|$
B) $y = |x| - 4$ D) $y = |x + 4|$

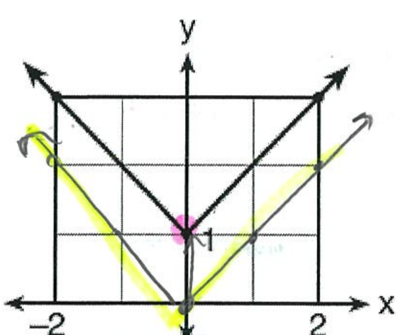
2) What will be the equation of the resulting graph if the graph of $y = |x|$ is shifted 8 units to the right?

A) $y = |x - 8|$ C) $y = |x| - 8$
B) $y = |x| + 8$ D) $y = |x + 8|$

3) When compared to the graph of $y = |x|$, the graph of $y = |x| + 1$ is

A) shifted down 1 unit
B) shifted to the right 1 unit
C) shifted to the left 1 unit
D) shifted up 1 unit

4) Which equation represents the function shown in the accompanying graph?



up 1

[A] $f(x) = |x| + 1$ [B] $f(x) = |x - 1|$
[C] $f(x) = |x + 1|$ [D] $f(x) = |x| - 1$

5) Describe the translation, reflection, and /or scaling that must be applied to $y = |x|$ to obtain the graph of the given function:

$$y = 3|x| - 5$$

if you multiply by

① narrower by a scale factor of 3

② Translated 5 units down

6) Describe the translation, reflection, and /or scaling that must be applied to $y = |x|$ to obtain the graph of the given function

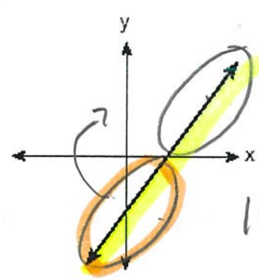
$$y = -2|x + 6| + 1$$

① Reflection over the x-axis

② narrower by a scale factor of 2

③ Translated 6 units left and 1 unit up.

7) The graph below represents $f(x)$.

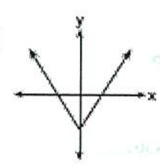


$|+y| = +y$

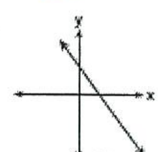
$|-y| = +y$

Which graph best represents $|f(x)|$?

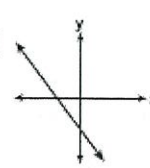
[A]



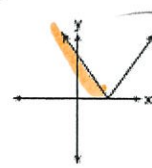
[B]



[C]



[D]



#'s 8-9: Describe the transformation from the graph of f(x) to the graph of g(x).

8) $f(x) = |x|$; $g(x) = |x+4|-3$

Translated 4 units left and 3 units down

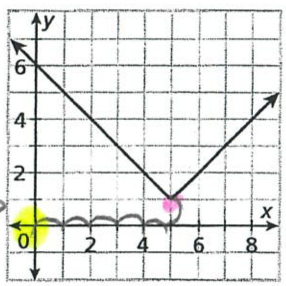
9) $f(x) = |x|$; $g(x) = |x-6|+2$

Translated 6 units right and 2 units up

#'s 10-13: Write the equation of each absolute value function whose graph is shown,

10)

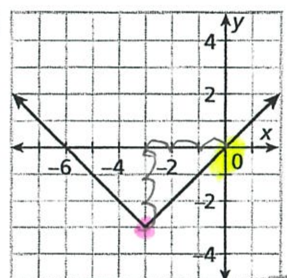
START (0,0)



x: 5 →
y: 1 ↑

$f(x) = |x-5|+1$

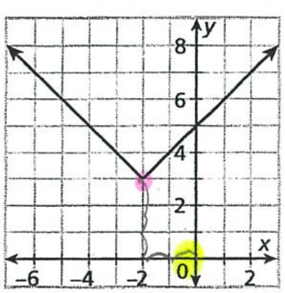
11)



x: 3 ←
y: 3 ↓

$f(x) = |x+3|-3$

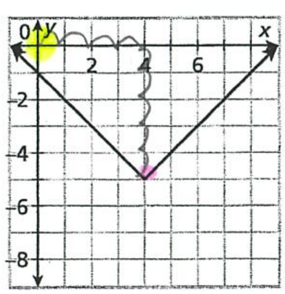
12)



x: 2 ←
y: 3 ↑

$y = |x+2|+3$

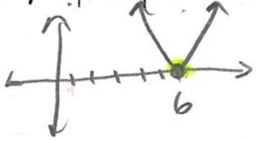
13)



x: 4 →
y: 5 ↓

$y = |x-4|-5$

14) Find the vertex of y = $|x-6|$. Is the vertex a maximum or minimum?

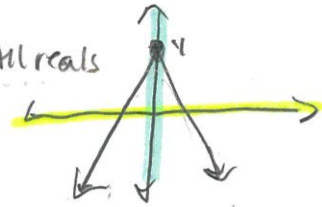


(6,0) minimum

15) Find the domain and range of y = $-|x|+4$

D: x $(-\infty, \infty)$ or $\mathbb{R}$ or All reals

R: y $(-\infty, 4]$ or $y \le 4$



16) Tell whether the following graphs open up or down:

+| | −| |

(a) y = $+\frac{1}{2}|x|$ — up

(b) y = $+|x+5|$ — up

(c) y = $-|x| + 2$ — down

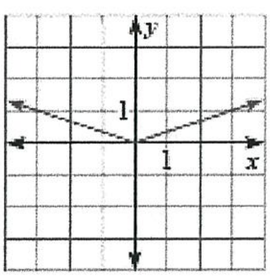
#'s 17- 19: Match the function with its graph.

17) $f(x)=3|x|$ (narrower) — B

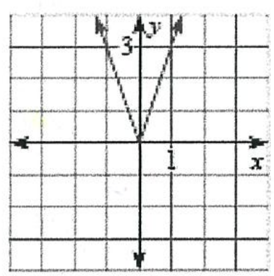
18) $f(x)=-3|x|$ — C

19) $y=\frac{1}{3}|x|$ (wider) — A

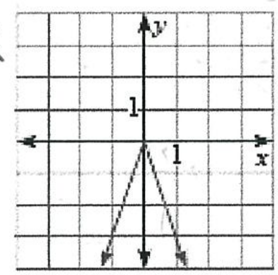
A.



B.



C.



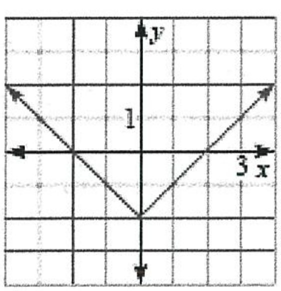
#'s 20- 22: Match the function with its graph.

20) $y=|x-2|$ — C

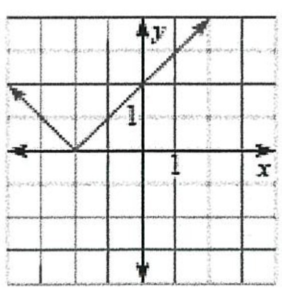
21) $y=|x|-2$ — A

22) $y=|x+2|$ — B

A.



B.



C.