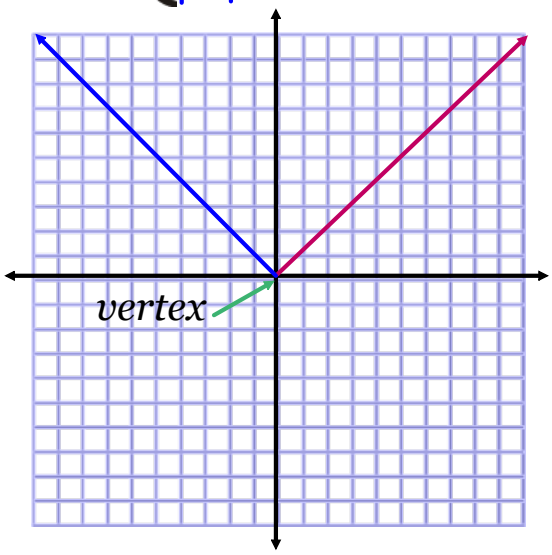
2.8 ABSOLUTE-VALUE FUNCTIONS

$f(x) = |x|$

defined as...

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



Graphing Absolute Value Functions

$$y = a|x - h| + k$$

h is opposite of what you see

k is exactly what you see

1. The graph has vertex (h, k) and is symmetric in the line $x = h$.

2. The graph is __V__-shaped.
   It opens __up__ if $a > 0$ and __down__ if $a < 0$.
   positive negative

3. The graph is __wide__ if $|a| < 1$. $0 < a < 1$
   The graph is __narrow__ if $|a| > 1$.

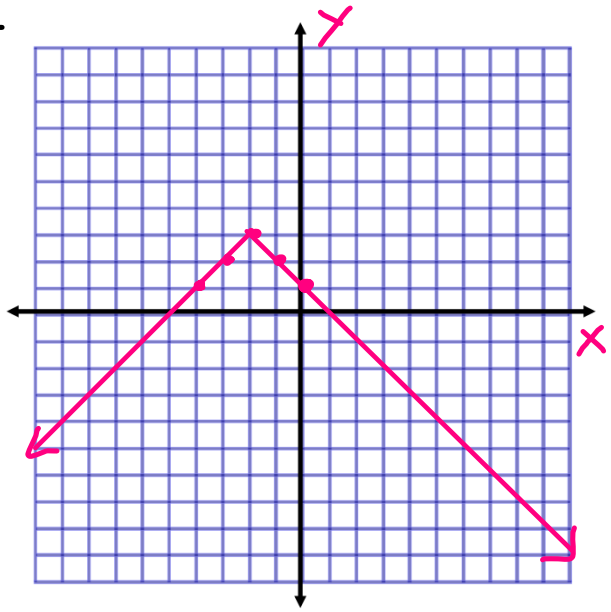
Example 1

Graph $y = -|x + 2| + 3$.

open down $a = -1$ $h = -2$ $k = 3$

vertex $(-2, 3)$

x	$-\lvert x + 2\rvert + 3$	y
−4	$-\lvert -4 + 2\rvert + 3$	1
−3	$-\lvert -3 + 2\rvert + 3$	2
−2		3
−1	$-\lvert -1 + 2\rvert + 3$	2
0	$-\lvert 0 + 2\rvert + 3$	1

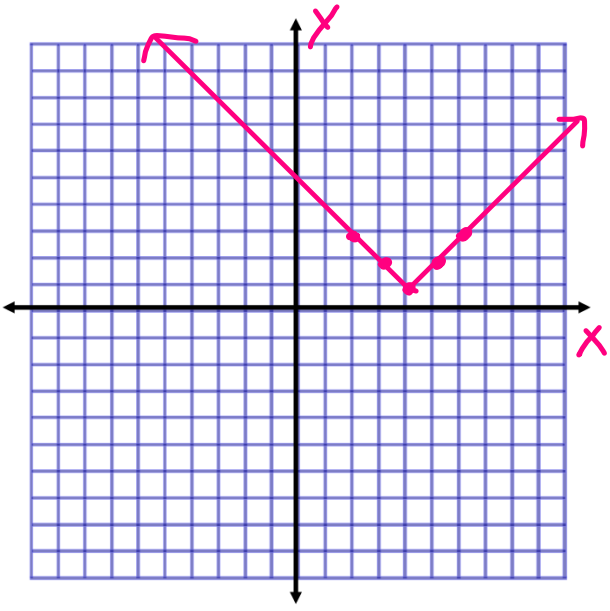


Example 2

Graph $y = |x - 4| + 1$.

$a = 1$ open up $h = 4$ $k = 1$

x	$\lvert x - 4\rvert + 1$	y
2	$\lvert 2 - 4\rvert + 1$	3
3	$\lvert 3 - 4\rvert + 1$	2
4		1
5	$\lvert 5 - 4\rvert + 1$	2
6	$\lvert 6 - 4\rvert + 1$	3

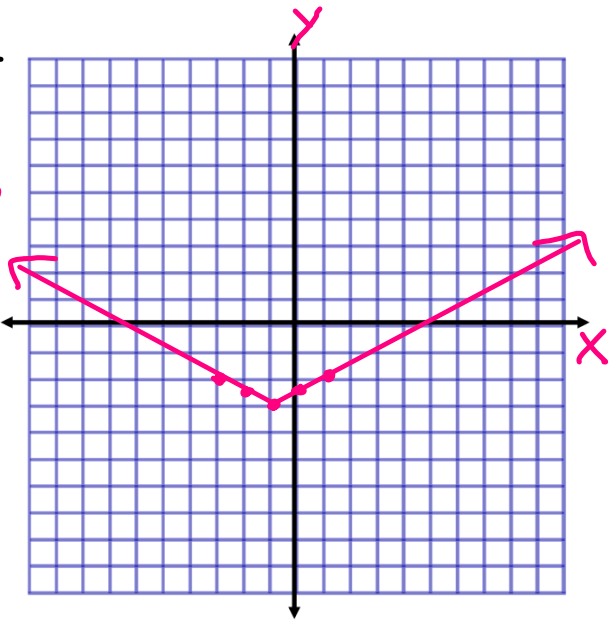


Example 3

$a = \frac{1}{2}$ open up $h = -1$ $k = -3$

Graph $y = \frac{1}{2}|x + 1| - 3$.

x		y
−3	$\frac{1}{2}\|-3+1\|-3$	−2
−2	$\frac{1}{2}\|-2+1\|-3$	−2.5
−1		−3
0	$\frac{1}{2}\|0+1\|-3$	−2.5
1	$\frac{1}{2}\|1+1\|-3$	−2



Example 4

$a = -2$ $h = -4$ $k = 7$

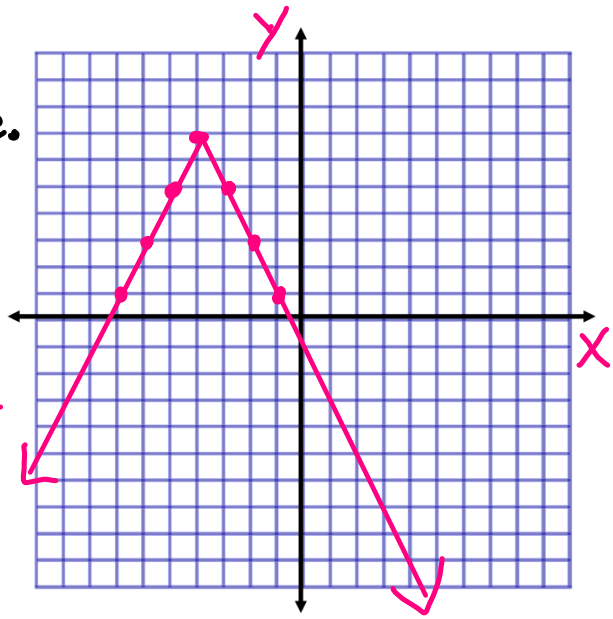
Graph $y = -2|x + 4| + 7$.

vertex $(-4, 7)$

Treat "a" like slope.

$a = \frac{-2}{1}$ down / right

Right side of V.



Example 5

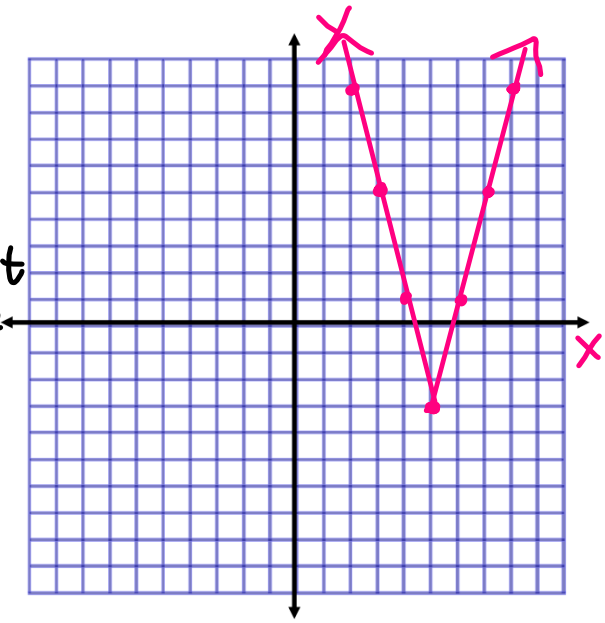
Graph $y = 4|x - 5| - 3$.

$a = 4$ $h = 5$ $k = -3$

vertex $(5, -3)$

$a = 4$ open up

$m = \frac{4 \text{ up}}{1 \text{ right}}$ } right side of V



Example 6

Graph $y = -\frac{2}{3}|x + 1| + 8$.

$h = -1$ $k = 8$

vertex $(-1, 8)$

$a = \frac{-2 \text{ down}}{3 \text{ right}}$ open down