

# Graphing Square/Cube Root & Absolute Value Functions

EQ: How do you graph radicals and absolute value functions? What are their characteristics?

## STANDARDS:

**MCC9-12.F.IF.7** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (*Limit to radical and rational functions.*)

**MCC9-12.F.IF.7b** Graph square root, cube root and piecewise functions, including step functions and absolute value functions.

**MCC9-12.F.IF.5** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

**MCC9-12.F.IF.4** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given verbal description of the relationship. Key features include: intercepts, intervals where the function is increasing, decreasing, positive or negative; relative maximums and minimums; symmetries; end behaviors; and periodicity.

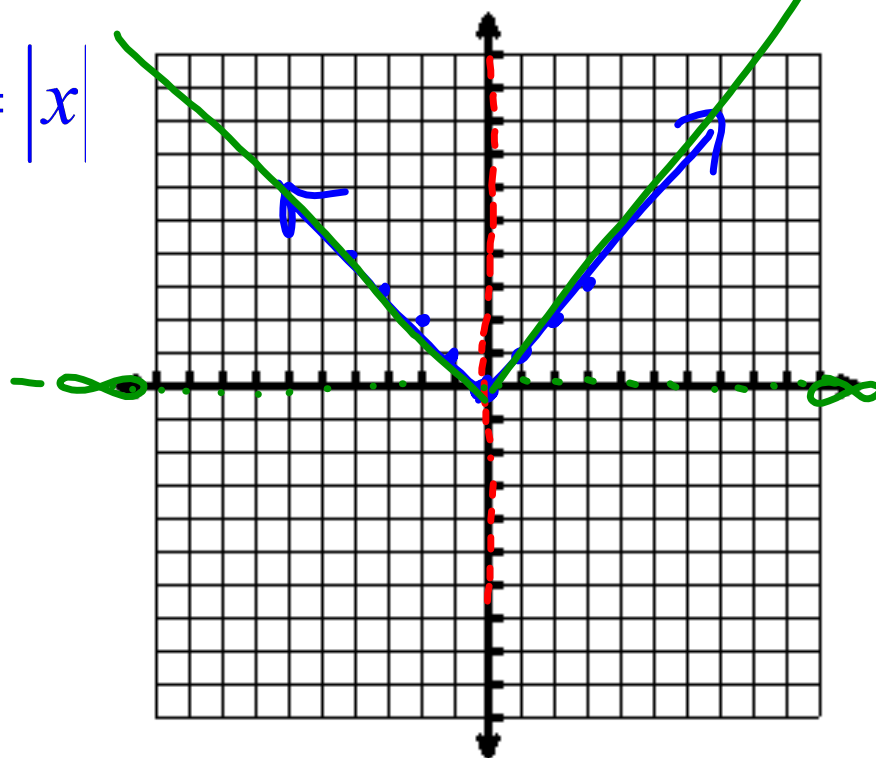
**MCC9-12.F.BF.3** Identify the effect on the graph of replacing  $f(x)$  by  $f(x) + k$ ,  $kf(x)$ ,  $f(kx)$  and  $f(x + k)$  for specific values of  $k$  (both positive and negative); find the value of  $k$  given the graphs. Experiment with cases and illustrate an explanation of the effects the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions from them.

## Parent Graphs and their Characteristics

Absolute Value

$$y = |x|$$

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



### Characteristics

Vertex:  $(0, 0)$

Domain:  $\mathbb{R}$

Max: none

Int of Inc:  $(0, \infty)$   
 $0 < x < \infty$

x-intercept:  $(0, 0)$

Axis of symmetry:

$x = 0$   
 Range:  $[0, \infty)$   
 $x \geq 0$

Min:  $y = 0$   
 Int of Dec:  $(-\infty, 0)$   
 $-\infty < x < 0$

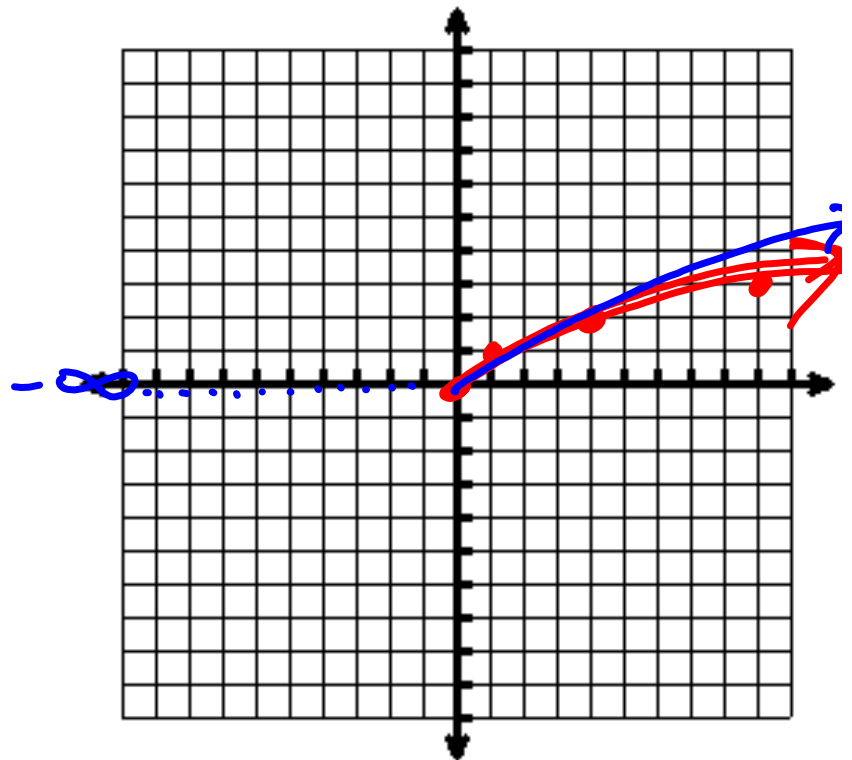
y-intercept:  $(0, 0)$

### End Behavior

$$\begin{array}{l}
 x \rightarrow -\infty \quad y \rightarrow \underline{\underline{+\infty}} \\
 x \rightarrow +\infty \quad y \rightarrow \underline{\underline{+\infty}}
 \end{array}$$

Square Root  $y = \sqrt{x}$

x	y
0	0
1	1
4	2
9	3



### Characteristics

Vertex:  $(0, 0)$

Domain:  $[0, \infty)$   $x \geq 0$  Range:  $[0, \infty)$   $y \geq 0$

Max: none

Min:  $y = 0$

Int of Inc:  $(0, \infty)$

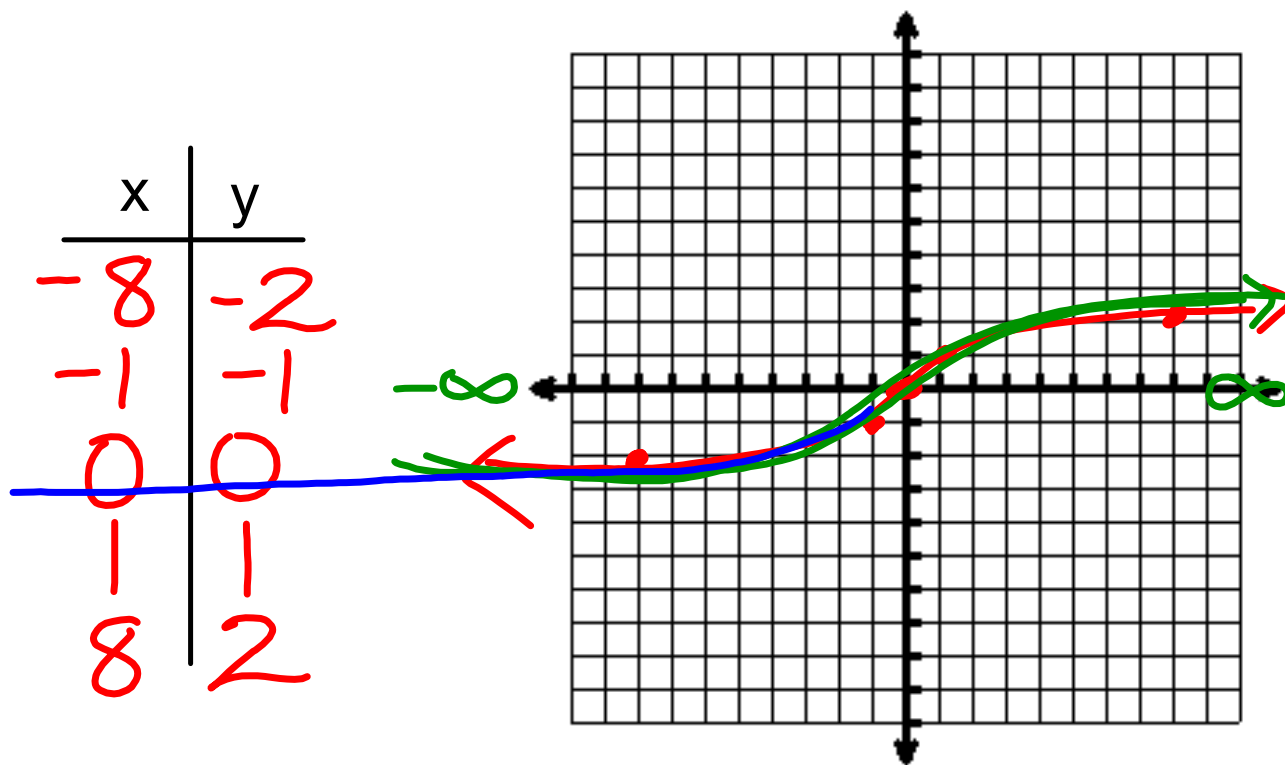
Int of Dec: none

x-intercept:  $(0, 0)$

y-intercept  $(0, 0)$

E.B.  $x \rightarrow -\infty$   $y \rightarrow \underline{\quad}$   
 $x \rightarrow +\infty$   $y \rightarrow \underline{+\infty}$

Cube Root  $y = \sqrt[3]{x}$



### Characteristics

Vertex:  $(0, 0)$

Domain:  $\mathbb{R}$

Max: none

Int of Inc:  $(-\infty, \infty)$

x-intercept:  $(0, 0)$

Range:  $\mathbb{R}$

Min: none

Int of Dec: none

y-intercept  $(0, 0)$

E.B.  $x \rightarrow -\infty$   $y \rightarrow -\infty$   
 $x \rightarrow +\infty$   $y \rightarrow +\infty$

Standard Forms  $(h, k)$   
vertex

$$y = a|b(x - \underline{h})| + \underline{k}$$

$$y = a\sqrt[3]{b(x - h)} + k$$

$$y = a\sqrt{b(x - h)} + k$$

## Transformation description for all graph types

-a: reflects over x-axis

$|a| > 1$ : vertical stretch by "a"

$0 < |a| < 1$ : vertical shrink/compress by "a"

-b: reflects over y-axis

$|1/b| > 1$ : horizontal stretch by "1/b"

$0 < |1/b| < 1$ : horizontal shrink/compress <sup>by</sup> "1/b"

h: +h shift left / -h shift right

k: +k up / -k down

## Steps to graphing ALL graph types

1. Get the function in the correct form - make use if there is a "b" that it has been factored out.
2. Give its description of its transformations compared to the parent graph.
3. Write down the parent table.
4. Adjust parent table by multiplying "a" and "1/b"  
Reminder: "a" affects the range (Ys)  
"1/b" affects the domain (Xs)
5. Adjust the new table by add/sub "h" and "k"  
Reminder: pull h (*opposite*) and k (*same*)  
add/sub "h" to **x-values**  
add/sub "k" to **y-values**
6. Plot your points and give the characteristics

\* Final Table  
the vertex is  
in the middle

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Graph and give the requested characteristics

1.  $f(x) = 2|x - 4| - 3$   $v(4, -3)$   
 Trans: vertical stretch by 2 = change y  
 right 4 = change x down 3 = change y

Parent

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

x	y
-2	4-3
-1	2-3
0	0-3
1	2-3
2	4-3

x	y
2	1
3	-1
4	-3
5	-1
6	1

### Characteristics

Vertex:  $(4, -3)$

AoS:  $x = 4$

Domain:  $\mathbb{R}$

Range:  $[-3, \infty)$

Max: none

Min:  $y = -3$

Int of Inc:  $(4, \infty)$  use x-values

Int of Dec:  $(-\infty, 4)$

x-intercept:  $(5.5, 0)$   $(2.5, 0)$

y-intercept:  $(0, 5)$

$0 = 2|x - 4| - 3$   
 $+3$   $+3$

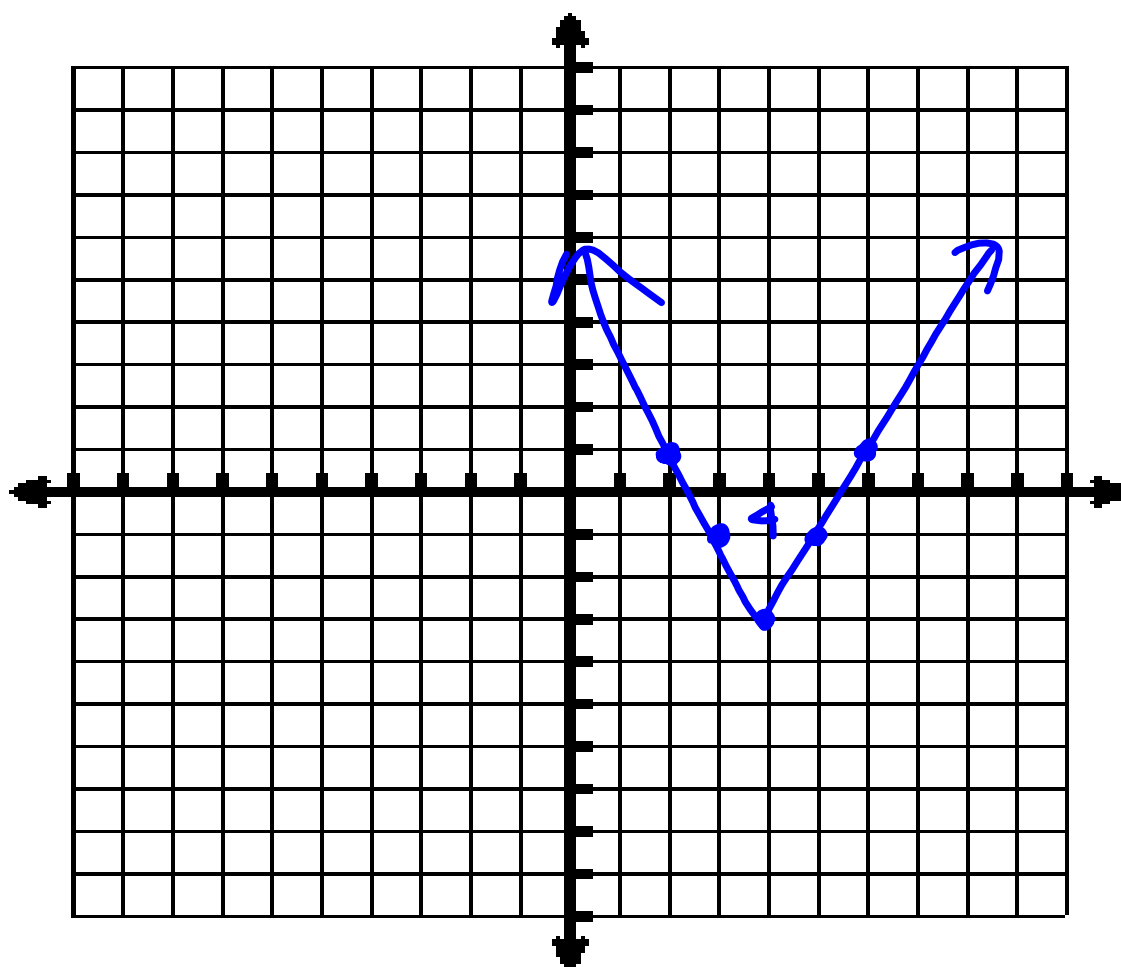
EB.  $x \rightarrow -\infty y \rightarrow +\infty$   
 $x \rightarrow +\infty y \rightarrow +\infty$

$\frac{3}{2} = \frac{2|x - 4|}{2}$

$x - 4 = \frac{3}{2}$  |  $x - 4 = -\frac{3}{2}$   
 $+4$   $+4$  |  $+4$   $+4$

$\frac{3}{2} = |x - 4|$

$x = 5\frac{1}{2}$  |  $x = 2\frac{1}{2}$   
 $(5.5)$  |  $(2.5)$



$$2. f(x) = \sqrt[3]{-x} + 5 \quad v(0, 5)$$

Trans: reflects over y-axis  $\Rightarrow$  change X

reflects up 5  $\Rightarrow$  change Y up 5

x	y
-8	-2
-1	-1
0	0
1	1
8	2

x	y
8	-2 + 5
1	-1 + 5
0	0 + 5
-1	1 + 5
-8	2 + 5

x	y
8	3
1	4
0	5
-1	6
-8	7

Characteristics

Vertex:  $(0, 5)$

Domain:  $\mathbb{R}$

Max: none

Int of Inc: none

x-intercept:  $(125, 0)$

end behaviors:  $x \rightarrow -\infty \quad y \rightarrow +\infty$   
 $x \rightarrow +\infty \quad y \rightarrow -\infty$

Range:  $\mathbb{R}$

Min: none

Int of Dec:  $(-\infty, \infty)$

y-intercept:

$(0, 5)$

Solve

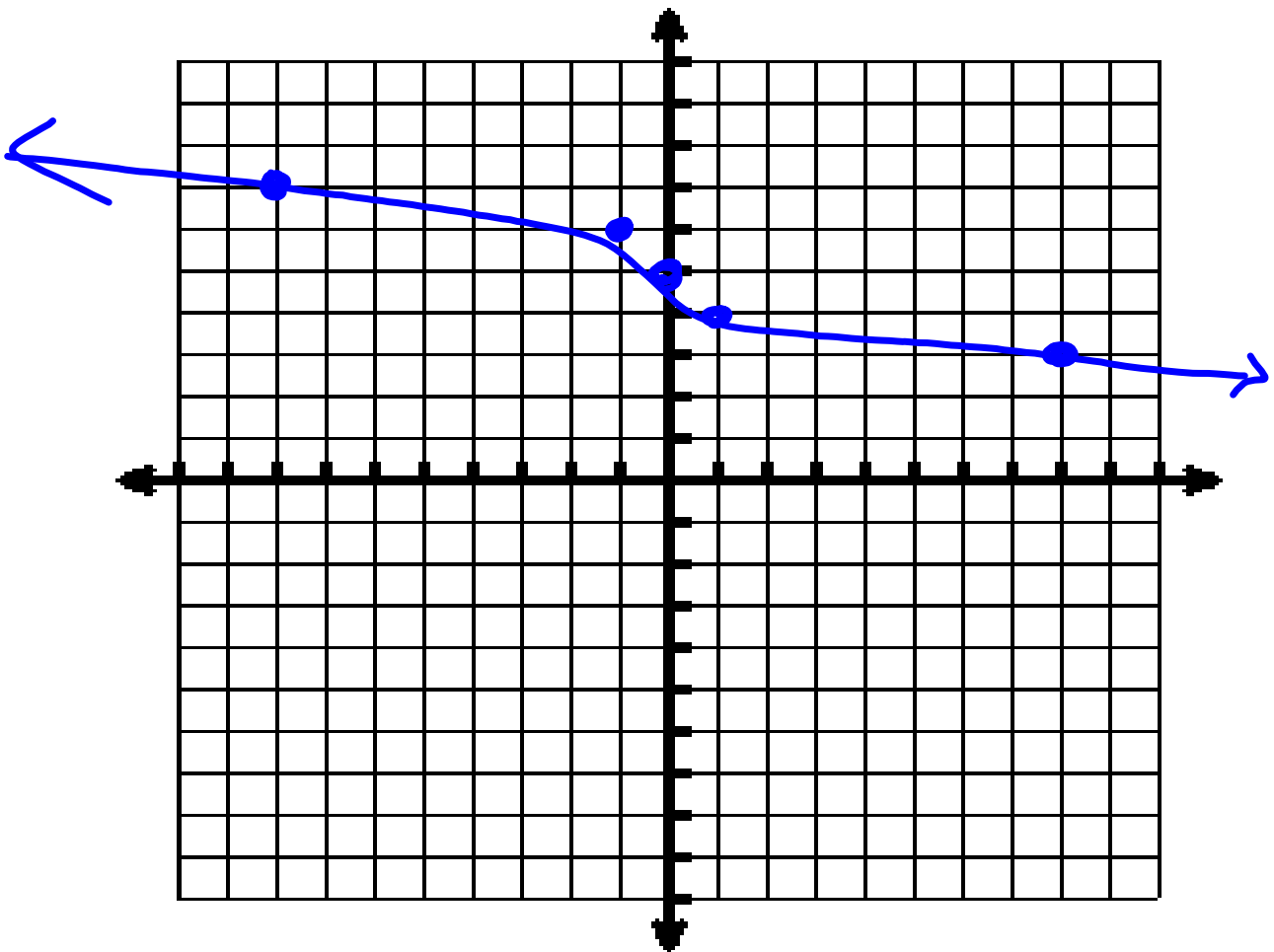
$$0 = \sqrt[3]{-x} + 5$$

$$\begin{array}{r} -5 \\ -5 \end{array}$$

$$(-5)^3 = (\sqrt[3]{-x})^3$$

$$\frac{-125}{-1} = \frac{-x}{-1}$$

$$x = 125$$



$$3. g(x) = -\frac{1}{2}\sqrt{x+4} \quad V(-4, 0)$$

Trans: reflects over x-axis  $\Rightarrow$  change  $y$   
 Vertical Shrink by  $1/2 \Rightarrow$  change  $y$   
 left 4  $\Rightarrow$  change  $x$

x	y
0	0
1	1
4	2
9	3

x	y
-4	0
-4	1
-4	4
-4	9

x	y
-4	0
-3	-1/2
0	-1
5	-1.5

## Characteristics

Vertex:  $(-4, 0)$

Domain:  $[-4, \infty)$

Max:  $y = 0$

Int of Inc: none

x-intercept:  $(-4, 0)$

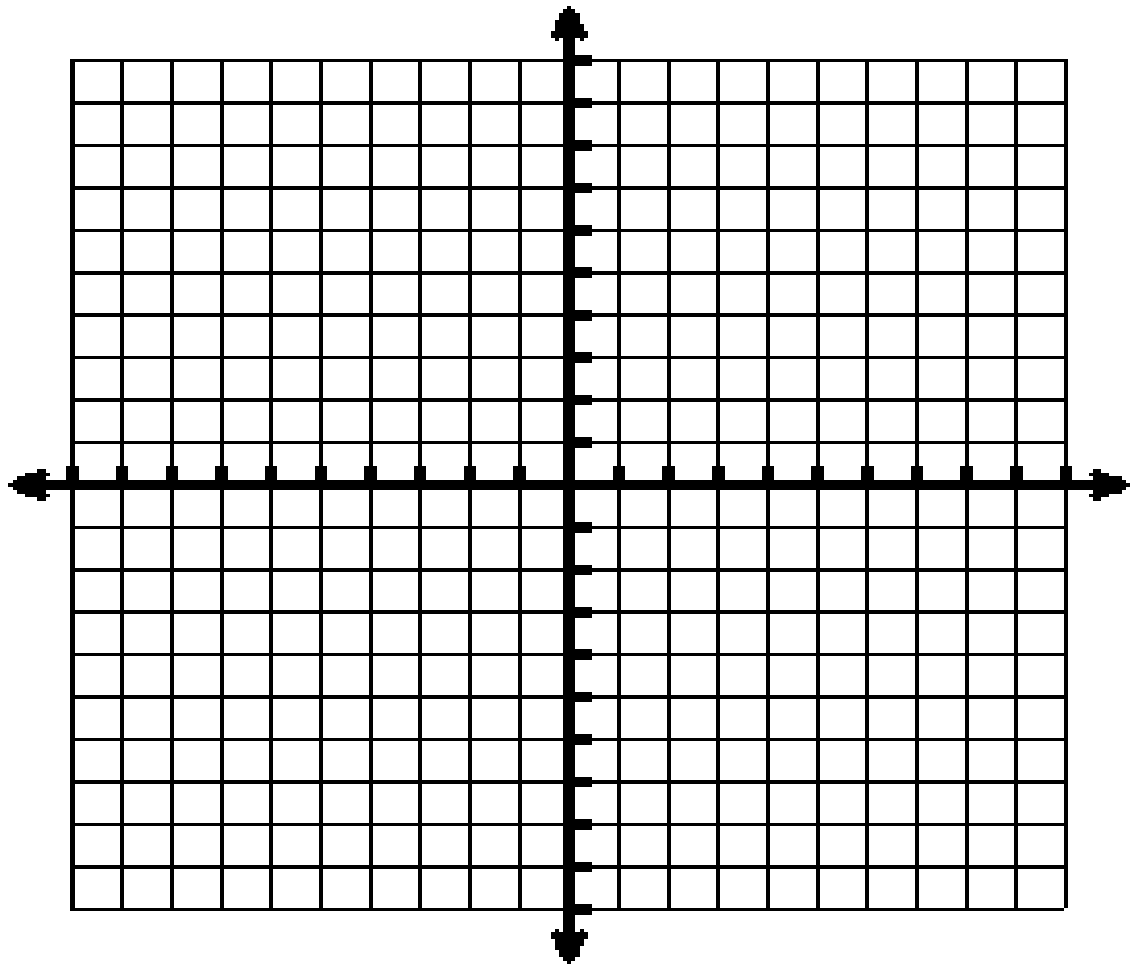
Range:  $(-\infty, 0]$

Min: none

Int of Dec:  $(-4, \infty)$

y-intercept:  $(0, -1)$

E.B.  $x \rightarrow +\infty \quad y \rightarrow -\infty$



$$4. f(x) = -|2x + 4| - 6 \quad v(-2, -6)$$

$$= -|2(x+2)| - 6$$

Trans: reflects over x-axis  $\Rightarrow$  change Y  
 $1/b = 1/2$  horizontal shrink  $\Rightarrow$  change X  
 left 2  $\Rightarrow$  change X down 6  $\Rightarrow$  Y

	x	y	
1/2	-2	2	-1
1/2	-1	1	-1
1/2	0	0	-1
1/2	1	1	-1
1/2	2	2	-1

	x	y	
1/2	-1	-2	-6
1/2	-1/2	-1	-6
1/2	0	0	-6
1/2	1/2	-1	-6
1/2	1	-2	-6

	x	y	
1/2	-3	-8	
1/2	-2.5	-7	
1/2	(-2)	(-6)	v
1/2	-1.5	-7	
1/2	-1	-8	

## Characteristics

Vertex:  $(-2, 6)$

Domain:  $\mathbb{R}$

Max:  $y = -6$

Int of Inc:  $(-\infty, -2)$

x-intercept: none

AoS:  $x = -2$

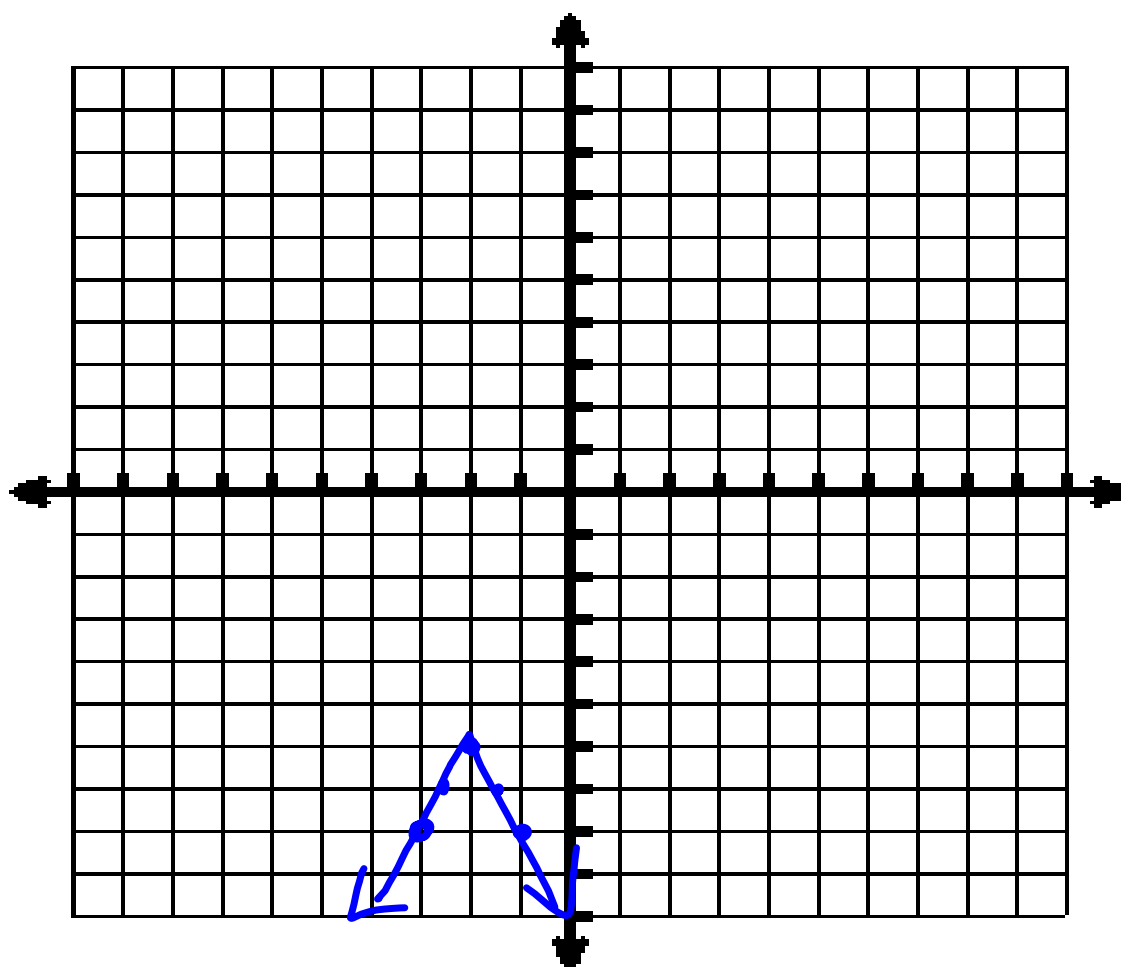
Range:  $(-\infty, -6]$

Min: none

Int of Dec:  $(-2, \infty)$

y-intercept

EB.  $x \rightarrow -\infty, y \rightarrow -\infty$   $(0, -12)$   
 $x \rightarrow +\infty, y \rightarrow -\infty$





$$5. g(x) = \frac{1}{4} \sqrt[3]{x+1} - 2$$

x	y
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x	y
---	---

x	y
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## Characteristics

Vertex:

Domain:

Max:

Int of Inc:

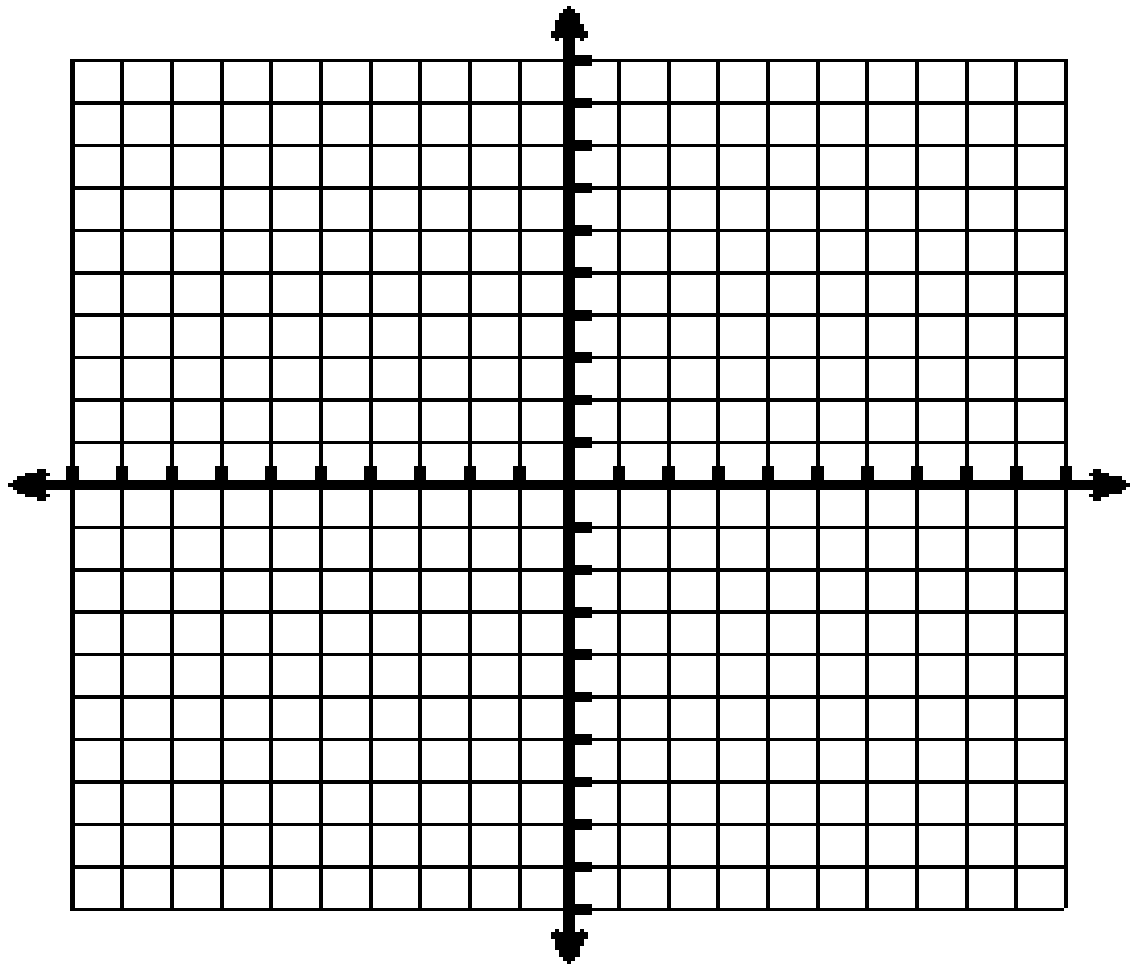
x-intercept:

Range:

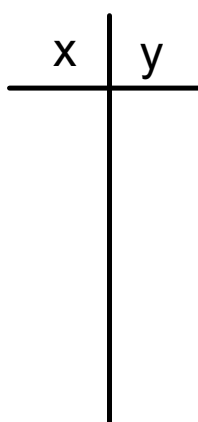
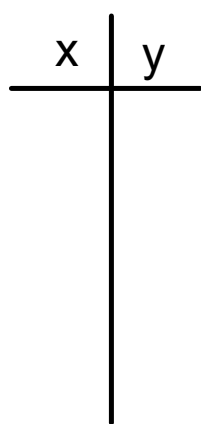
Min:

Int of Dec:

y-intercept



$$6. h(x) = \sqrt{-3x} + 5$$



## Characteristics

Vertex:

Domain:

Max:

Int of Inc:

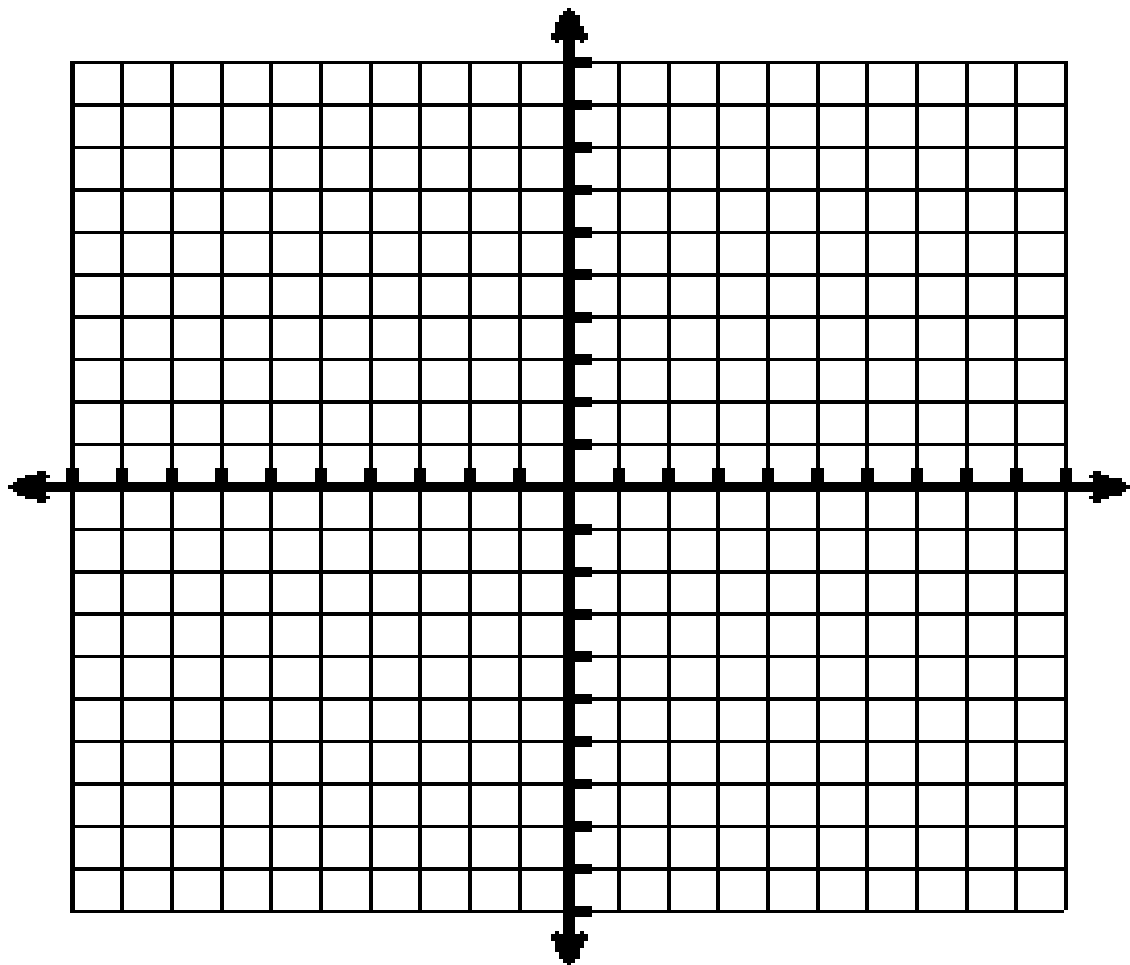
x-intercept:

Range:

Min:

Int of Dec:

y-intercept



$$7. f(x) = \sqrt{-\frac{1}{3}(x-4)} + 3$$

x	y
---	---

x	y
---	---

x	y
---	---

## Characteristics

Vertex:

Domain:

Max:

Int of Inc:

x-intercept:

Range:

Min:

Int of Dec:

y-intercept

