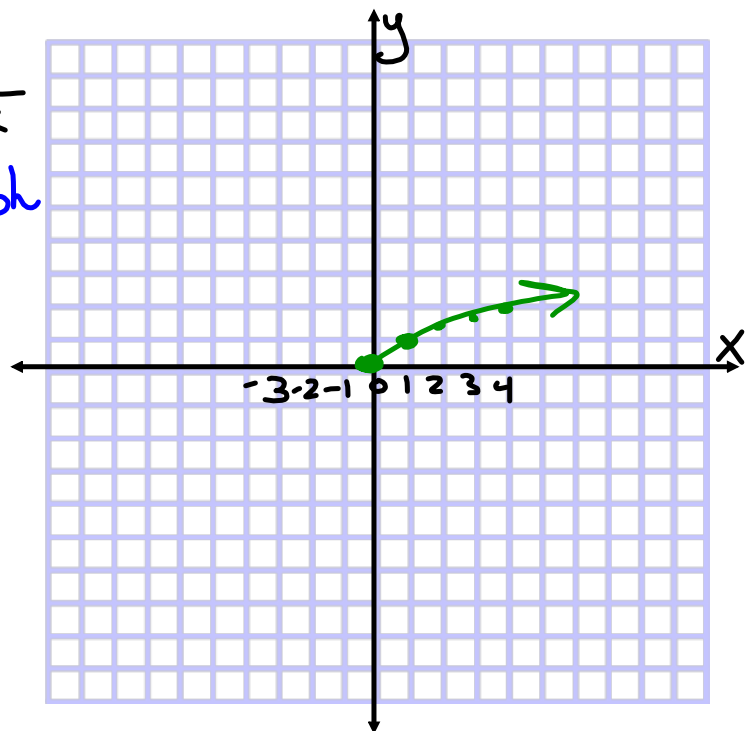


Graphing Radical Functions

Basics:

x	y
-3	$\sqrt{-3}$
-2	$\sqrt{-2}$
-1	$\sqrt{-1}$
0	$\sqrt{0} = 0$
1	$\sqrt{1} = 1$
2	$\sqrt{2} = 1.41$
3	$\sqrt{3} = 1.73$
4	$\sqrt{4} = 2$

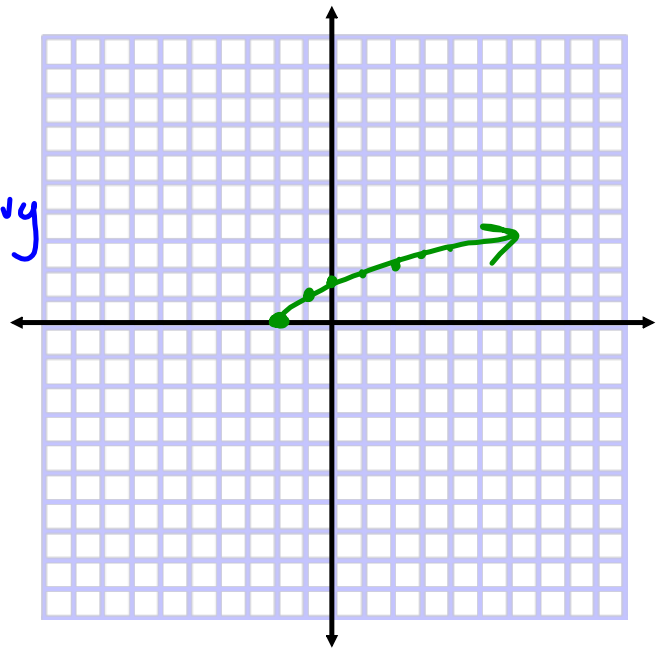
$y = \sqrt{x}$
 Not on graph
 imaginary
 imaginary
 imaginary



Graphing Radical Functions

Basics: $y = \sqrt{x+2}$

x	y
-3	$\sqrt{-3+2} = \sqrt{-1} = \text{imaginary}$
-2	$\sqrt{-2+2} = \sqrt{0} = 0$
-1	$\sqrt{-1+2} = \sqrt{1} = 1$
0	$\sqrt{0+2} = \sqrt{2} = 1.41$
1	$\sqrt{1+2} = \sqrt{3} = 1.73$
2	$\sqrt{2+2} = \sqrt{4} = 2$
3	$\sqrt{3+2} = \sqrt{5} = 2.24$
4	$\sqrt{4+2} = \sqrt{6} = 2.45$



$\sqrt{x+}$
 \uparrow
 left

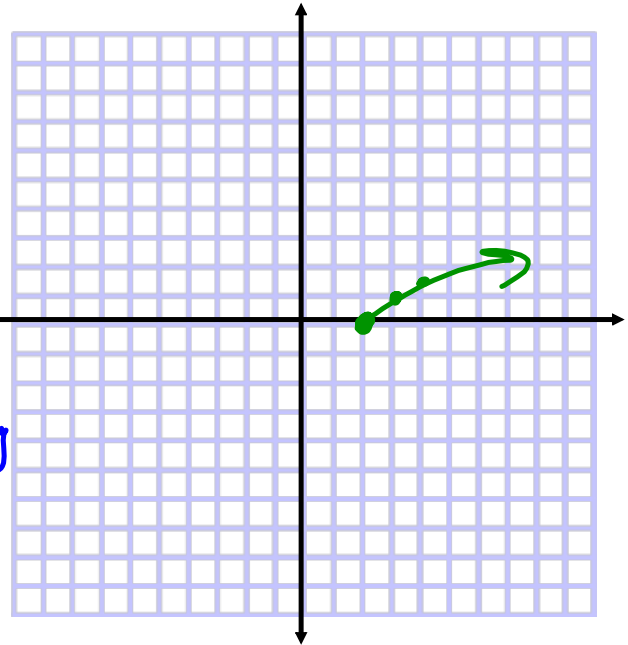
\leftarrow x-axis

Graphing Radical Functions

Basics:

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

x	y
-3	$\sqrt{-3-2} = \sqrt{-5} = \text{imaginary}$
-2	$\sqrt{-2-2} = \sqrt{-4} = \text{imaginary}$
-1	$\sqrt{-1-2} = \sqrt{-3} = \text{imaginary}$
0	$\sqrt{0-2} = \sqrt{-2} = \text{imaginary}$
1	$\sqrt{1-2} = \sqrt{-1} = \text{imaginary}$
2	$\sqrt{2-2} = \sqrt{0} = 0$
3	$\sqrt{3-2} = \sqrt{1} = 1$
4	$\sqrt{4-2} = \sqrt{2} = 1.41$



$$\sqrt{x - \quad}$$

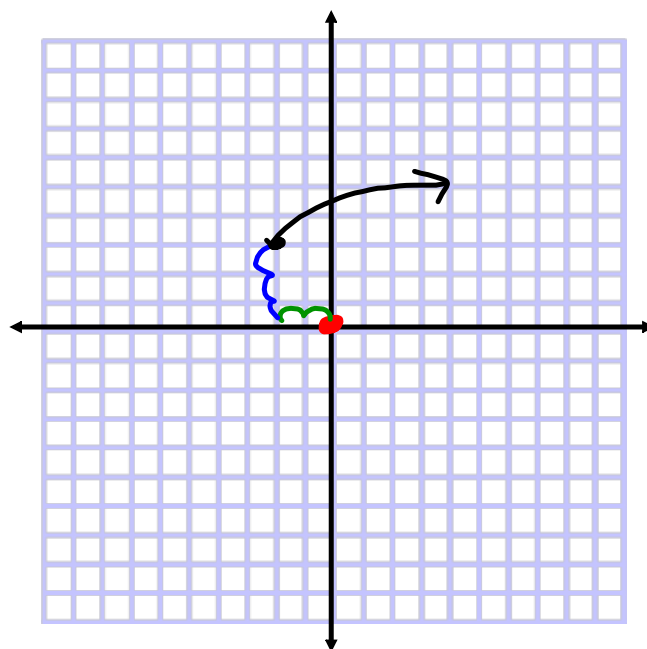
↑
Right

→ on axis

$$y = \sqrt{x+2} + 3$$

opposite
left 2
same
up 3

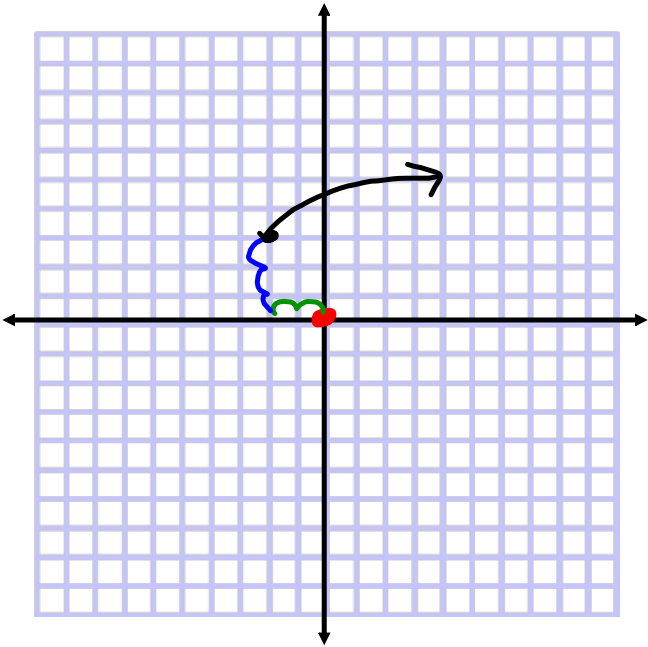
x	y
-3	
-2	
-1	
0	
1	
2	
3	
4	



$$y = \sqrt{x+2} + 3$$

opposite
left 2
SAME
up 3

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



$$y = \sqrt{x+3} - 4$$

left 3 down 4

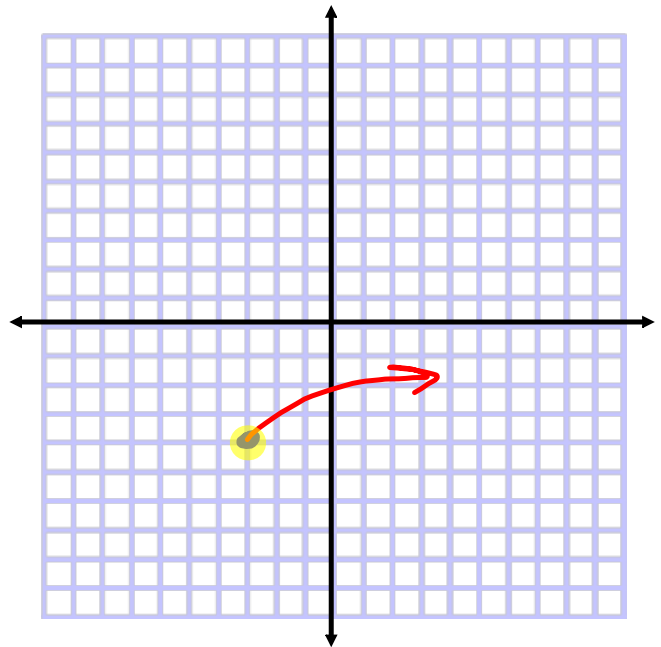
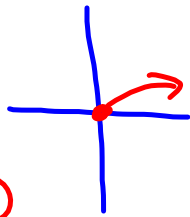
x	y
-3	0
-2	1
-1	2
0	3
1	4
2	5

Forgot shape

$$y = \sqrt{x}$$

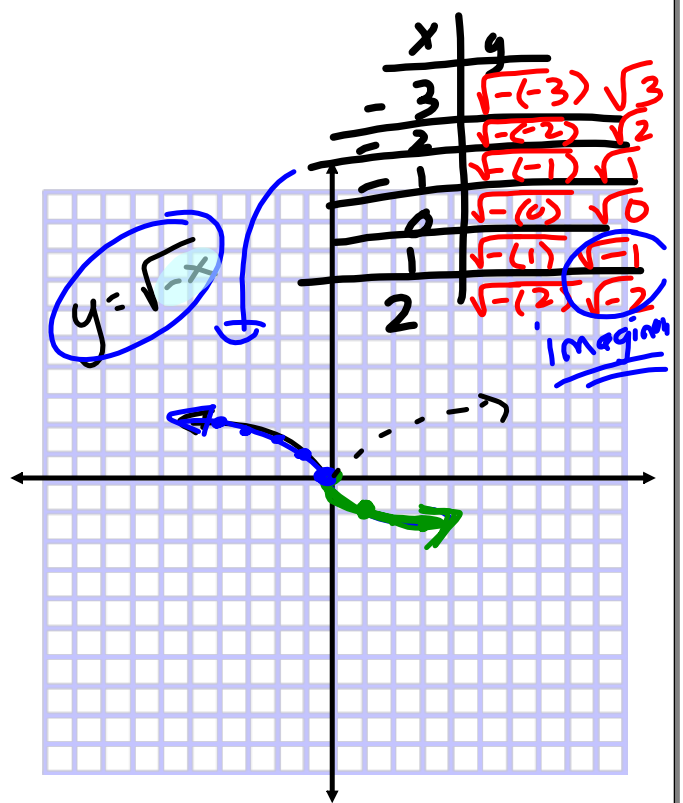
x	y
-3	$\sqrt{-3}$
-2	$\sqrt{-2}$
-1	$\sqrt{-1}$
0	$\sqrt{0} = 0$
1	$\sqrt{1} = 1$
2	$\sqrt{2} = 1.41$
3	$\sqrt{3} = 1.73$

not on graph



$y = -\sqrt{x}$

x	y
-3	$-\sqrt{-3}$ imaginary
-2	$-\sqrt{-2}$ imaginary
-1	$-\sqrt{-1}$ imaginary
0	$-\sqrt{0} = 0$
1	$-\sqrt{1} = -1$
2	$-\sqrt{2} = -1.41$
3	$-\sqrt{3} = -1.73$



$$\sqrt[3]{27} = \sqrt[3]{3 \cdot 3 \cdot 3} = 3$$

1	$1 \cdot 1 \cdot 1 = 1$
2	$2 \cdot 2 \cdot 2 = 8$
3	$3 \cdot 3 \cdot 3 = 27$
4	$4 \cdot 4 \cdot 4 = 64$
5	$5 \cdot 5 \cdot 5 = 125$

$$\sqrt[4]{81} = \sqrt[4]{3 \cdot 3 \cdot 3 \cdot 3} = 3$$

1	$1 \cdot 1 \cdot 1 \cdot 1 = 1$	1^4
2	$2 \cdot 2 \cdot 2 \cdot 2 = 16$	2^4
3	$3 \cdot 3 \cdot 3 \cdot 3 = 81$	3^4
4	$4 \cdot 4 \cdot 4 \cdot 4 = 256$	4^4

$$\sqrt{\frac{48x}{27x^2}} = \frac{\sqrt{48x}}{\sqrt{27x^2}}$$

$$= \frac{4\sqrt{3x} \cdot \sqrt{3}}{3x\sqrt{3} \cdot \sqrt{3}}$$

$$= \frac{4\sqrt{9x}}{3x \cdot 3}$$

$$= \frac{4 \cdot \sqrt{9} \cdot \sqrt{x}}{9x} = \frac{12\sqrt{x}}{9x} = \frac{4\sqrt{x}}{3x}$$

$$\begin{aligned} \sqrt{48x} &= \\ \sqrt{16 \cdot 3 \cdot x} &= \\ 4\sqrt{3} \cdot \sqrt{x} &= \\ 4\sqrt{3x} & \end{aligned}$$

$$\begin{aligned} \sqrt{27x^2} &= \\ \sqrt{9 \cdot 3 \cdot x^2} &= \\ 3 \cdot \sqrt{3} \cdot x &= \\ 3x\sqrt{3} & \end{aligned}$$

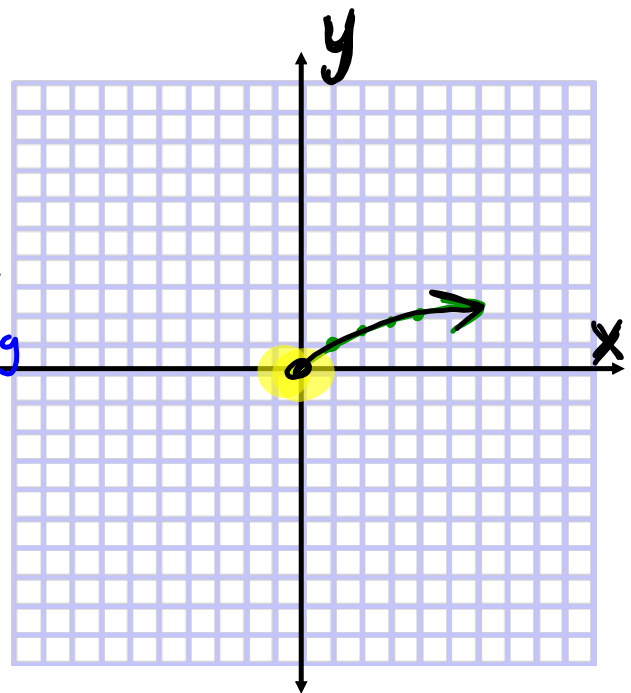
Graphing Radicals

$$y = \sqrt{x}$$

x	y
-3	$\sqrt{-3}$
-2	$\sqrt{-2}$
-1	$\sqrt{-1}$
0	$\sqrt{0} = 0$
1	$\sqrt{1} = 1$
2	$\sqrt{2} = 1.41$
3	$\sqrt{3} = 1.73$
4	$\sqrt{4} = 2$

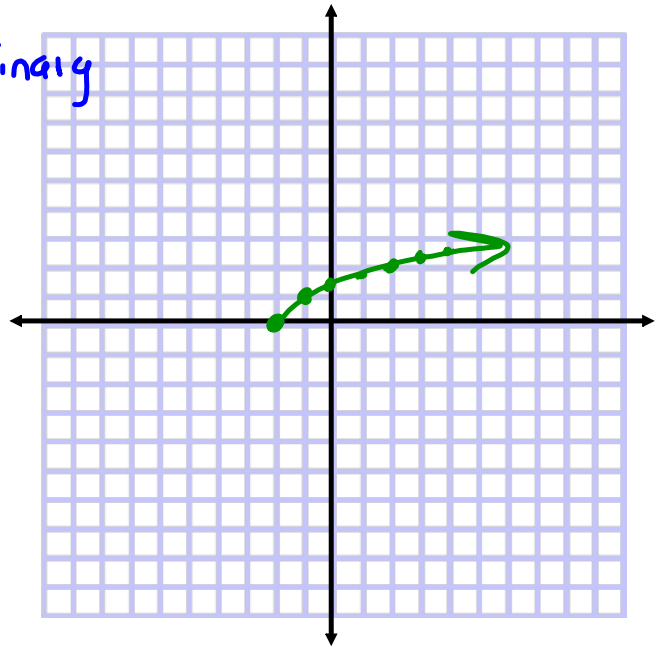
$i\sqrt{3}$
 $i\sqrt{2}$
 $i\sqrt{1}$
 } can't graph
 } imaginary

} graph



$$y = \sqrt{x+2}$$

x	y
-3	$\sqrt{-3+2} = \sqrt{-1}$ imaginary
-2	$\sqrt{-2+2} = \sqrt{0} = 0$
-1	$\sqrt{-1+2} = \sqrt{1} = 1$
0	$\sqrt{0+2} = \sqrt{2} = 1.41$
1	$\sqrt{1+2} = \sqrt{3} = 1.71$
2	$\sqrt{2+2} = \sqrt{4} = 2$
3	$\sqrt{3+2} = \sqrt{5} = 2.24$
4	$\sqrt{4+2} = \sqrt{6} = 2.45$



left 2

compared to $y = \sqrt{x}$
 \uparrow
 $x = 0$

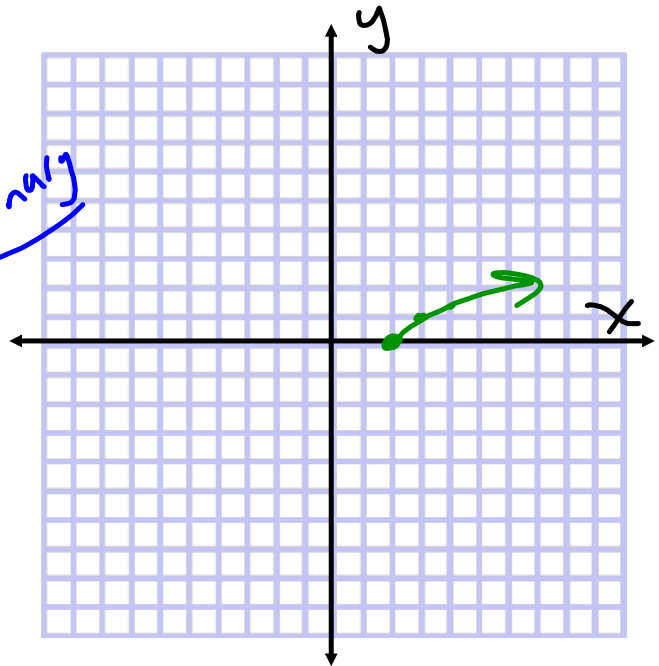
$$\sqrt{x+2} \quad x+2=0$$

$$x = -2$$

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

x	y
-3	$\sqrt{-3-2} = \sqrt{-5}$
-2	$\sqrt{-2-2} = \sqrt{-4}$
-1	$\sqrt{-1-2} = \sqrt{-3}$
0	$\sqrt{0-2} = \sqrt{-2}$
1	$\sqrt{1-2} = \sqrt{-1}$
2	$\sqrt{2-2} = \sqrt{0} = 0$
3	$\sqrt{3-2} = \sqrt{1} = 1$
4	$\sqrt{4-2} = \sqrt{2} = 1.41$

Imaginary



Right 2

$$x - 2 = 0$$

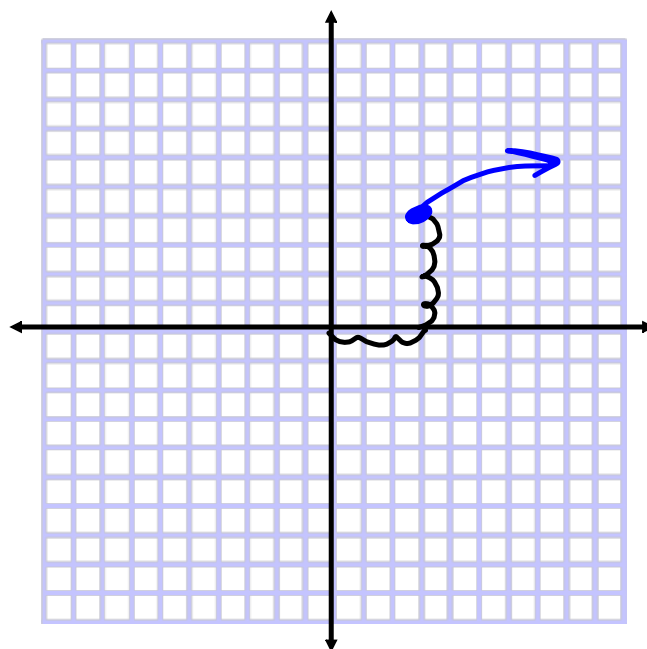
$$x = 2$$

$$y = \sqrt{x - 3} + 4$$

opposit same

\leftarrow $R + 3$

x	y
---	---



$$y = -\sqrt{x}$$

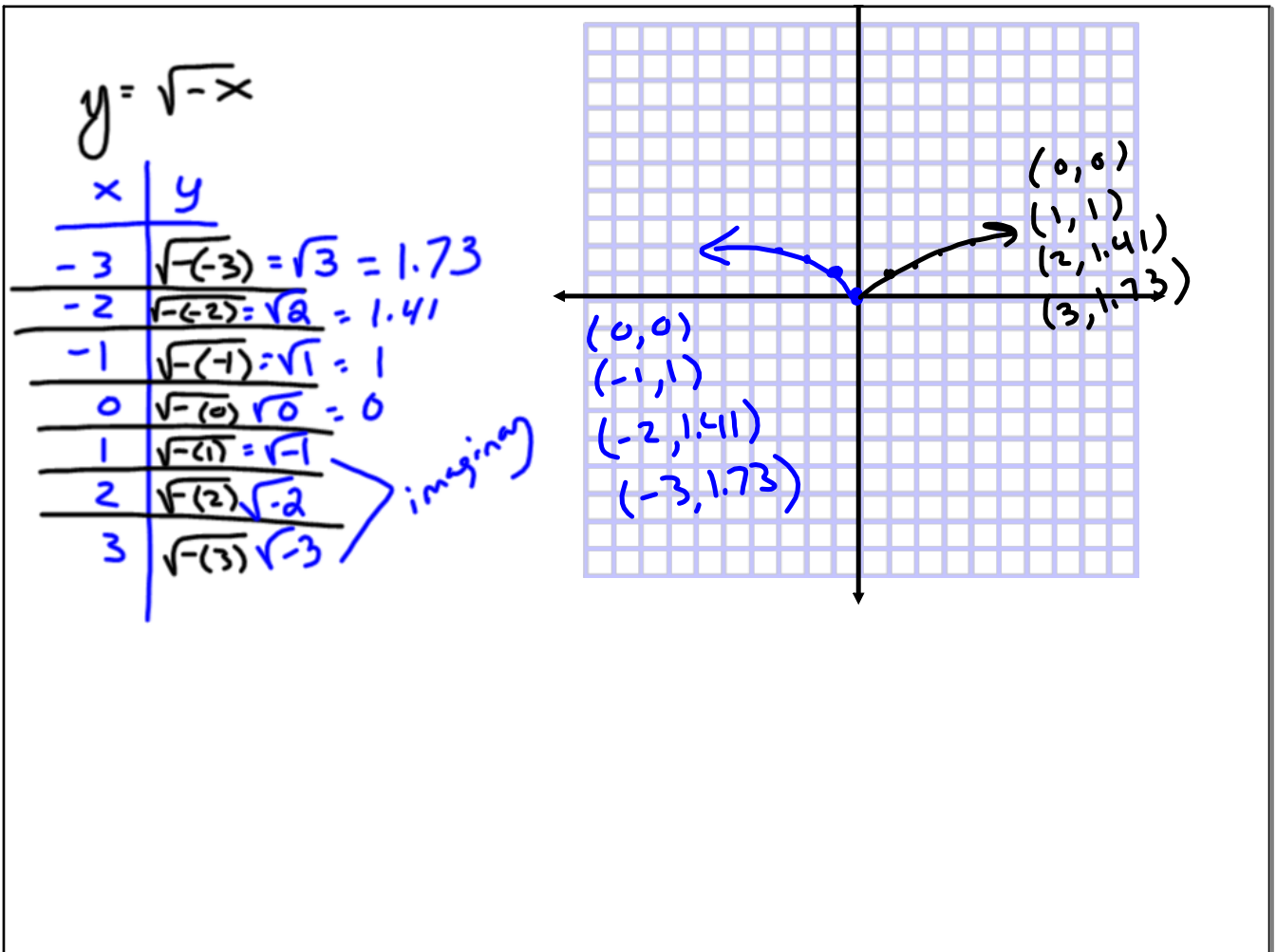
x	y
-3	$-\sqrt{-3}$
-2	$-\sqrt{-2}$
-1	$-\sqrt{-1}$
0	$-\sqrt{0} = -(0) = 0$
1	$-\sqrt{1} = -(1) = -1$
2	$-\sqrt{2} = -(1.41) = -1.41$
3	$-\sqrt{3} = -(1.73) = -1.73$

} Imaginary

$$y = \sqrt{-x}$$

x	y
-3	$\sqrt{-(-3)} = \sqrt{3} = 1.73$
-2	$\sqrt{-(-2)} = \sqrt{2} = 1.41$
-1	$\sqrt{-(-1)} = \sqrt{1} = 1$
0	$\sqrt{-(0)} = \sqrt{0} = 0$
1	$\sqrt{-(1)} = \sqrt{-1}$
2	$\sqrt{-(2)} = \sqrt{-2}$
3	$\sqrt{-(3)} = \sqrt{-3}$

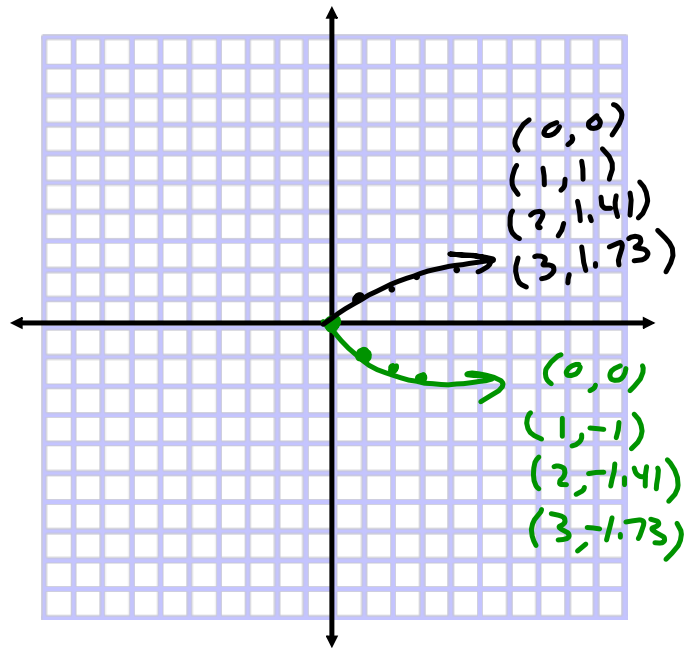
} imaginary



$$y = -\sqrt{x}$$

x	y
-3	$-\sqrt{-3}$
-2	$-\sqrt{-2}$
-1	$-\sqrt{-1}$
0	$-\sqrt{0} = -(0) = 0$
1	$-\sqrt{1} = -(1) = -1$
2	$-\sqrt{2} = -(1.41) = -1.41$
3	$-\sqrt{3} = -(1.73) = -1.73$

Imaginary



$$y = \sqrt{x}$$

x	y
0	0
1	1
2	1.41
3	1.73

$$\sqrt{x}$$

$$y = 5\sqrt{x}$$

x	y
0	$5\sqrt{0} = 0$
1	$5\sqrt{1} = 5(1)$
2	$5\sqrt{2} = 5(1.41)$
3	$5\sqrt{3} = 5(1.73)$

$$\sqrt{\frac{48x}{27x^2}} \Rightarrow \frac{\sqrt{48x}}{\sqrt{27x^2}} = \frac{\sqrt{16 \cdot 3} \cdot \sqrt{x}}{3x \cdot \sqrt{3}} = \frac{4\sqrt{3x} \cdot \sqrt{3}}{3x \cdot 3} = \frac{4\sqrt{9x}}{9x}$$

Simplify $\sqrt{\quad}$

$$\sqrt{\frac{\cancel{16} \cdot \cancel{3} \cdot x}{9 \cdot \cancel{27} \cdot x}} = \sqrt{\frac{16}{9x}} = \frac{\sqrt{16}}{\sqrt{9x}} = \frac{4}{3\sqrt{x}} \cdot \frac{\sqrt{x}}{\sqrt{x}} = \frac{4\sqrt{x}}{3x}$$

$$= \frac{4\sqrt{9x}}{9x} = \frac{4 \cdot 3\sqrt{x}}{9x} = \frac{12\sqrt{x}}{9} = \frac{4\sqrt{x}}{3x}$$

$$\sqrt{x^5} = \sqrt{\cancel{x \cdot x} \cdot \cancel{x \cdot x} \cdot x}$$

$x \cdot x \cdot \sqrt{x} = x^2\sqrt{x}$

$$\sqrt[3]{x^5} = \sqrt[3]{\cancel{x \cdot x \cdot x} \cdot x \cdot x}$$

$x \sqrt[3]{x^2}$

$$\sqrt[4]{x^5} = \sqrt[4]{\cancel{x \cdot x \cdot x \cdot x} \cdot x}$$

$x \sqrt[4]{x}$

$$\sqrt[3]{27} \quad 3 \sqrt[3]{\cancel{3} \cdot \cancel{3} \cdot 3} = 3$$

1	$1 \cdot 1 \cdot 1 = 1$
2	$2 \cdot 2 \cdot 2 = 8$
3	$3 \cdot 3 \cdot 3 = 27$
4	$4 \cdot 4 \cdot 4 = 64$

$$\sqrt[4]{81} = \sqrt[4]{3 \cdot 3 \cdot 3 \cdot 3} = 3$$

1	$1 \cdot 1 \cdot 1 \cdot 1 = 1$
2	$2 \cdot 2 \cdot 2 \cdot 2 = 16$
3	$3 \cdot 3 \cdot 3 \cdot 3 = 81$
4	$4 \cdot 4 \cdot 4 \cdot 4 = 256$

$$\sqrt[3]{32}$$

$$\sqrt[3]{8 \cdot 4}$$

$$1 \cdot 1 \cdot 1 = 1$$

$$2 \cdot 2 \cdot 2 = 8$$

$$3 \cdot 3 \cdot 3 = 27$$

$$\sqrt[3]{8} \cdot \sqrt[3]{4}$$

$$= 2 \sqrt[3]{4}$$

$$\sqrt[4]{48}$$

$$\sqrt[4]{16 \cdot 3}$$

$$\sqrt[4]{16} \cdot \sqrt[4]{3}$$

$$2 \sqrt[4]{3}$$

$$1^4 = 1$$

$$2^4 = 16$$

$$3^4 = 81$$

$$\sqrt[4]{321}$$

$$\sqrt[4]{324} =$$

$$\sqrt[4]{81 \cdot 3}$$

$$3\sqrt[4]{3}$$

$$\sqrt[4]{81}$$

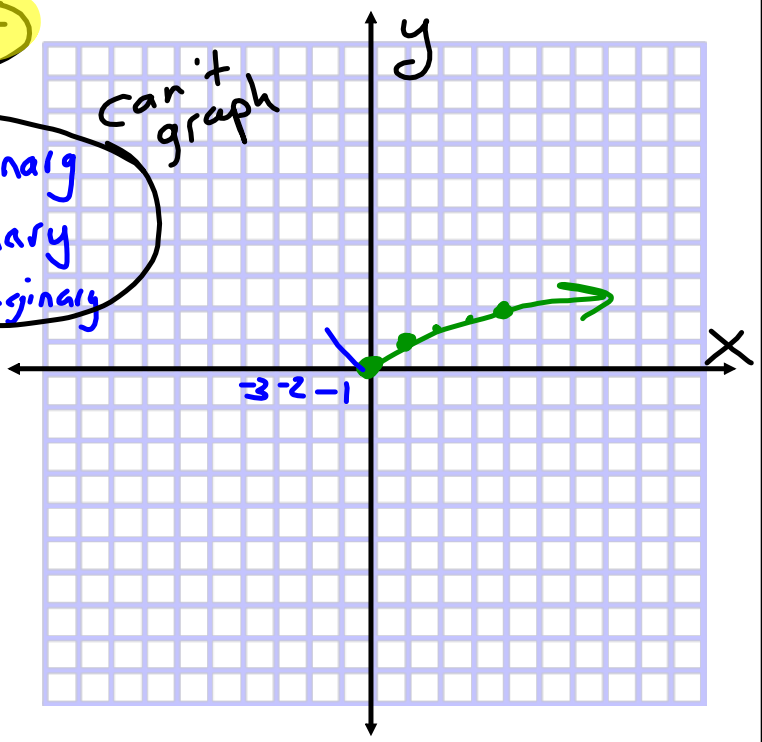
$$\begin{aligned} 1^4 &= 1 \rightarrow 3^{21}/16 \\ 2^4 &= 16 \rightarrow 3^{21}/81 = \\ 3^4 &= 81 \rightarrow 3^{21}/256 \\ 4^4 &= 256 \rightarrow 3^{21}/625 \\ 5^4 &= 625 \end{aligned}$$

Graphing Radical Functions

$y = \sqrt{x}$

x	y
-3	$\sqrt{-3} = i\sqrt{3}$ imaginary
-2	$\sqrt{-2} = i\sqrt{2}$ imaginary
-1	$\sqrt{-1} = i\sqrt{1} = i$ imaginary
0	$\sqrt{0} = 0$
1	$\sqrt{1} = 1$
2	$\sqrt{2} = 1.41$
3	$\sqrt{3} = 1.73$
4	$\sqrt{4} = 2$

can't graph

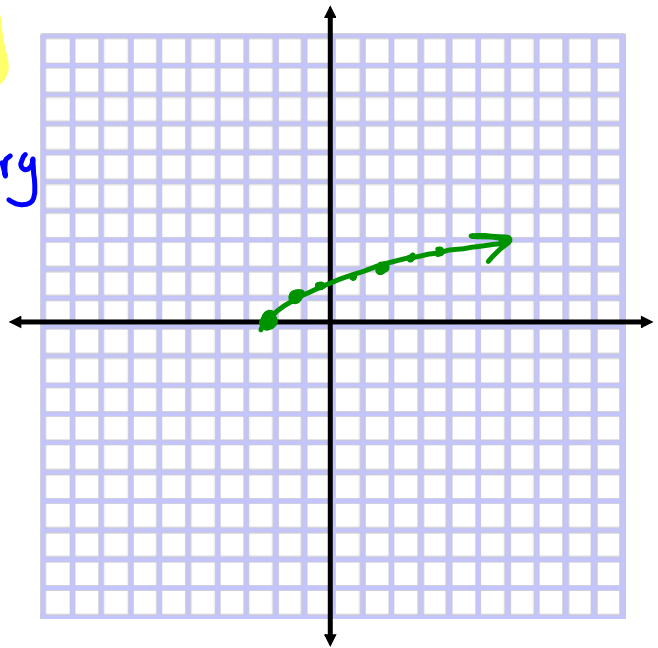


Graphing Radical Functions

Basics:

$$y = \sqrt{x+2}$$

x	y
-3	$\sqrt{-3+2} = \sqrt{-1}$ imaginary
-2	$\sqrt{-2+2} = \sqrt{0} = 0$
-1	$\sqrt{-1+2} = \sqrt{1} = 1$
0	$\sqrt{0+2} = \sqrt{2} = 1.41$
1	$\sqrt{1+2} = \sqrt{3} = 1.73$
2	$\sqrt{2+2} = \sqrt{4} = 2$
3	$\sqrt{3+2} = \sqrt{5} = 2.24$
4	$\sqrt{4+2} = \sqrt{6} = 2.45$



Left + 2

$$y = \sqrt{x}$$

$$y = \sqrt{x+2}$$

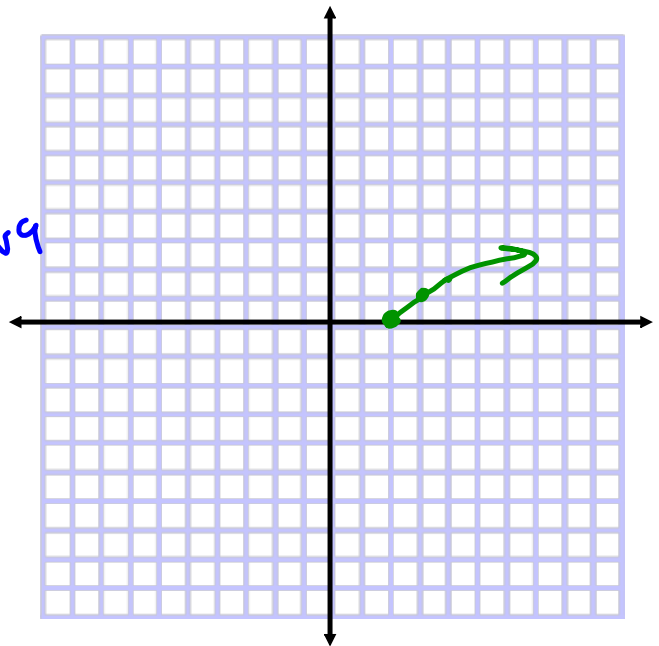
Graphing Radical Functions

Basics:

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

x	y
-3	$\sqrt{-3-2} = \sqrt{-5}$
-2	$\sqrt{-2-2} = \sqrt{-4}$
-1	$\sqrt{-1-2} = \sqrt{-3}$
0	$\sqrt{0-2} = \sqrt{-2}$
1	$\sqrt{1-2} = \sqrt{-1}$
2	$\sqrt{2-2} = \sqrt{0} = 0$
3	$\sqrt{3-2} = \sqrt{1} = 1$
4	$\sqrt{4-2} = \sqrt{2} = 1.41$

Imaginary



$$\underline{\underline{R+2}}$$

$$y = \sqrt{x}$$

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

$$y = \sqrt{x-2} + 3$$

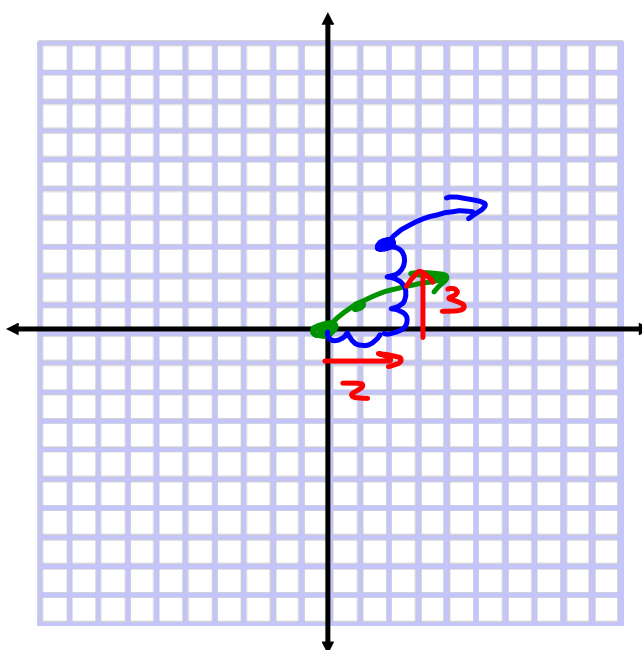
opposite
R+2
same
up 3

① parent function

$$y = \sqrt{x}$$

② moves $\textcircled{R+2}$ / left

$\textcircled{+3}$ / down



$$y = -\sqrt{x}$$

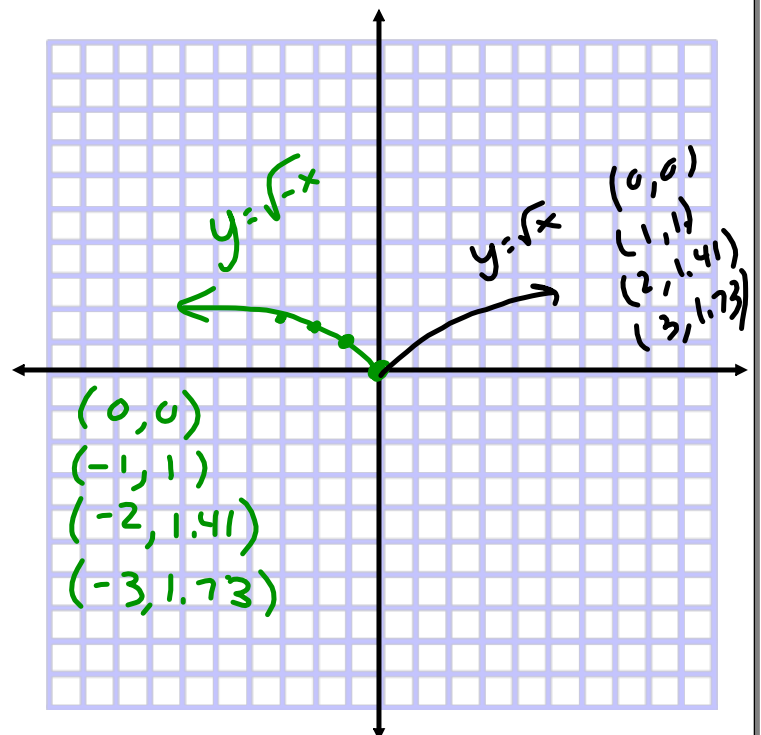
x	y
-3	- $\sqrt{-3}$ Imaginary
-2	- $\sqrt{-2}$ imaginary
-1	- $\sqrt{-1}$ imaginary
0	$-\sqrt{0} = 0$
1	$-\sqrt{1} = -(1) = -1$
2	$-\sqrt{2} = -(1.41) = -1.41$
3	$-\sqrt{3} = -(1.73) = -1.73$

$$y = \sqrt{-x}$$

x	y
-3	$\sqrt{-(-3)} = \sqrt{3} = 1.73$
-2	$\sqrt{-(-2)} = \sqrt{2} = 1.41$
-1	$\sqrt{-(-1)} = \sqrt{1} = 1$
0	$\sqrt{-(0)} = \sqrt{0} = 0$
1	$\sqrt{-(1)} = \sqrt{-1}$ imaginary
2	$\sqrt{-(2)} = \sqrt{-2}$ imaginary
3	$\sqrt{-(3)} = \sqrt{-3}$ imaginary

$$y = \sqrt{-x}$$

x	y
-3	$\sqrt{-(-3)} = \sqrt{3} = 1.73$
-2	$\sqrt{-(-2)} = \sqrt{2} = 1.41$
-1	$\sqrt{-(-1)} = \sqrt{1} = 1$
0	$\sqrt{-(0)} = \sqrt{0} = 0$
1	$\sqrt{-(1)} = \sqrt{-1}$ imaginary
2	$\sqrt{-(2)} = \sqrt{-2}$ imaginary
3	$\sqrt{-(3)} = \sqrt{-3}$ imaginary

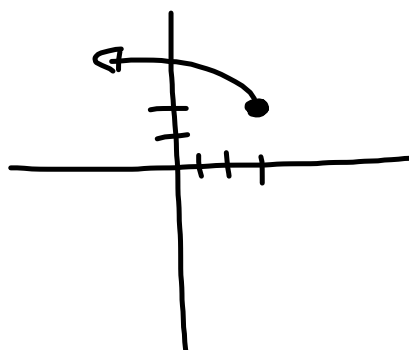
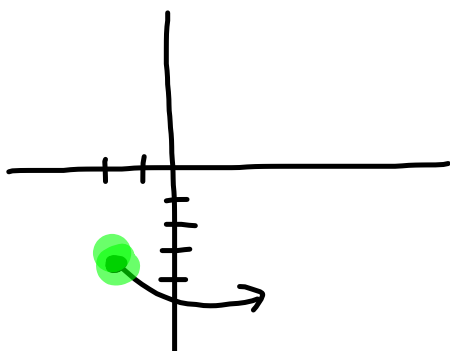


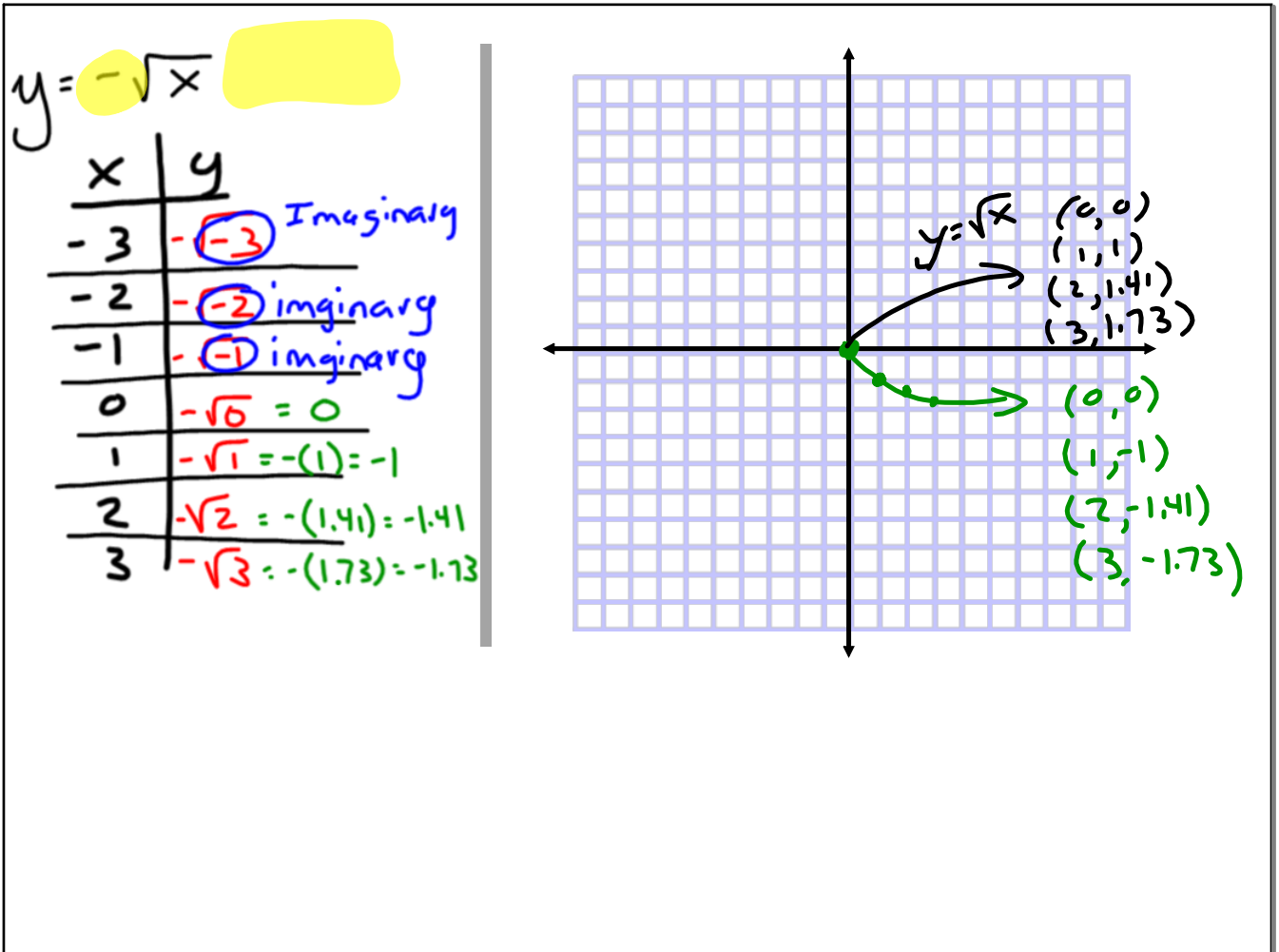
$$y = -\sqrt{x+2} - 4$$

Annotations: $x+2$ is highlighted in yellow with "left 2" written in red below it. -4 is highlighted in blue with "down 4" written in blue below it. A coordinate plane sketch shows the radical symbol pointing left and down.

$$y = \sqrt{-x-3} + 2$$

Annotations: $-x-3$ is highlighted in yellow with "Rt 3" written in red below it. $+2$ is highlighted in blue with "up 2" written in blue below it. A coordinate plane sketch shows the radical symbol pointing right and up.





$$\begin{array}{l} \sqrt{18} \\ \swarrow \searrow \\ \sqrt{9 \cdot 2} \\ \swarrow \searrow \\ \sqrt{3 \cdot 3 \cdot 2} \\ \leftarrow \quad \circ \quad \circ \quad \cdot \sqrt{2} \\ \circ \quad 3 \sqrt{2} \end{array} \quad + \quad \begin{array}{l} \sqrt{32} \\ \swarrow \searrow \\ \sqrt{16 \cdot 2} \\ \swarrow \searrow \\ \sqrt{4 \cdot 4 \cdot 2} \\ \downarrow \\ + \quad 4 \sqrt{2} \end{array} \quad + \quad \begin{array}{l} \sqrt{72} \\ \swarrow \searrow \\ \sqrt{36 \cdot 2} \\ \swarrow \searrow \\ \sqrt{6 \cdot 6 \cdot 2} \\ \downarrow \\ + \quad 6 \sqrt{2} \end{array}$$
$$= 13\sqrt{2}$$

$$\sqrt[2]{x^5} = \sqrt{\cancel{x \cdot x} \cdot \cancel{x \cdot x} \cdot x} = x^2 \sqrt{x}$$

$$\sqrt[3]{x^5} = \sqrt[3]{\cancel{x \cdot x \cdot x} \cdot x \cdot x} = x \sqrt[3]{x^2}$$

$$\sqrt[4]{x^5} = \sqrt[4]{\cancel{x \cdot x \cdot x \cdot x} \cdot x} = x \sqrt[4]{x}$$

$$\sqrt[3]{27} = 3$$

$$3 \sqrt[3]{\cancel{3 \cdot 3 \cdot 3}}$$

1	$1 \cdot 1 \cdot 1 = 1$
2	$2 \cdot 2 \cdot 2 = 8$
3	$3 \cdot 3 \cdot 3 = 27$
4	$4 \cdot 4 \cdot 4 = 64$

$$\sqrt[4]{81} = 4 \sqrt[4]{\cancel{3 \cdot 3 \cdot 3 \cdot 3}} = 3$$

1	$1 \cdot 1 \cdot 1 \cdot 1 = 1$
2	$2 \cdot 2 \cdot 2 \cdot 2 = 16$
3	$3 \cdot 3 \cdot 3 \cdot 3 = 81$
4	$4 \cdot 4 \cdot 4 \cdot 4 =$

$$\sqrt{\frac{48x}{27x^2}} = \frac{\sqrt{48x}}{\sqrt{27x^2}}$$

$$= \sqrt{\frac{48x}{27x^2}} \left. \begin{array}{l} \text{simplify} \\ \end{array} \right\} = \sqrt{\frac{16}{9x}}$$

$$\begin{array}{cc} 48 & 27 \\ \swarrow & \swarrow \\ 16 \cdot 3 & 9 \cdot 3 \end{array}$$

$$= \frac{\sqrt{16}}{\sqrt{9x}} = \frac{4}{3\sqrt{x}}$$

