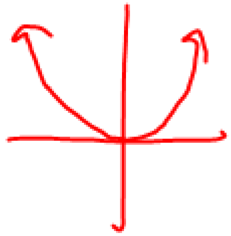
# Warm Up



**Use the description to write the quadratic function *g* based on the parent function $f(x) = x^2$.**

**1.** *f* is translated 3 units up. $x^2 + 3$ $g(x) = x^2 + 3$

**2.** *f* is translated 2 units left. ~~$(x-2)^2$~~ $(x+2)^2$ $g(x) = (x+2)^2$

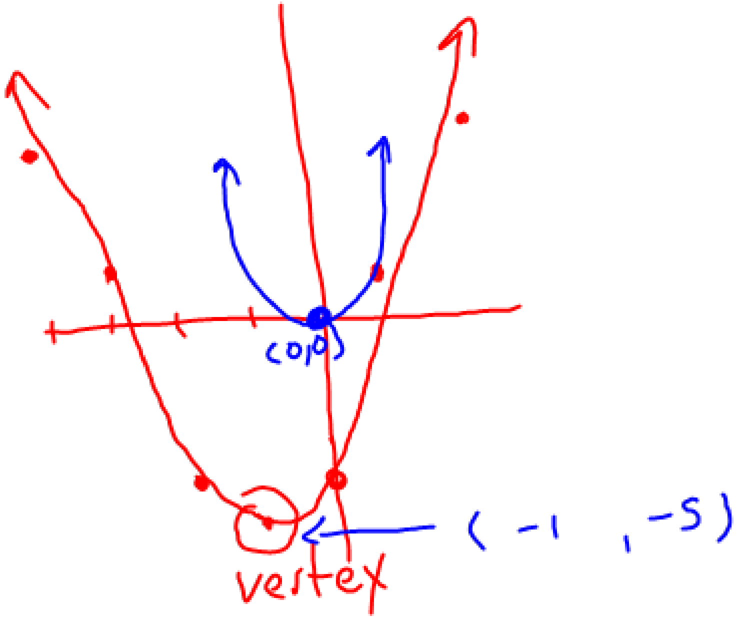
**3.** *f* is reflected over the x-axis. $-x^2$ $g(x) = -(x)^2$

$y = (x+1)^2 - 5$ down 5

$y = (x+1)^2 - 5$ down 5

left 1

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

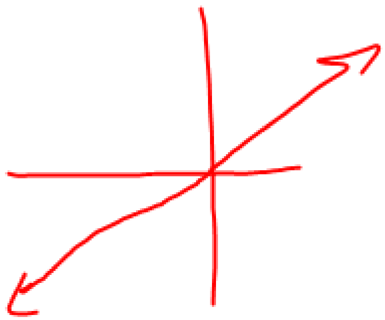



transformations?

Down 5

Left 1

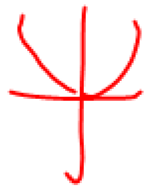
$y = x$



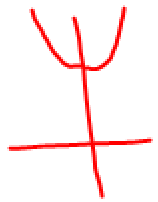
$y = x + 5$ up 5

$y = x - 2$ down 2

$y = x^2$



$y = x^2 + 5$



# Radical Functions

# *Objectives*

$\sqrt[\square]{\phantom{x}}$

- Graph radical functions. $\sqrt{x}$ $\sqrt[3]{x}$
- Transformations of radical functions.

A **radical function** is a function whose rule is a radical expression.

$y = 4x + 3$        $y = \sqrt{x+2} - 3$

The square-root parent function is $f(x) = \sqrt{x}$. The cube-root parent function is $f(x) = \sqrt[3]{x}$

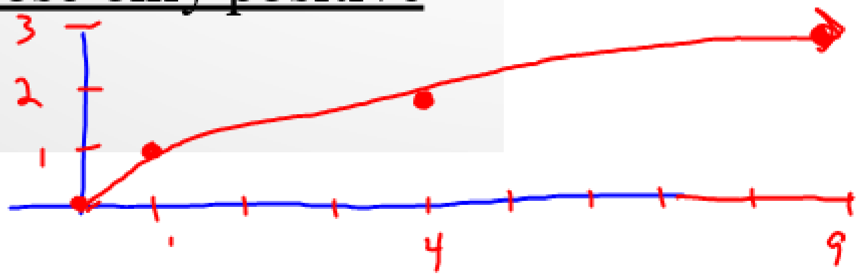
# Radical Functions

Example 1:

**Using the table in your calculator, draw a rough sketch of the parent function** . $f(x) = \sqrt{x}$

| x | y |
|---|---|
| 0 | 0 |
| 1 | 1 |
| 2 | 1.4 |
| 3 | 1.7 |
| 4 | 2 |
| 5 | 2.23 |
| 6 | |
| 7 | |
| 8 | |
| 9 | 3 |

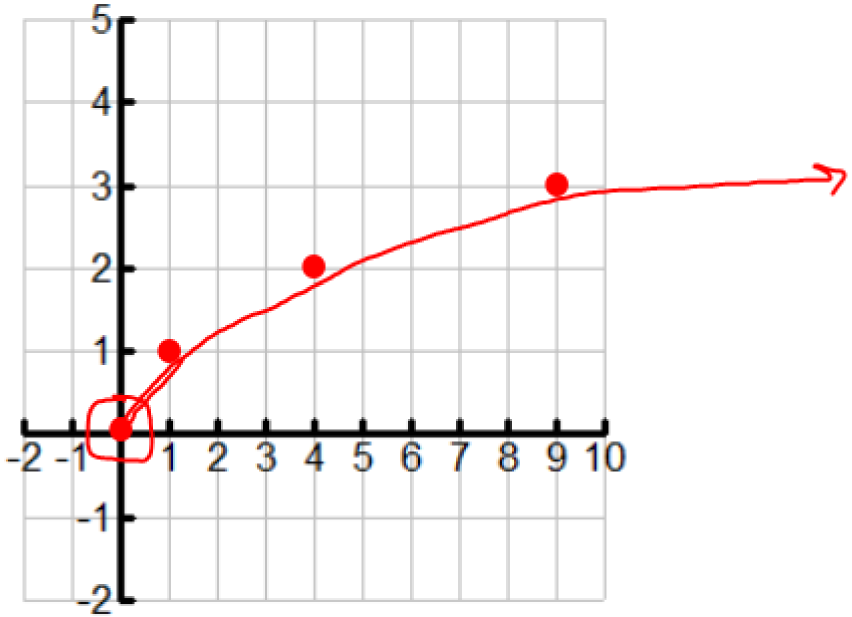
Make a table of values. Plot enough ordered pairs to see the shape of the curve. Because **the square root of a negative number is imaginary**, choose only positive values for *x*.

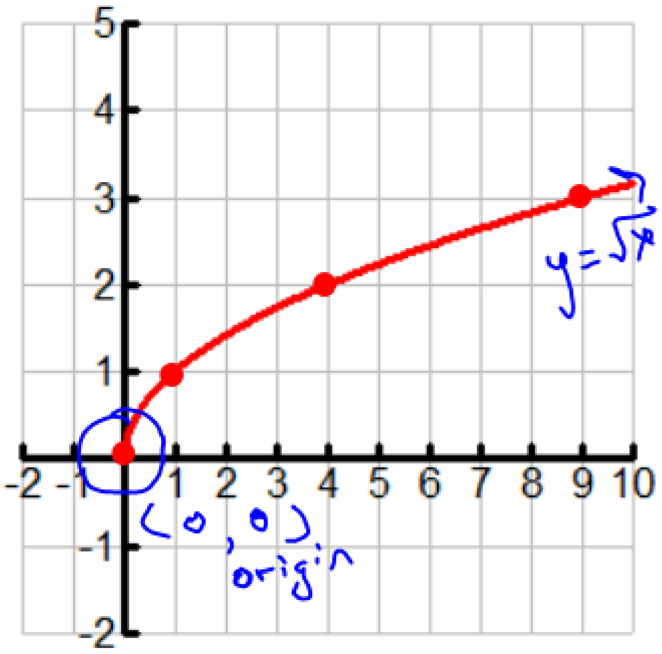


# Radical Functions

Example 1 – Find "good" points in your table

| $x$ | $f(x)=\sqrt{x}$ | $(x, f(x))$ |
|---|---|---|
| 0 | $f(0)=\sqrt{0}=0$ | (0, 0) |
| 1 | $f(1)=\sqrt{1}=1$ | (1, 1) |
| 4 | $f(4)=\sqrt{4}=2$ | (4, 2) |
| 9 | $f(9)=\sqrt{9}=3$ | (9, 3) |






We are going to use this parent graph and apply transformations!

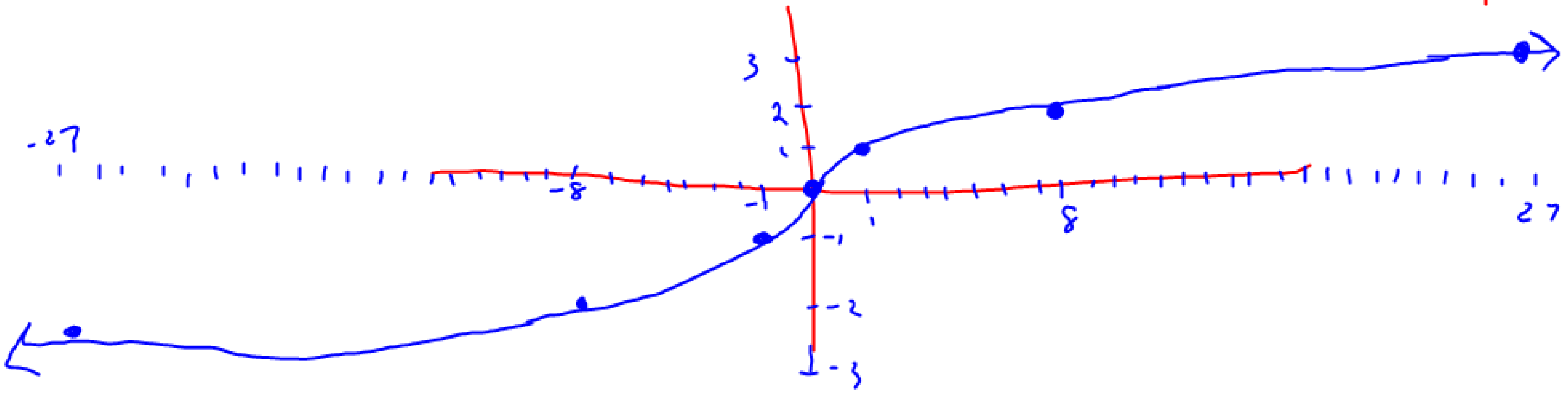
## Example 2

**Using the table in your calculator, draw a rough sketch of the parent function $f(x) = \sqrt[3]{x}$.**

Make a table of values. Plot enough ordered pairs to see the shape of the curve. Choose both negative and positive values for $x$.

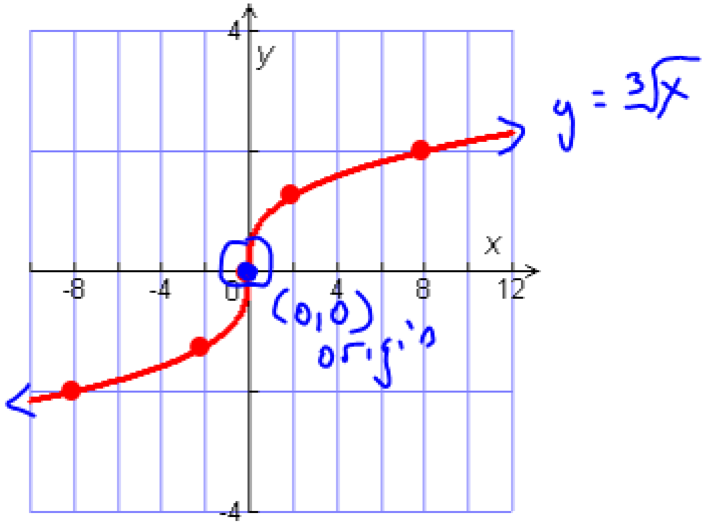
Make a table of values. Plot enough ordered pairs to see the shape of the curve. Choose both negative and positive values for $x$.

| x | y |
|---|---|
| -27 | -3 |
| -8 | -2 |
| -1 | -1 |
| 0 | 0 |
| 1 | 1 |
| 8 | 2 |
| 27 | 3 |



# Example 2 Continued

| **x** | $f(x)=\sqrt[3]{x}$ | **(x, f(x))** |
|---|---|---|
| –8 | $f(-8)=\sqrt[3]{-8}=-2$ | (–8, –2) |
| –1 | $f(-1)=\sqrt[3]{-1}=-1$ | (–1,–1) |
| 0 | $f(0)=\sqrt[3]{0}=0$ | (0, 0) |
| 1 | $f(1)=\sqrt[3]{1}=1$ | (1, 1) |
| 8 | $f(8)=\sqrt[3]{8}=2$ | (8, 2) |



# Radical Functions - Transformations

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

coefficient

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

**When "a" is negative: Reflect over the x-axis**

****Negative on the outside – it "x-caped"****

**When "a" is a fraction between 0 and 1: Vertical Shrink (Compression)**

**When "a" is a number greater than 1: Vertical Stretch**

# Examples:

1. $f(x) = -\sqrt{x}$

Reflect over the x-axis

2. $f(x) = 2\sqrt{x}$

Vertical Stretch by 2

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

Reflect over the x-axis, Vertical Shrink by 1/3

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

**Inside the radical, opposite of what you think**

**When "b" is negative: Reflect over the y-axis**

****Negative on the inside – "y" am I in here?****

**When "b" is a fraction between 0 and1: Horizontal Stretch**

**When "b" is a number greater than 1: Horizontal Shrink (Compression)**

# Examples:

1. $f(x) = \sqrt{-x}$

Reflect over the y-axis

2. $f(x) = \sqrt{3x}$

Horizontal Shrink by 1/3

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

Horizontal Stretch by 4

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

****Inside the radical, opposite of what you think****

**If "h" is <u>positive</u>, then the graph moves <u>left</u>:**

**Horizontal shift to the <u>left</u>**

**If "h" is <u>negative</u>, then the graph moves <u>right</u>:**

**Horizontal shift to the <u>right</u>**

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

**If "k" is <u>positive</u>, then the graph moves <u>up</u>: Vertical shift <u>up</u>**

**If "k" is <u>negative</u>, then the graph moves <u>down</u>: Vertical shift <u>down</u>**

# Examples:

1. $f(x) = \sqrt{x-3}$ — Right 3

2. $f(x) = \sqrt{x} - 5$ — Down 5

3. $f(x) = \sqrt{(x+2)} + 4$ — Left 2, Up 4

# Radical Functions - Graphing

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

- **Use your table to help find good points**
- **"Starting point" will always be (h, k)**

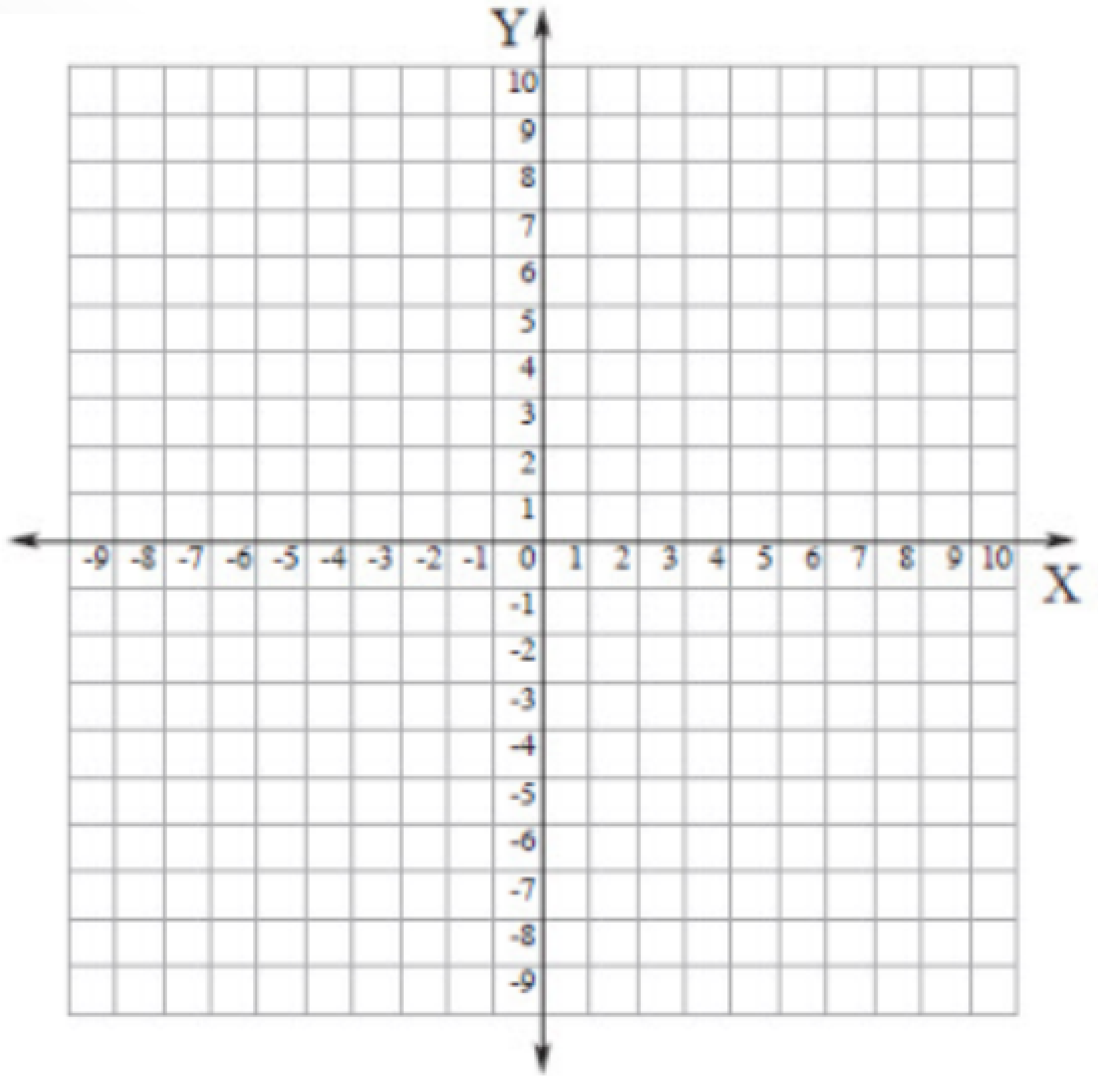
# Radical Functions – Let's Graph!!

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

1. $f(x) = \sqrt{x+6}$

2. $f(x) = 3\sqrt[3]{x}$

1. $f(x) = \sqrt{x+6}$



2. $f(x) = 3\sqrt[3]{x}$