LEARNING TARGET: I will recognize the general shape of function families and convert between graphic and algebraic forms of the function

Domain: the set of input values (x's that work)

Range: the set of output values (y's resulting from function)

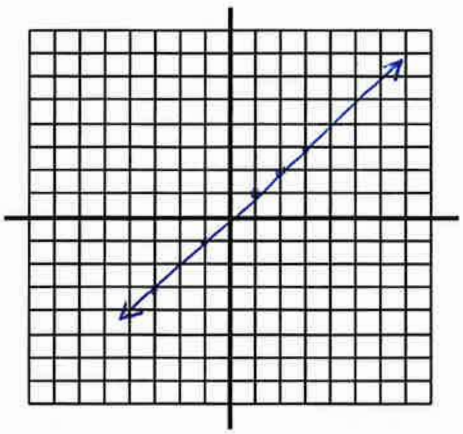
REMEMBER: amplitude $y = f(x)$ vertical shift

$$y = a \cdot f(x - h) + k$$

horizontal shift

Linear Functions

Parent Function: Graph $f(x) = x$

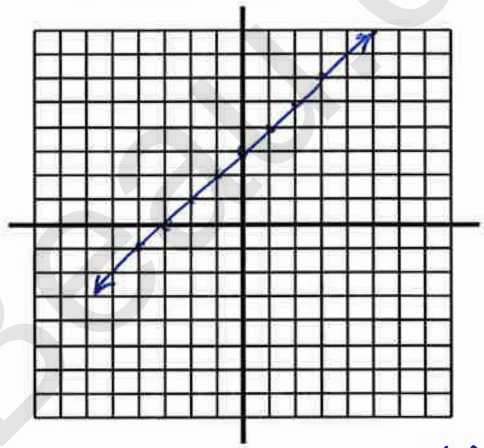


Function Type: linear

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

Graph $f(x) = x + 3$



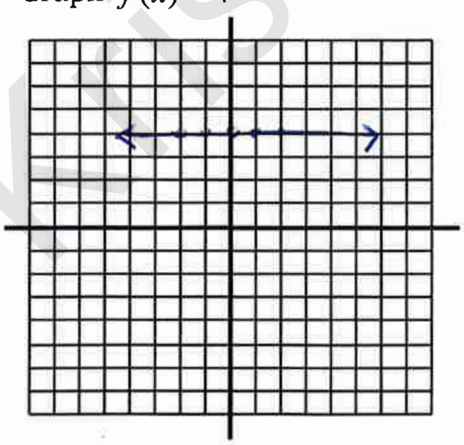
Changes in parent function: Shift up 3

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

There is another linear function called a constant function.

Graph $f(x) = 4$



Domain: All $\mathbb{R}$

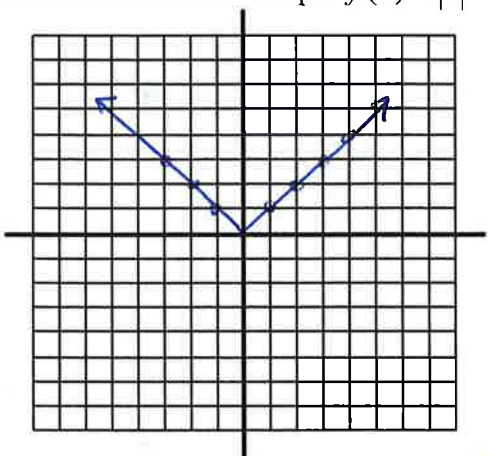
Range: 4

Why is this called a constant function?

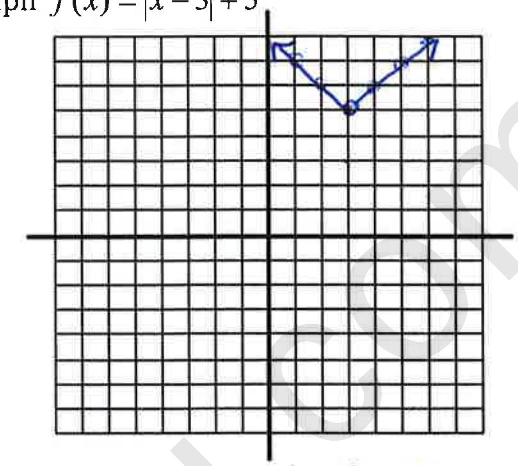
the values (range) does not vary, for any x, y=4

Absolute Value Functions

Parent Function: Graph $f(x) = |x|$



Graph $f(x) = |x-3| + 5$



Function Type: Absolute Value

Changes in parent function: Shift up 5, right 3

Domain: All $\mathbb{R}$

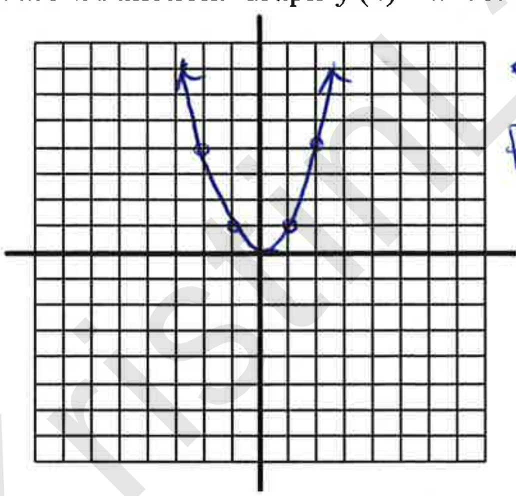
Range: $y \geq 0$

Domain: All $\mathbb{R}$

Range: $y \geq 5$

Quadratic Functions

Parent Function: Graph $f(x) = x^2$ using a table of values



parabola

x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

Function Type: Quadratic

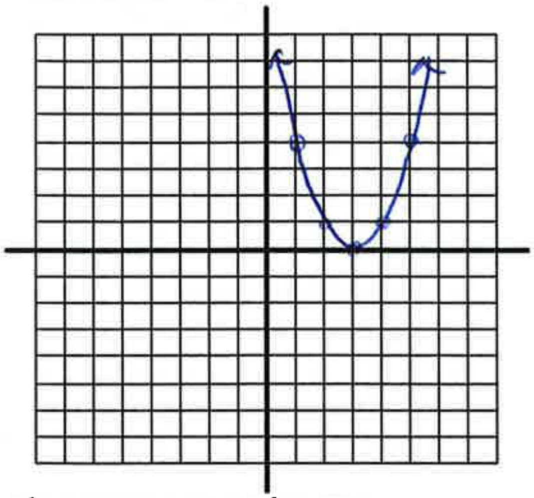
Vertex: 0, 0

Domain: All $\mathbb{R}$

Range: $y \geq 0$

Using what you know from graphing absolute value functions…

Graph $f(x)=(x-3)^2$



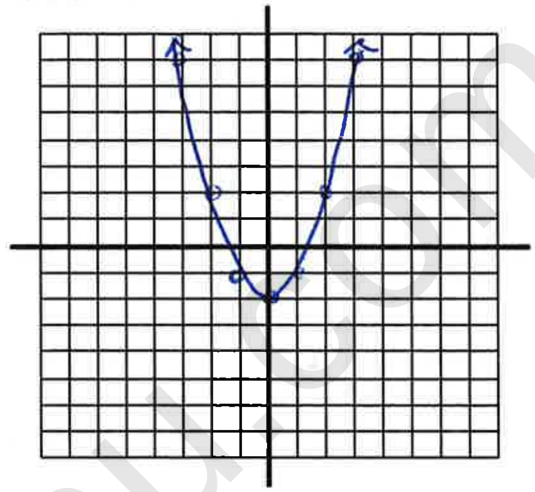
Changes in parent function:

Shift right 3

Domain: All $\mathbb{R}$

Range: $y \geq 0$

Graph $f(x)=x^2-2$



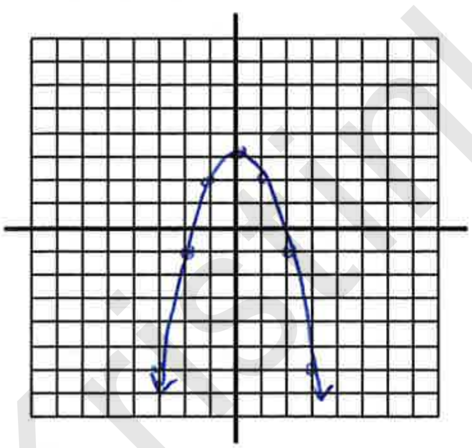
Changes in parent function:

Shift down 2

Domain: All $\mathbb{R}$

Range: $y \geq -2$

Graph $f(x)=-x^2+3$



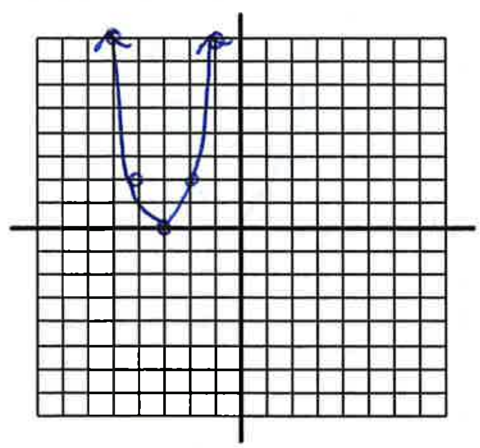
Changes in parent function:

down facing + up 3

Domain: All $\mathbb{R}$

Range: $y \leq 3$

Graph $f(x)=2(x+3)^2$



Changes in parent function:

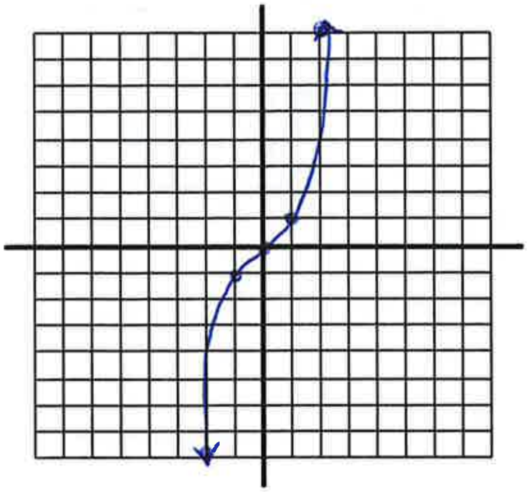
narrower, shift left 3

Domain: All $\mathbb{R}$

Range: $y \geq 0$

Cubic Functions

Parent Function: Graph $f(x) = x^3$ using a table of values



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

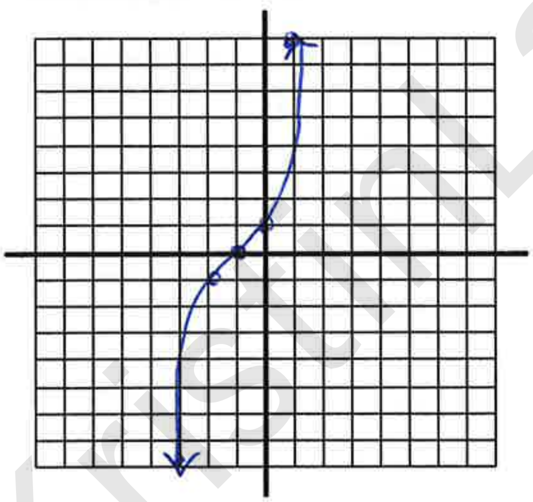
Function Type: Cubic

Coordinates of 3 Central Points: (-1,-1), (0,0), (1,1)

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

Graph $f(x) = (x+1)^3$

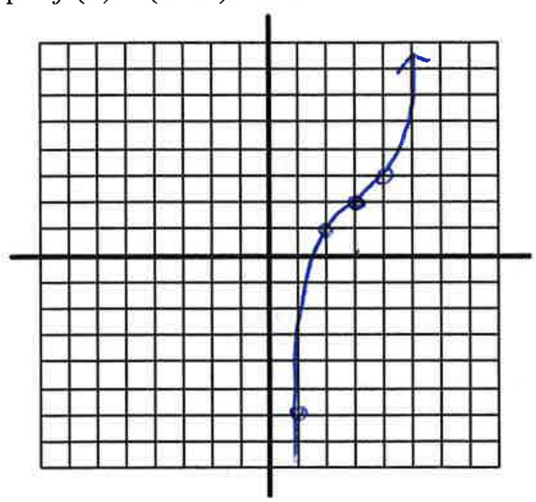


Changes in parent function: Shifted left 1

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

Graph $f(x) = (x-3)^3 + 2$

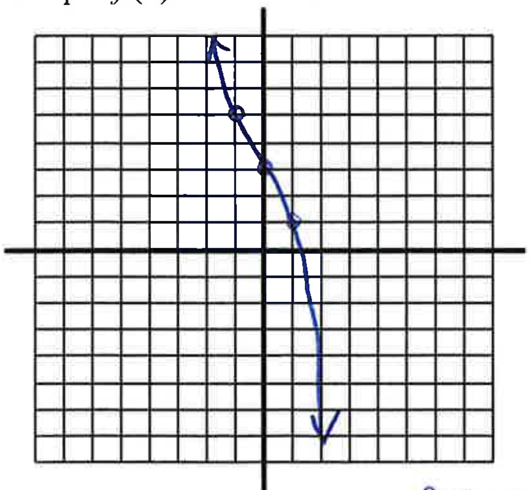


Changes in parent function: Shifted right 3, up 2

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

Graph $f(x) = -2x^3 + 3$

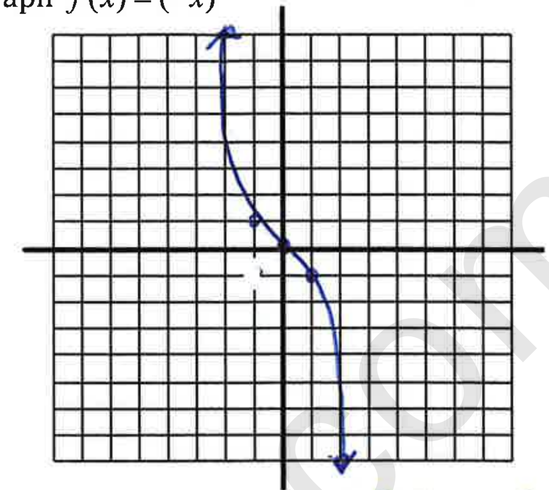


Changes in parent function: flipped, Stretched out, + Shifted up 3

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

Graph $f(x) = (-x)^3$



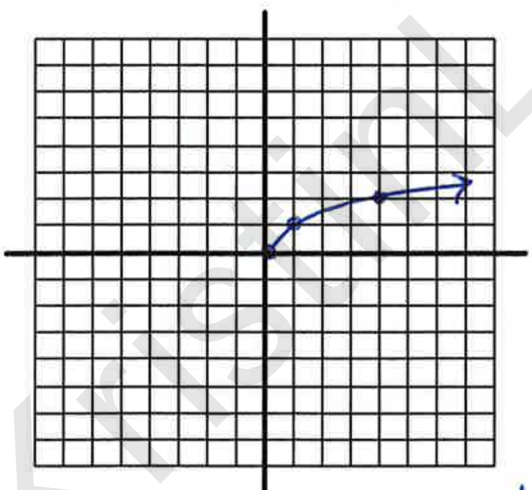
Changes in parent function: flipped

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

Square Root Functions

Parent Function: Use a table of values to graph $f(x) = \sqrt{x}$



x	y
0	0
1	1
4	2
9	3

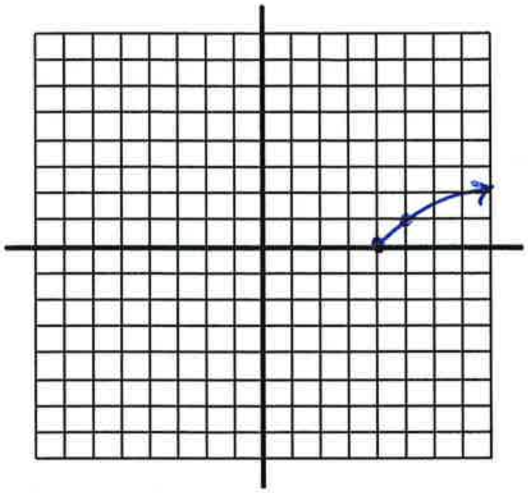
Function Type: Square root

Vertex: (0, 0)

Domain: $x \geq 0$

Range: $y \geq 0$

Graph $f(x) = \sqrt{x-4}$

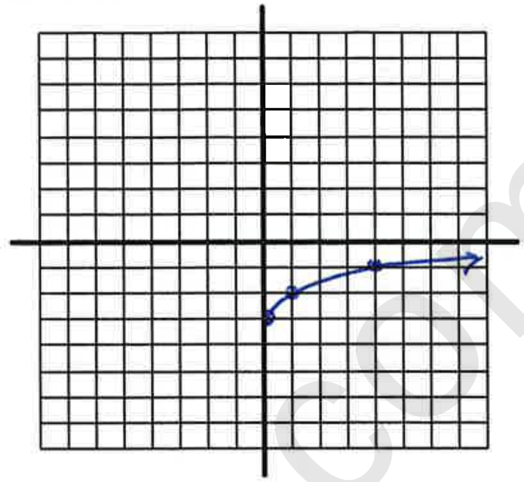


Changes in parent function: Shifted 4 right

Domain: $x \geq 4$

Range: $y \geq 0$

Graph $f(x) = \sqrt{x} - 3$

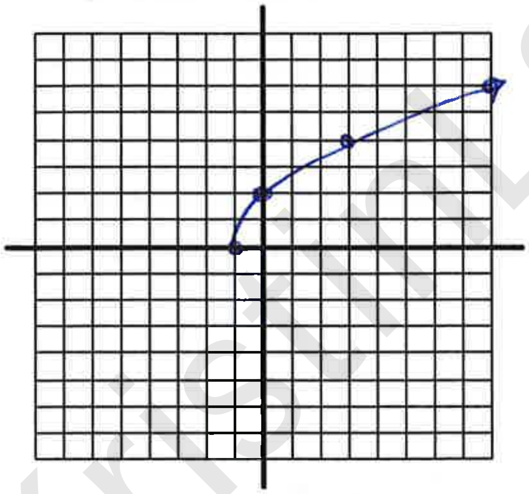


Changes in parent function: Shifted 3 down

Domain: $x \geq 0$

Range: $y \geq -3$

Graph $f(x) = 2\sqrt{x+1}$

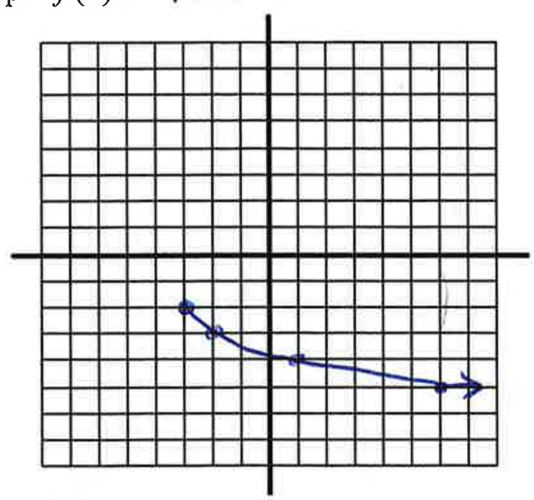


Changes in parent function: amplified, shifted 1 left

Domain: $x \geq -1$

Range: $y \geq 0$

Graph $f(x) = -\sqrt{x+3} - 2$

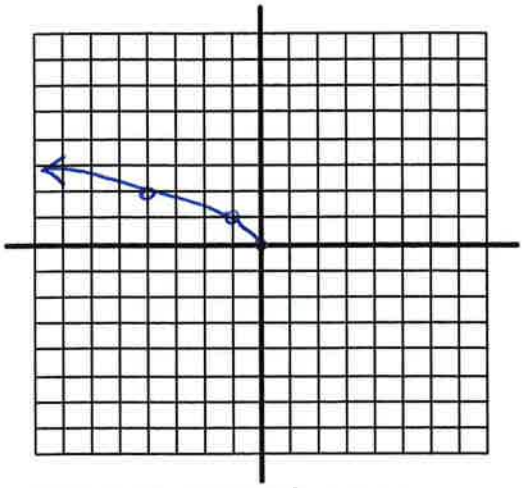


Changes in parent function: reflected, shifted down 2, left 3

Domain: $x \geq -3$

Range: $y \leq -2$

Graph $f(x)=\sqrt{-x}$

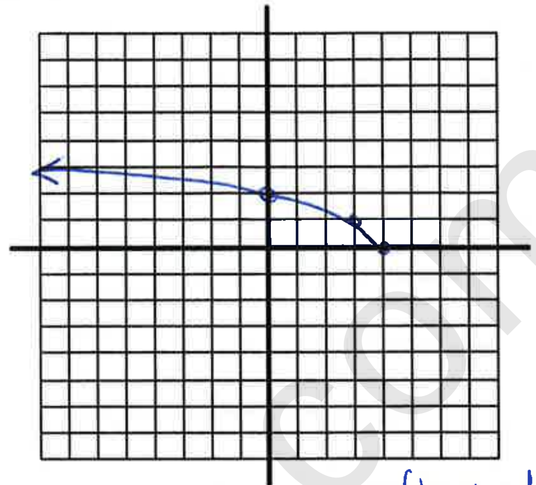


Changes in parent function: reflected over y axis

Domain: $x \le 0$

Range: $y \ge 0$

Graph $f(x)=\sqrt{4-x}$



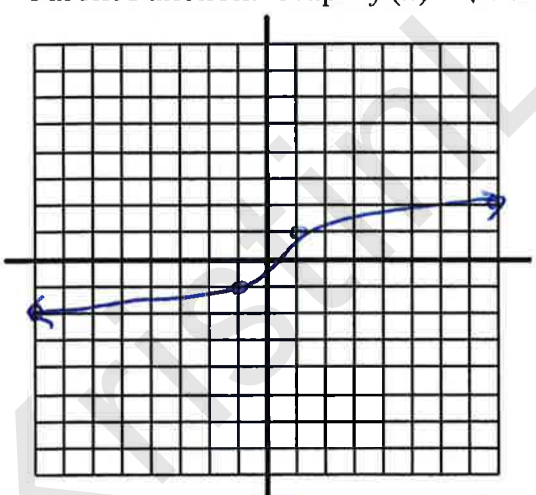
Changes in parent function: reflected over y axis, shifted right 4

Domain: $x \le 4$

Range: $y \ge 0$

Cube Root Functions

Parent Function: Graph $f(x)=\sqrt[3]{x}$ using a table of values



x	$\sqrt[3]{x}$
-8	-2
-1	-1
0	0
1	1
8	2

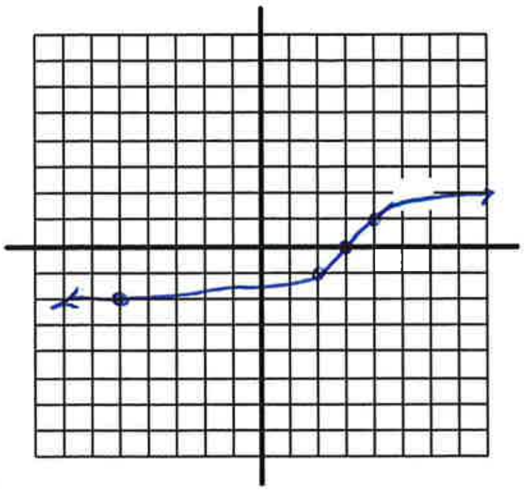
Function Type: Cube root

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

Coordinates of 3 Central Points: $(-1,-1)$, $(0,0)$, $(1,1)$

Graph $f(x)=\sqrt[3]{x-3}$



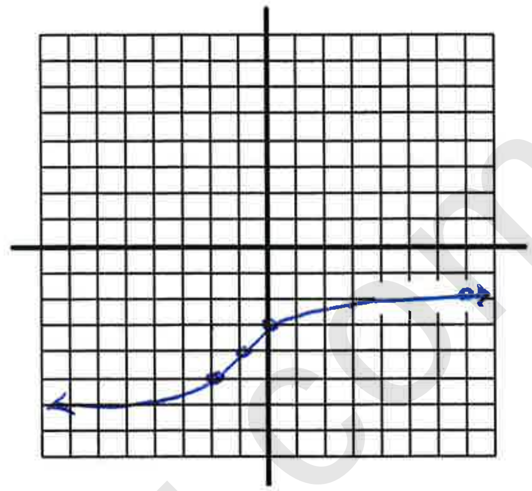
Changes in parent function:

Shifted right 3

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

Graph $f(x)=\sqrt[3]{x+1}-4$

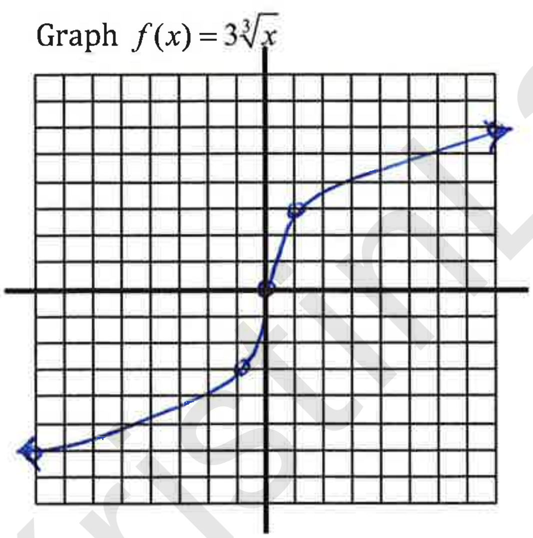


Changes in parent function: Shifted 1 left + down 4

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

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



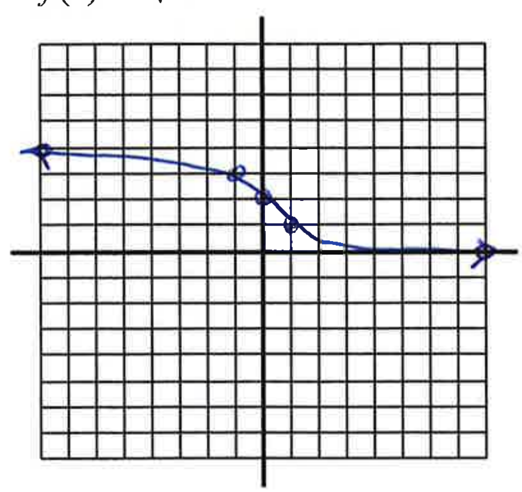
Changes in parent function:

amplitude changed (stretched)

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

Graph $f(x)=-\sqrt[3]{x}+2$



Changes in parent function:

reflected over x, shifted up 2

Domain: All $\mathbb{R}$

Range: All $\mathbb{R}$

CONCLUSIONS

Answer the following based on the graphs you completed for each type of function.

1. What is the domain and range of a linear function? Does it ever change? If so, what causes the changes?

   All $\mathbb{R}$, does not change.

2. What is the domain of an absolute value function? The range?

   D: All $\mathbb{R}$
   R: varies, allways less than or greater than vertex

3. Do either of these ever change? If so, which one? What causes those changes?

   Range changes based on up or down direction of function + up + down shifts of the function

4. What did you notice about the domain of the quadratic function? The range?

   D: All $\mathbb{R}$
   R: Varies

5. Do either of these ever change? If so, which one? What causes those changes?

   Range varies based upon up or down direction (- or +) and vertex (vertical shifts)

6. Compare and contrast the shape of the absolute value and the quadratic graphs.

   Absolute value is constant slope on both sides of the vertex, where quadratic function slope varies

7. What did you notice about the domain of the cubic function? The range?

   D: All $\mathbb{R}$
   R: All $\mathbb{R}$

8. Do either of these ever change? Explain why.

   No, does not change.

9. Explain why the domain of the square root parent function must be restricted.

negatives under the radical result in imaginary numbers

10. Explain why the range of the square root parent function is also restricted.

Since the domain is restricted, the range is restricted based on our domain

11. Do either of these ever change? If so, what causes those changes?

Yes, D & R vary based on the transformations applied to the parent function

12. What did you notice about the domain and range of the cube root function? Explain why.

D: All $\mathbb{R}$
R: All $\mathbb{R}$

any input can be entered into a cube root function

13. Do either of these ever change? If so, what causes those changes?

No, does not change

14. What causes the parent function to be reflected over the y-axis?

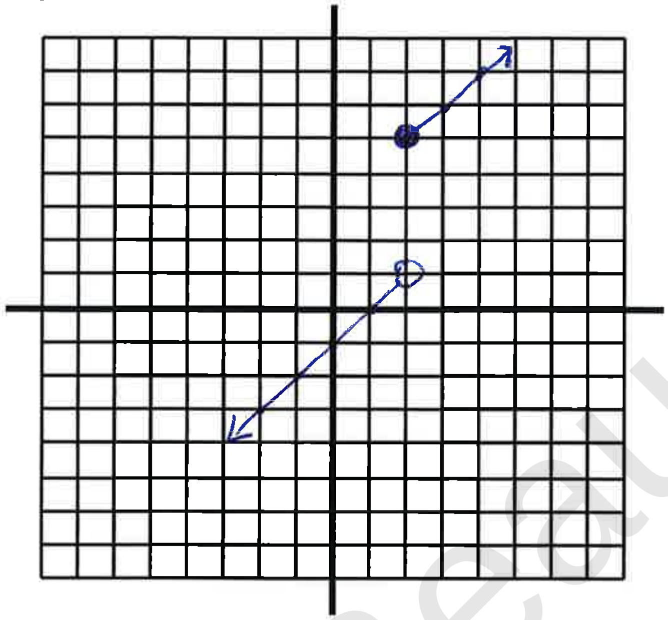
$y = f(-x)$

15. What causes the parent function to be reflected over the x-axis?

$y = -f(x)$

Piecewise Functions

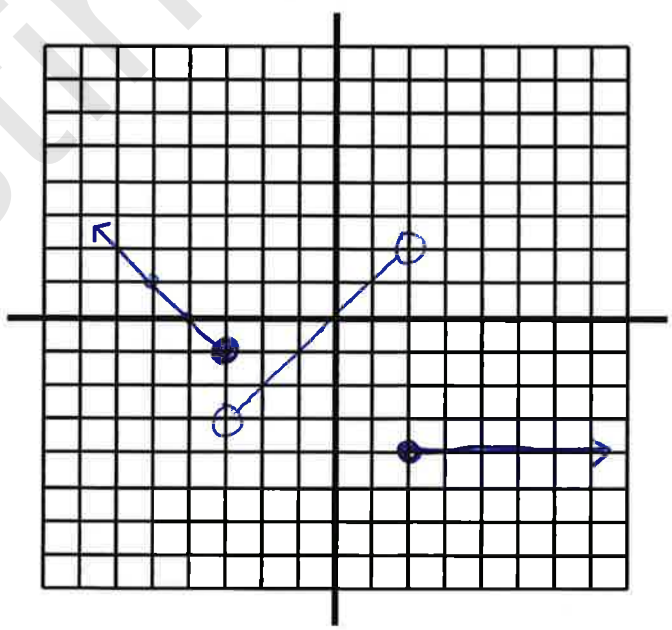
Graph $g(x) = \begin{cases} x+3, \ if \ x \geq 2 \\ x-1, \ if \ x < 2 \end{cases}$



x	x+3
2	5
3	6
4	7
5	8
6	9

Which of these functions actually has the number 2 as part of its domain? Make sure the part of the function that includes 2 has a darkened circle at x = 2. The other function that does not include 2 should have an open circle at x = 2

Graph the function $f(x) = \begin{cases} |x+3|-1, & if \ x \leq -3 \\ x, & if \ -3 < x < 2 \\ -4, & if \ x \geq 2 \end{cases}$



x	|x+3|-1
-5	1
-4	0
-3	-1

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

x	-4
2	-4
3	-4

Step Functions

These are called step functions because they resemble stair steps.

$$\text{Graph } f(x) = \begin{cases} -2, & \text{if } -1 \le x < 0 \\ -1, & \text{if } 0 \le x < 1 \\ 0, & \text{if } 1 \le x < 2 \\ 1, & \text{if } 2 \le x < 3 \\ 2, & \text{if } 3 \le x < 4 \end{cases}$$

What kind of line is f(*x*) = -2?

horizontal - constant function

What is the domain of this function?

[-1, 4)

Graph each piece.