FST 3-1 Notes

Topic: Graphs of Parent Functions

<u>GOAL:</u>

Introduce concepts and language associated with certain relations and their graphs, and allow students to become familiar with the ways in which graphing utilities deal with these concepts.

E Describe and identify symmetries and asymptotes of graphs.

I Recognize functions and their properties from their graphs.

Vocabulary

parent function MEMBER WITH SIMPLEST EQUATION

window – WHAT SHOWS ON GRAPH, NEED TO SEE IMPORTANT ASPECTS OF GRAPH

WARM-UP

Graph $y = x^3$ using zoom 6

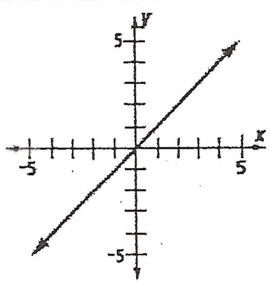
Domain: $-10 \le x \le 10$ Range: $-10 \le y \le 10$

1) Describe the default window.

2) Change ~~the x-scale on~~ the window so that the graph goes into the corners of the window.

$-2.2 \le x \le 2$

State the **domain** and **range** of each Parent Function

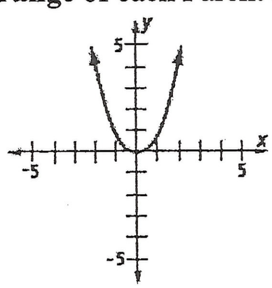


$f(x) = x$

(linear)

D $\{x \mid x \in \mathbb{R}\}$

R $\{y \mid y \in \mathbb{R}\}$

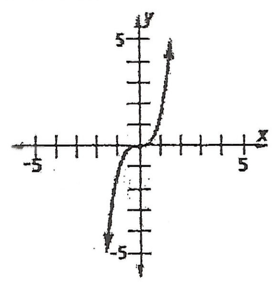


$f(x) = x^2$

(quadratic)

D $\{x \mid x \in \mathbb{R}\}$

R $\{y \mid y \ge 0\}$

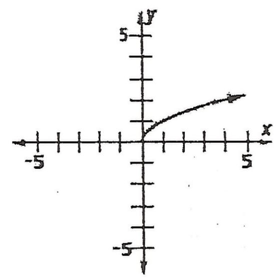


$f(x) = x^3$

(cubic)

D $\{x \mid x \in \mathbb{R}\}$

R $\{y \mid y \in \mathbb{R}\}$



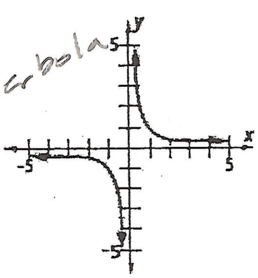
$f(x) = \sqrt{x}$

(square root)

D $\{x \mid x \ge 0\}$

R $\{y \mid y \ge 0\}$

hyperbolas

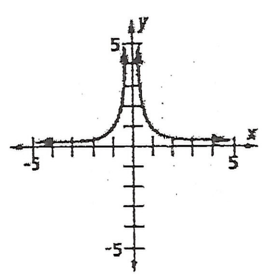


$f(x) = \frac{1}{x}$

(inverse variation)

D $\{x \mid x \ne 0\}$

R $\{y \mid y \ne 0\}$

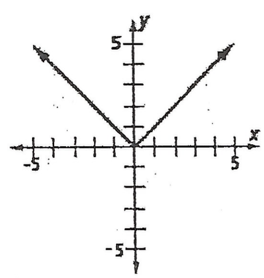


$f(x) = \frac{1}{x^2}$

(inverse square)

D $\{x \mid x \ne 0\}$

R $\{y \mid y > 0\}$

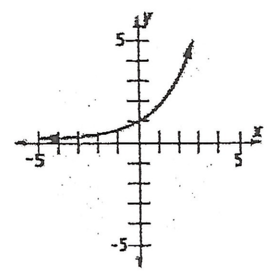


$f(x) = |x|$

(absolute value)

D $\{x \mid x \in \mathbb{R}\}$

R $\{y \mid y \ge 0\}$



$f(x) = 2^x$

(exponential growth)

D $\{x \mid x \in \mathbb{R}\}$

R $\{y \mid y > 0\}$

Describe the shape of the graph of each equation.

a. $3x - 4y = 7$ $\quad \frac{4y}{4} = \frac{3x}{4} - \frac{7}{4}$ $\quad y = \frac{3}{4}x - \frac{7}{4}$ • Linear

b. $3x^2 - 4y = 7$ $\quad \frac{4y}{4} = \frac{3x^2}{4} - \frac{7}{4}$ $\quad y = \frac{3}{4}x^2 - \frac{7}{4}$ • Quadratic

c. $\frac{3x \cdot 4y}{3x \cdot 4} = \frac{7}{3x \cdot 4}$ $\quad y = \frac{7}{12x}$ • Hyperbola (Inverse Variation)

When you plot a function with a graphing utility, you want to choose the viewing window that shows important aspects of the function. Graphing utilities have a standard window, zoom 6, which is used as a default for plotting functions. The standard window, zoom 6, is usually appropriate for parent functions but often misses important features of graphs of their offspring. Your knowledge of the parent graphs can help you choose a good window. On graphing utilities, the window is described by identifying the least and greatest values of x and y that will be shown, **Xmin, Xmax, Ymin and Ymax**.

Additional Example 1

opens down   up 17

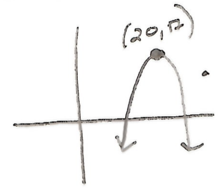
a. Display the graph of $h(x) = -(x - 20)^2 + 17$ in an appropriate window.   Right 20

b. State the domain and range of the function.

• Show vertex (20, 17)

• Show x-ints

(20,17)



Window
Xmin: 0
Xmax: 30
ymin: -10
ymax: 20
(VARY)

D: $\{x \mid x \in \mathbb{R}\}$

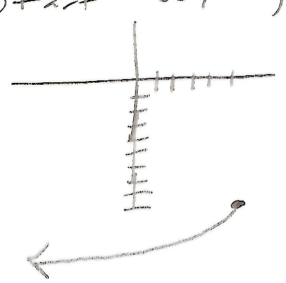
R: $\{y \mid y \le 17\}$

Additional Example 2

reflect over x-axis   reflect over y-axis

Graph the real function h with $h(x) = -9 - \sqrt{5 - x}$ in a window that shows important features. State the domain and range.

Start (5, -9)



$h(x) = -9 - \sqrt{-1(x-5)}$

Down 9   Right 5

$5 - x \ge 0$
$-5 \quad -5$
$-x \ge -5$
$\frac{-x}{-1} \quad \frac{-5}{-1}$
$x \le 5$

Domain: $\{x \mid x \le 5\}$

Range: $\{y \mid y \le -9\}$

Window • Show Start, curve + axes

X-min: -10
X-max: 10
y-min: -20
y-max: 5

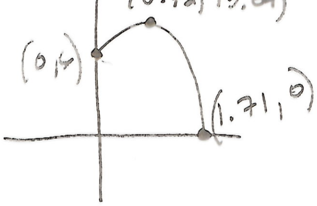
(VARY)

Additional Example 3

Tony makes a free throw in basketball practice. From its point of release, 6 ft in the air, the ball goes directly into the hoop which is 13 ft away and 10 ft high. An equation modeling the height $b(x)$ of the ball in feet at time x in seconds is $b(x) = -13.5x^2 + 19.5x + 6$. → y-int

a. Create a graph that would be helpful in determining the maximum height of the ball and how long it lasts.

b. What is the domain and range of b within the context of this situation?



$X = \frac{-(19.5) \pm \sqrt{(19.5)^2 - 4(-13.5)(6)}}{2(-13.5)}$

$X = \frac{-19.5 \pm \sqrt{704.25}}{-27}$

$X = -0.26$ $\boxed{X = 1.71}$

Vertex

$X = \frac{-b}{2a}$

$= \frac{-19.5}{2(-13.5)}$

$= \frac{-19.5}{-27} = 0.72$

$y = -13.5(0.72)^2 + 19.5(0.72) + 6$

$= 13.64$

$\boxed{(0.72, 13.04)}$

Domain: $\{x \mid 0 \le x \le 1.71\}$ x-int: (1.71, 0)

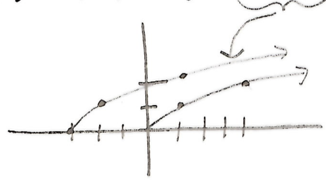
Range: $\{y \mid 0 \le y \le 13.04\}$ max: {0.72, 13.04}

In 4 and 5, Equations for two functions are given

a) Sketch graphs of each pair of functions on the same set of axes.

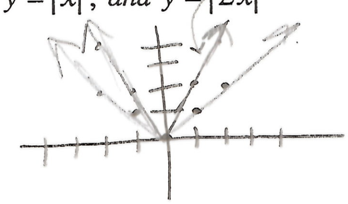
b) How are the two graphs related?

4) $y = \sqrt{x}$, and $y = \sqrt{x+3}$ → Left 3



x	y
4	2
1	1
0	0

5) $y = |x|$, and $y = |2x|$



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

6) a. Graph $f(x) = \frac{1}{x}$, $g(x) = \frac{1}{x-5}$, $h(x) = \frac{1}{x} + 3$ on the same set of axes.

Set denominator = 0 and solve.

b. At what value(s) of x is each of *f*, *g* and *h* discontinuous?

$\frac{1}{x}$ $\boxed{X = 0}$ | $\frac{1}{x-5}$ $X - 5 = 0$, $+5\ +5$, $\boxed{X = 5}$ | $\frac{1}{x} + 3$ $\boxed{X = 0}$

c. Give an equation of the vertical asymptote of each curve.

$\frac{1}{x}$ $\boxed{VA: X = 0}$ | $\frac{1}{x-5}$ $\boxed{VA: X = 5}$ | $\frac{1}{x} + 3$ $\boxed{VA: X = 0}$

d. How is each of *g* and *h* related to *f*?

- g is shifted right 5 units
- h is shifted up 3 units