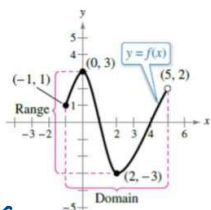


Functions and Their Graphs

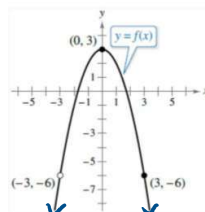
- x = directed distance from the y -axis
- $f(x) = y$ = directed distance from the x -axis
- Domain – Set of all x for which the function is defined
- Range – Set of all y for which the function is defined



$$D: \{x \mid -1 \leq x \leq 5\}$$

$$R: \{y \mid -3 \leq y \leq 3\}$$

- x -intercepts: $(-1, 0)$
- y -intercepts: $(0, 3)$



$$D: \{x \mid x \neq -3\}$$

$$R: \{y \mid y \leq 3\}$$

- Standard Form of a Polynomial Function
 - $P(x) = a_n x^n + a_{n-1} x^{n-1} + \dots + a_1 x + a_0$
 - Notice: State in Decreasing order of power
- Classifications of Polynomials

Degree	Name if Using Degree	Number of Terms	Name if Using Terms
0	Constant	1 $(5, 4x^2, \text{etc.})$	Monomial
1	Linear	2 $(x + 1, 2x^4 + 5x^2, \text{etc.})$	Binomial
2	Quadratic	3 $(3x^2 + 2x - 5, \text{etc.})$	Trinomial
3	Cubic	4 $(-3x^5 - 2x^4 + x^2 + 5x)$	Polynomial of 4 terms
4	Quartic		
5	Quintic		

- Graph features of Polynomials: Continuous, Smooth, Rounded turns
- General thoughts to aid when graphing polynomials: LEFT-HAND and RIGHT-HAND BEHAVIOR
 - If n is even, and
 - a is positive – Graph is up and up
 - a is negative – Graph is down and down
 - If n is odd, and
 - a is positive – Graph is down and up
 - a is negative – Graph is up and down

Disco

- Consider the leading term of $y = 3x^4 - 2x^3 + x - 1$. What is the end behavior of the graph?

EVEN $a > 0$ so UP to left, UP to Right
 or, as $x \rightarrow -\infty, f(x) \rightarrow \infty$ and as $x \rightarrow \infty, f(x) \rightarrow \infty$

- Zero's of a Function – Where the function equals zero ($f(x) = 0$). Graphically, x -intercepts. Zero's are

0r, as $x \rightarrow -\infty$, $f(x) \rightarrow \infty$ and as $x \rightarrow \infty$, $f(x) \rightarrow \infty$

- Zero's of a Function – Where the function equals zero ($f(x) = 0$). Graphically, x-intercepts. Zero's are the same as roots, are the same as solutions, are the same as x-intercepts.

- Find the zero's of the following functions.

o $f(x) = 2x^2 + 13x - 14$

$(-7.441, 0)$

$(.941, 0)$

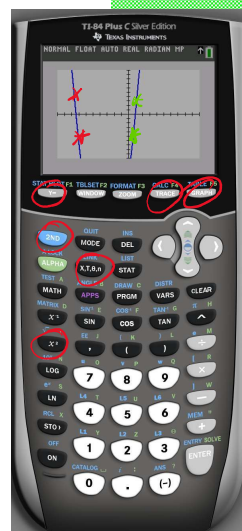
o $g(t) = \sqrt{t-25}$

Zero's are when function equals zero.

$\sqrt{t-25} = 0$ when $t-25=0$
 $t=25$ $(25, 0)$

o $f(x) = \frac{x^2-2}{x-1}$ Rational equations equal zero $\frac{0}{k}$ Not $\frac{N}{0}$

$x^2-2=0$
 $\sqrt{x^2-2} = \pm\sqrt{2}$ $(\sqrt{2}, 0)$ $(-\sqrt{2}, 0)$



$Y1 = 2x^2 + 13x - 14$

2nd → Trace → Zero

Left Bound?

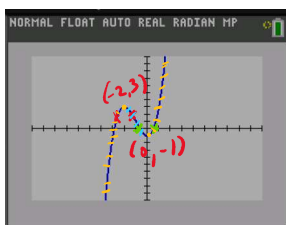
Right Bound?

Guess?

Zoom: 6 (Standard)
if needed

- Increasing and Decreasing Behavior of Functions

- o Graph $x^3 + 3x^2 - 1$, then determine the open intervals that the function is increasing, decreasing, or constant.



$Y1 = \underline{\hspace{2cm}}$

2nd → Trace → Max / Min

Inc: $(-\infty, -2) \cup (0, \infty)$

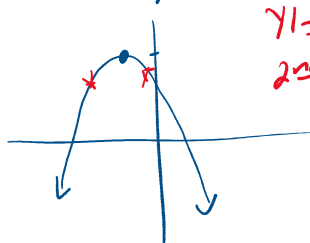
Dec: $(-2, 0)$

Constant: $(-2, 3)$ $(0, -1)$

- Relative Minimum and Maximums of Functions

- o Use a graphing utility to determine the relative maximum of $f(x) = -4x^2 - 7x + 3$.

Parabola, aining down



$Y1 = \underline{\hspace{2cm}}$

2nd → Trace → Max

Maximum $(-.875, 6.063)$

No minimum.

- Parent functions basics

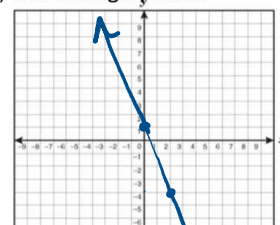
- o EX: Write the linear function f for which $f(-2) = 6$ and $f(4) = -9$, and then graph and describe.

$m = \frac{-9-6}{4-(-2)} = \frac{-15}{6} = -\frac{5}{2}$

$y-6 = -\frac{5}{2}(x+2)$ $y = -\frac{5}{2}x + 1$

$(-2, 6)$ $(4, -9)$

$m = \frac{y_2 - y_1}{x_2 - x_1}$



$$y - 6 = -\frac{5}{2}(x + 2) \quad \left\{ \quad y = -\frac{5}{2}x + 1 \right.$$

$$\begin{array}{l} y - 6 = -\frac{5}{2}x - 5 \\ +6 \quad \quad +6 \end{array}$$

- EX: Graph and describe: $f(x) = y = x^2$

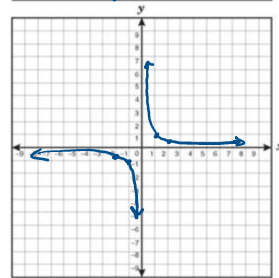
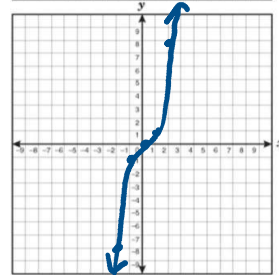
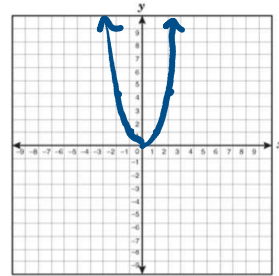
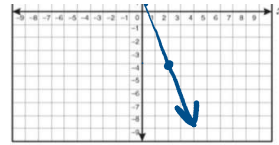
x	y
-2	4
-1	1
0	0
1	1
2	4

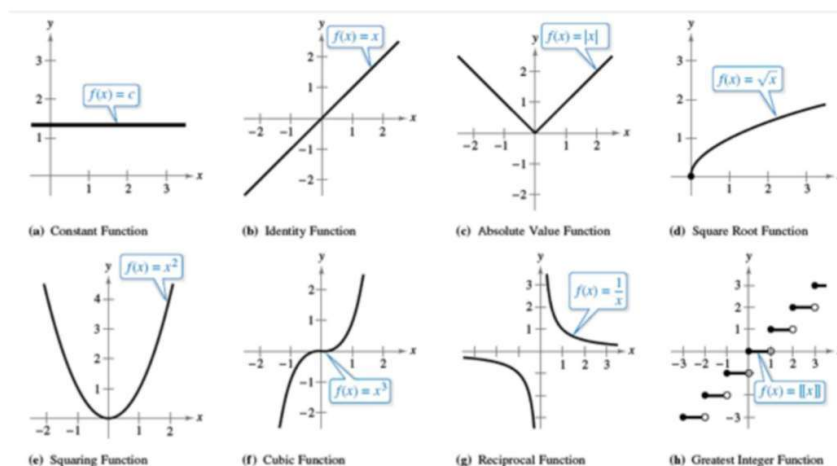
- EX: Graph and describe: $f(x) = x^3$

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

- EX: Graph and describe: $f(x) = \frac{1}{x}$

x	y
-2	$-\frac{1}{2}$
-1	-1
0	undefined
1	1
2	$\frac{1}{2}$





- Transformations of the parent functions
 - Vertex format of Quadratic (can be altered to suit *any* functions) $y = a(x - h)^2 + k$
 - Increasing a , narrows graph; Decreasing a , widens graph
 - a positive = up; a negative = down
 - h shifts graph left and right
 - k shifts graph up and down
 - $-a$ reflection on x - axis

Vertex (h, k)

- EX: Use the parent function $f(x) = x^3$ to describe the transformation in the following:

- $f(x) = x^3 + 5$

UP 5 Units

- $h(x) = -(x - 2)^3 - 1$

reflection, Right 2 units Down 1 unit

Vertex: $(2, -1)$

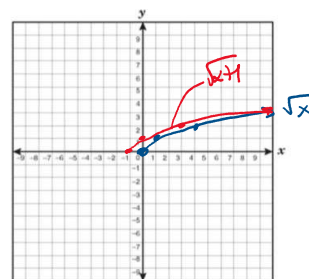
- Describe the transformation of $f(x) = \sqrt{x + 1}$ and graph.

$$f(x) = \sqrt{x - (-1)} + 0$$

$$h = -1 \quad k = 0$$

Parent $\sqrt{x}$

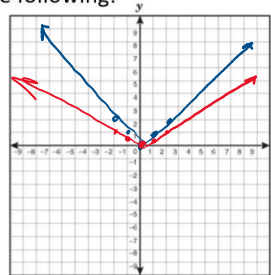
Left 1 unit



- EX: Use the parent function $f(x) = |x|$ to describe the transformation in the following:

○ $f(x) = \frac{1}{2}|x|$ *wider*

$y = |x|$
 $y = \frac{1}{2}|x|$



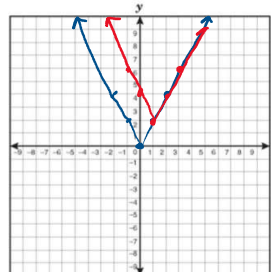
○ $h(x) = 2|x - 1| + 2$

narrower

1 unit right, 2 units up

$y = 2|x|$

$y = 2|x - 1| + 2$



$y = -(x + 4)^2 + 7$

reflection on x-axis
4 units to the left
Up 7 units

$y = \frac{1}{2} \log(x - 3) + 1$
wider Right 3 units Up 1 unit

$f(x) = y = x^2$
 $f(-2) = (-2)^2$
 $f(-1) = (-1)^2$

$y = (x - 0)^2 + 0$

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

$y = (x + 1)^3 - 2$