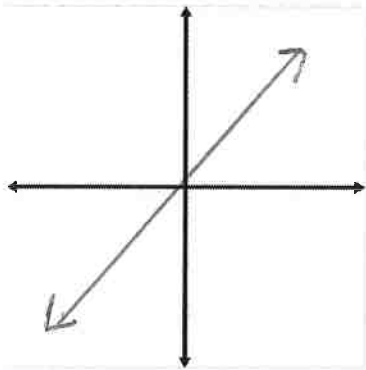
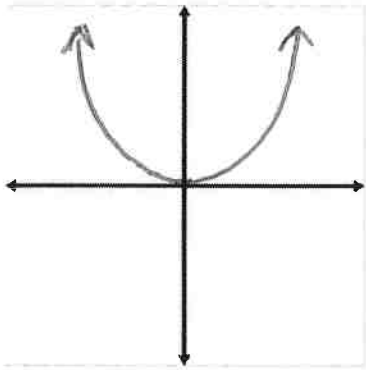
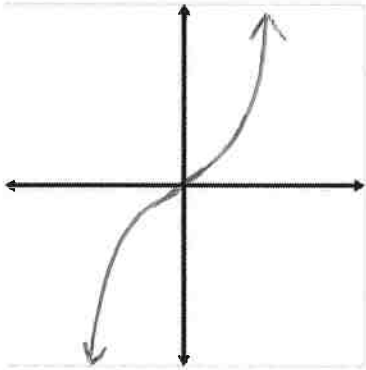
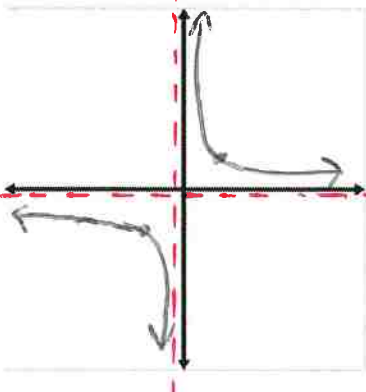


AB Calculus – Chapter P (Day 2) – Parent Graphs of Families of Functions and Transformations

Review of Parent Functions and Graphs

| Parent Function | Graph | Characteristics | | | | | | | | | | |
|--|--|---|----|----|---|---|---|---|---|---|---|---|
| <p>Linear Function</p> <p>$y = x$</p> |  | <p>Domain: $(-\infty, \infty)$</p> <p>Range: $(-\infty, \infty)$</p> <p>End Behavior:</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow -\infty$</p> <p>As $x \rightarrow +\infty$, $f(x) \rightarrow +\infty$</p> | | | | | | | | | | |
| <p>Quadratic Function</p> <p>$y = x^2$</p> |  | <p>Domain: $(-\infty, \infty)$</p> <p>Range: $[0, \infty)$</p> <p>End Behavior:</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow +\infty$</p> <p>As $x \rightarrow +\infty$, $f(x) \rightarrow +\infty$</p> | | | | | | | | | | |
| <p>Cubic Function</p> <p>$y = x^3$</p> <table border="1" data-bbox="123 1318 248 1535"> <tr><td>x</td><td>y</td></tr> <tr><td>-1</td><td>-1</td></tr> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>2</td><td>8</td></tr> </table> | x | y | -1 | -1 | 0 | 0 | 1 | 1 | 2 | 8 |  | <p>Domain: $(-\infty, \infty)$</p> <p>Range: $(-\infty, \infty)$</p> <p>End Behavior:</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow -\infty$</p> <p>As $x \rightarrow +\infty$, $f(x) \rightarrow +\infty$</p> |
| x | y | | | | | | | | | | | |
| -1 | -1 | | | | | | | | | | | |
| 0 | 0 | | | | | | | | | | | |
| 1 | 1 | | | | | | | | | | | |
| 2 | 8 | | | | | | | | | | | |
| <p>Reciprocal (Rational Function)</p> <p>$y = \frac{1}{x}$</p> <p>VA: $x = 0$</p> <p>HA: $y = 0$</p> <table border="1" data-bbox="418 1822 508 2053"> <tr><td>x</td><td>y</td></tr> <tr><td>-1</td><td>-1</td></tr> <tr><td>1</td><td>1</td></tr> </table> | x | y | -1 | -1 | 1 | 1 |  | <p>Domain: $(-\infty, 0), (0, \infty)$</p> <p>Range: $(-\infty, 0), (0, \infty)$</p> <p>End Behavior:</p> <p>As $x \rightarrow -\infty$, $f(x) \rightarrow 0$</p> <p>As $x \rightarrow +\infty$, $f(x) \rightarrow 0$</p> | | | | |
| x | y | | | | | | | | | | | |
| -1 | -1 | | | | | | | | | | | |
| 1 | 1 | | | | | | | | | | | |

Parent Function

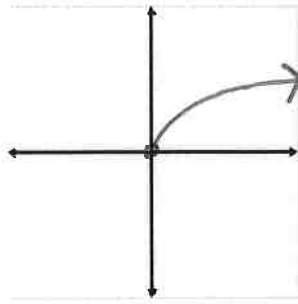
Graph

Characteristics

Square Root Function

$y = \sqrt{x}$

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



Domain: $[0, \infty)$

Range: $[0, \infty)$

End Behavior:

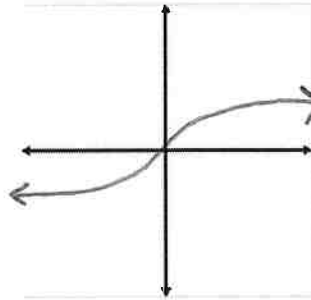
As $x \rightarrow 0$, $f(x) \rightarrow 0$

As $x \rightarrow +\infty$, $f(x) \rightarrow +\infty$

Cube Root Function

$y = \sqrt[3]{x}$

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



Domain: $(-\infty, \infty)$

Range: $(-\infty, +\infty)$

End Behavior:

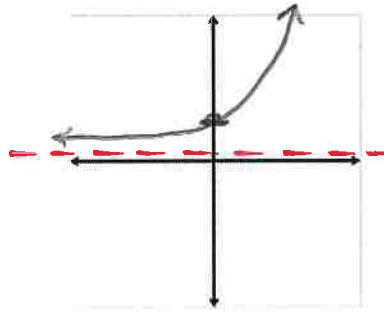
As $x \rightarrow -\infty$, $f(x) \rightarrow -\infty$

As $x \rightarrow +\infty$, $f(x) \rightarrow +\infty$

Exponential Function

$y = e^x$

| | |
|----|-----------|
| x | y |
| -1 | e^{-1} |
| 0 | $e^0 = 1$ |
| 1 | e |



Domain: $(-\infty, \infty)$

Range: $(0, \infty)$

End Behavior:

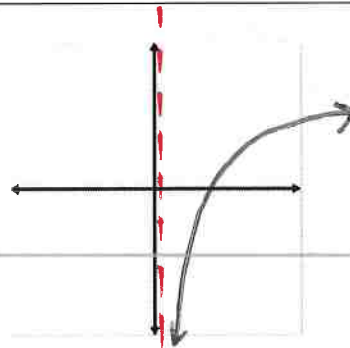
As $x \rightarrow -\infty$, $f(x) \rightarrow 0$

As $x \rightarrow +\infty$, $f(x) \rightarrow +\infty$

Logarithmic Function

$y = \ln x$

VA: $x = 0$



Domain: $(0, \infty)$

Range: $(-\infty, \infty)$

End Behavior:

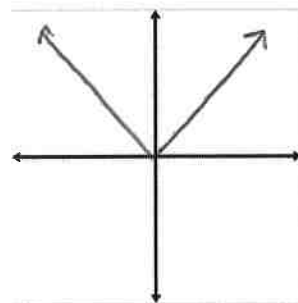
As $x \rightarrow 0$, $f(x) \rightarrow -\infty$

As $x \rightarrow +\infty$, $f(x) \rightarrow +\infty$

Absolute Value Function

$y = |x|$

| | |
|----|---|
| x | y |
| -1 | 1 |
| 0 | 0 |
| 1 | 1 |



Domain: $(-\infty, \infty)$

Range: $[0, \infty)$

End Behavior:

As $x \rightarrow -\infty$, $f(x) \rightarrow +\infty$

As $x \rightarrow +\infty$, $f(x) \rightarrow +\infty$

Transformations of Parent Functions *Given parent function $f(x)$, the family of functions can be represented by the transformed function $f(x) = -Af(x - h) + k$

Transformations Review

| | |
|--------------------------|--|
| $f(x + h)$ or $f(x - h)$ | shift left (+h) or shift right (-h) |
| $f(x) + k$ or $f(x) - k$ | shift up (+k) or shift down (-k) |
| $A * f(x)$ | vertical stretch if $ A > 1$ vertical compress if $ A < 1$ |
| $-f(x)$ | reflection over x-axis |

* opposite direction than what sign indicates

For the following functions, i) identify parent function, ii) list the transformations

iii) find domain and range iv) sketch the graph

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

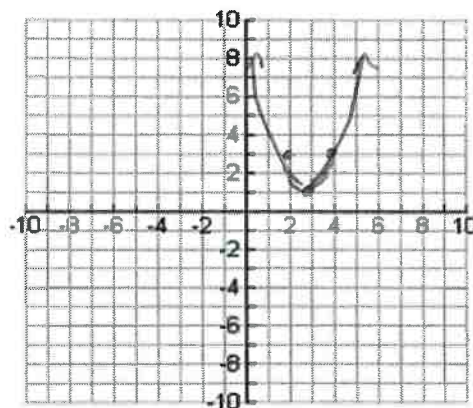
* vertical stretch by 2, right 3, up 1

* vertex: (3, 1)

* parent: $y = x^2$

D: $(-\infty, \infty)$

R: $[1, \infty)$



2) $f(x) = -\sqrt{x + 3} + 1$

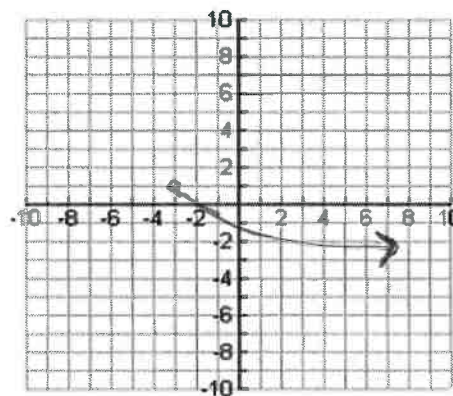
* reflection, left 3, up 1

* starting point: (-3, 1)

* parent: $y = \sqrt{x}$

D: $[-3, \infty)$

R: $(-\infty, 1]$



3) $f(x) = |x + 4| - 1$

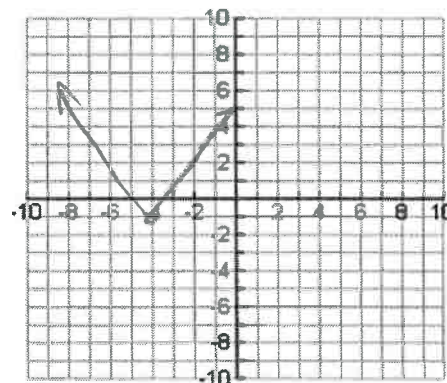
* parent: $y = |x|$

* vertex: (-4, -1)

* shift left 4, down 1

D: $(-\infty, \infty)$

R: $[-1, \infty)$



$$4) f(x) = \frac{2}{(x+1)} - 3$$

*parent: $y = \frac{1}{x}$ 

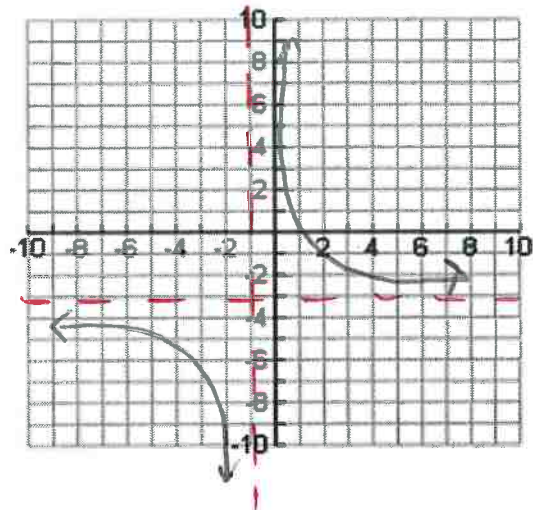
* stretch by 2, left 1, down 3

* VA: $x = -1$

* HA: $y = -3$


D: $(-\infty, -1), (-1, \infty)$

R: $(-\infty, -3), (-3, \infty)$



$$5) f(x) = e^{x+2} - 3$$

* shift left 2 units, down 3

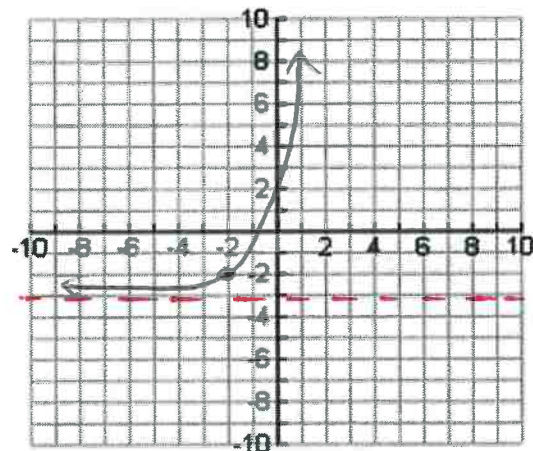
*parent: $y = e^x$ 

* HA: $y = -3$

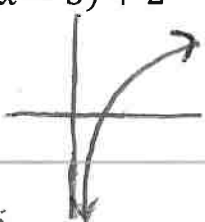
D: $(-\infty, \infty)$

R: $(-3, \infty)$

| x | y |
|----|---|
| -2 | $e^{-2+2} - 3 \rightarrow e^0 - 3 \rightarrow 1 - 3 = -2$ |



$$6) f(x) = \ln(x-3) + 2$$

parent: $y = \ln x$ 

* shift right 3 units
up 2 units

* VA: $x = 3$

D: $(3, \infty)$

R: $(-\infty, \infty)$

| x | y |
|---|----|
| 3 | VA |
| 4 | 2 |

