Pre-Calculus Sec 3-1 Transformation Review **Name**________________________________

MathBitsNotebook Algebra 1

The Parabola as a Parent Function

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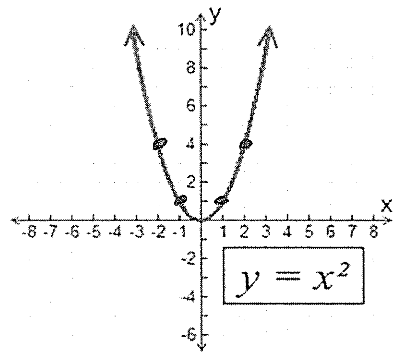
Definition: A parent function is the simplest function of a family of functions.

For the family of quadratic functions, $y = ax^2 + bx + c$, the simplest function of this form is $y = x^2$.

The "Parent" Graph:

The simplest parabola is $y = x^2$, whose graph is shown at the right. The graph passes through the origin (0,0), and is contained in Quadrants I and II.

This graph is known as the "Parent Function" for parabolas, or quadratic functions. All other parabolas, or quadratic functions, can be obtained from this graph by one or more transformations.



V: (0,0)

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

R: $\{y \mid y \geq 0\}$

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

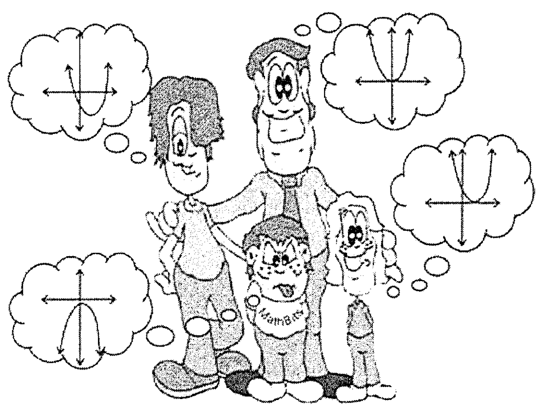
The "Children" Graphs:

The "parent" parabola can give birth to a myriad of other parabolic shapes through the process of transformations.

Brush off your memories of transformations and let's take a quick look at what is possible.

When graphing quadratic functions (parabolas), keep in mind that two forms of equations may be used:

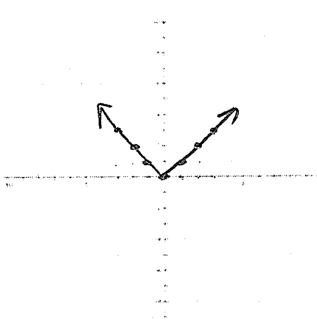
$y = ax^2 + bx + c$ or $y = a(x - h)^2 + k$



Some other "Parent" Functions

1)Absolute Value (V Shape)

$y = |x|$ V: (0,0)



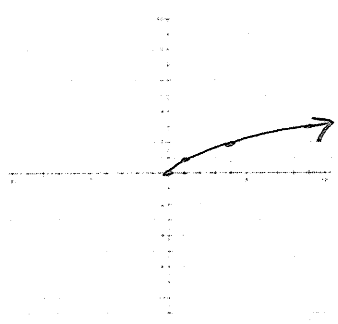
x	y
-3	3
-2	2
-1	1
0	0
1	1
2	2
3	3

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

R: $\{y \mid y \geq 0\}$

2) Square Root (swoosh?)

$y = \sqrt{x}$ Start: (0,0)



x	y
0	0
1	1
4	2
9	3

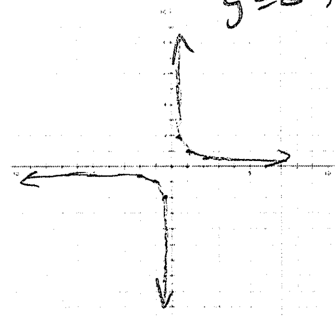
D: $\{x \mid x \geq 0\}$

R: $\{y \mid y \geq 0\}$

3) Inverse Variation (hyperbola)

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

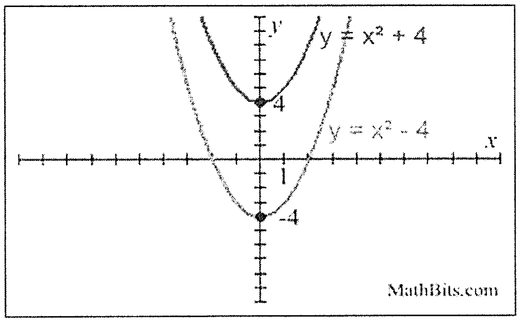
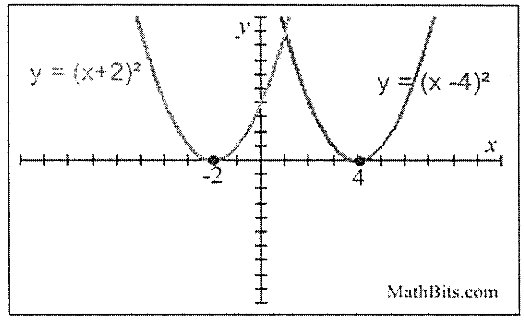
Asymptotes
$x = 0 \rightarrow$ y-axis
$y = 0 \rightarrow$ x-axis



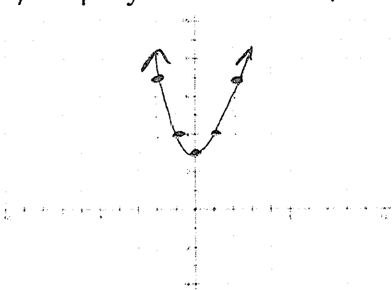
x	y
-2	-0.5
-1	-1
0	Error
1	1
2	0.5
0.5	2
-0.5	-2

D: $\{x \mid x \neq 0\}$

R: $\{y \mid y \neq 0\}$

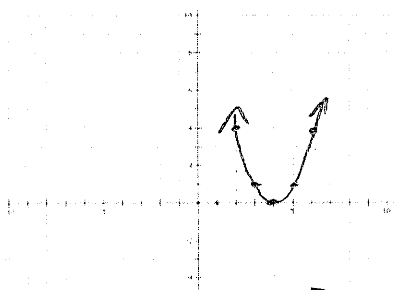
Vertical Translation	Horizontal Translation
move the graph vertically - up or down	*move the graph horizontally - left or right*
$y = x^2 + k$	$y = (x - h)^2$
$y = x^2 + 4$ moves the graph UP 4 units	$y = (x - 4)^2$ moves the graph RIGHT 4 units
$y = x^2 - 4$ moves the graph DOWN 4 units	$y = (x + 2)^2$ moves the graph LEFT 2 units
	

4) Graph $y = x^2 + 3$ ↗ up 3 V: (0,3)



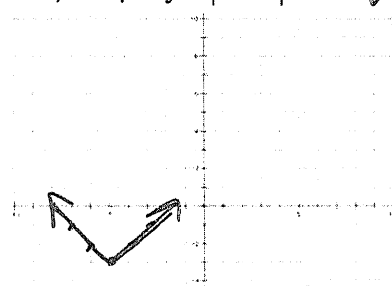
D: {x | x ∈ ℝ}
R: {y | y ≥ 3}

5) Graph $y = (x - 4)^2$ ↗ Right 4 V: (4,0)



D: {x | x ∈ ℝ}
R: {y | y ≥ 0}

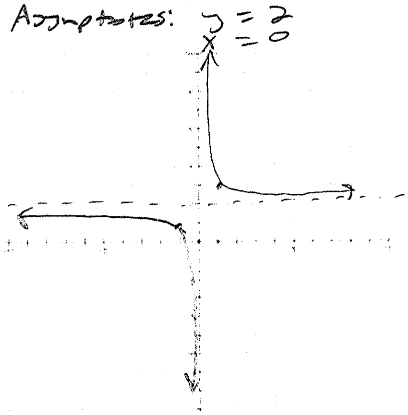
6) Graph $y = |x + 5| - 3$ ↗ Left 5 ↗ Down 3 V: (-5, -3)



D: {x | x ∈ ℝ}
R: {y | y ≥ -3}

7) Graph $y = \frac{1}{x} + 2$ ↗ up 2

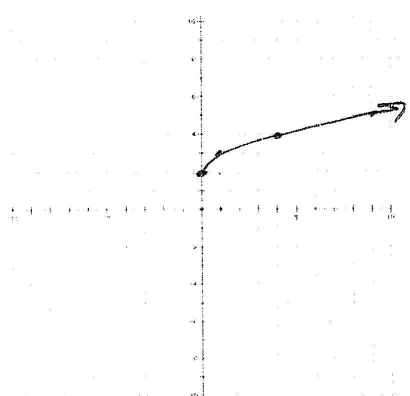
Asymptotes: y = 2
x = 0



D: {x | x ≠ 0}
R: {y | y ≠ 2}

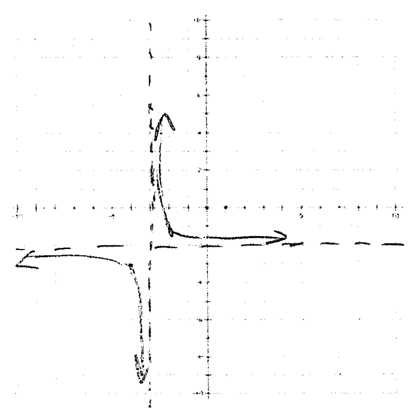
8) Graph $y = \sqrt{x} + 2$ ↗ up 2

Start: (0,2)



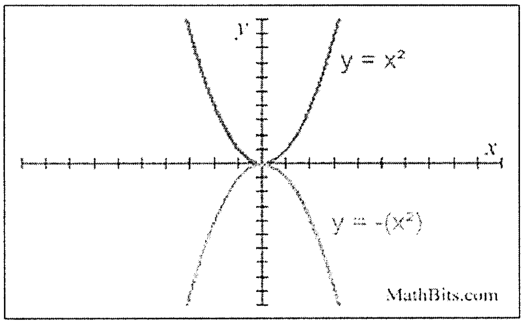
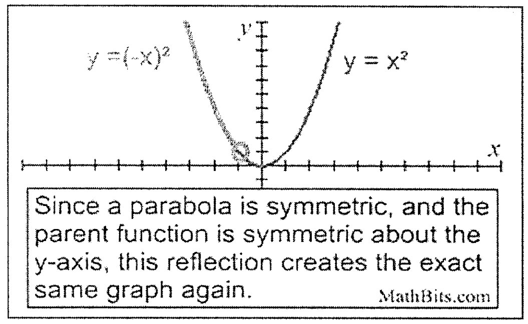
D: {x | x ≥ 0}
R: {y | y ≥ 2}

9) Graph $y = \frac{1}{x+3} - 2$ ↗ Down 2 ↳ Left 3



Asymptotes y = -2
x = -3

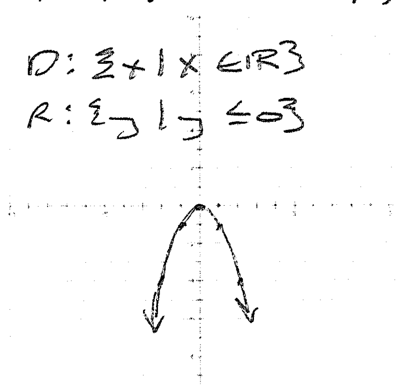
D: {x | x ≠ -3}
R: {y | y ≠ -2}

Reflection in x-axis	Reflection in y-axis
flip the graph over the x-axis *(negates the y-values of the coordinates)* $y = -(x^2)$ $y = x^2$ parent graph opens up $y = -(x^2)$ parent reflected over x-axis opens down	*flip the graph over the y-axis* *(negates the x-values of the coordinates)* $y = (-x)^2$ $y = x^2$ parent graph $y = (-x)^2$ parent reflected over y-axis
	

Reflect over x-axis

10) Graph $y = -x^2$ V: (0,0)

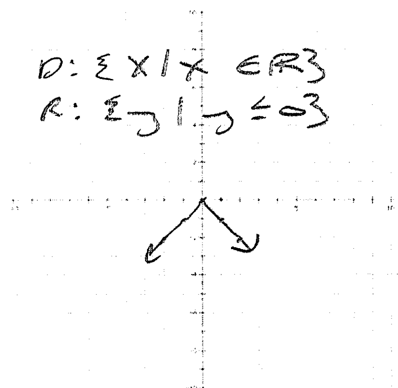
D: {x | x ∈ ℝ}
R: {y | y ≤ 0}



Reflect over x-axis

11) Graph $y = -|x|$ V: (0,0)

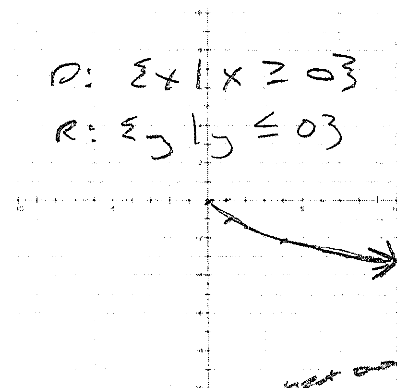
D: {x | x ∈ ℝ}
R: {y | y ≤ 0}



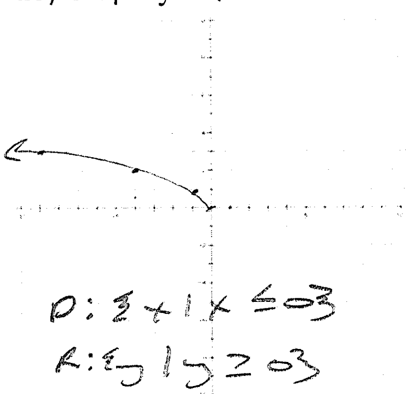
Reflect over x-axis

12) Graph $y = -\sqrt{x}$ Start (0,0)

D: {x | x ≥ 0}
R: {y | y ≤ 0}



13) Graph $y = \sqrt{-x}$



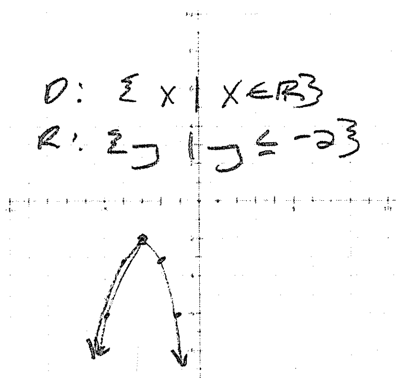
D: {x | x ≤ 0}
R: {y | y ≥ 0}

Reflect over y-axis
Start (0,0)

reflect over x-axis, left 3, down 2

14) Graph $y = -(x+3)^2 - 2$

D: {x | x ∈ ℝ}
R: {y | y ≤ -2}



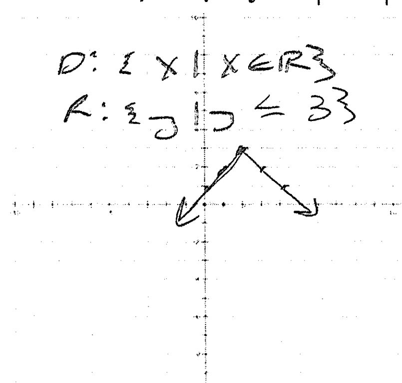
Vertex: (-3, -2)
Reflect over x-axis
(opens down)

Reflect over x-axis, Right 2, up 3

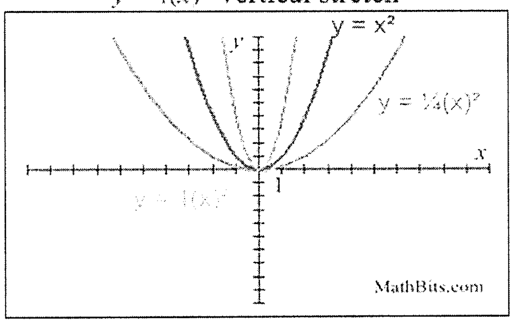
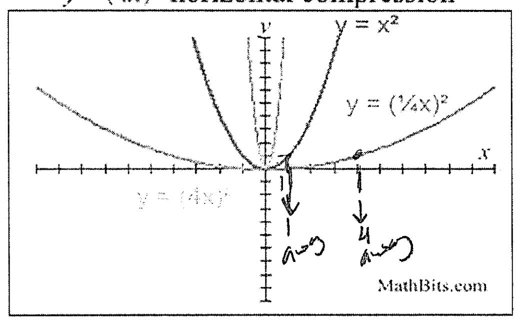
15) Graph $y = -|x-2| + 3$

D: {x | x ∈ ℝ}
R: {y | y ≤ 3}

?

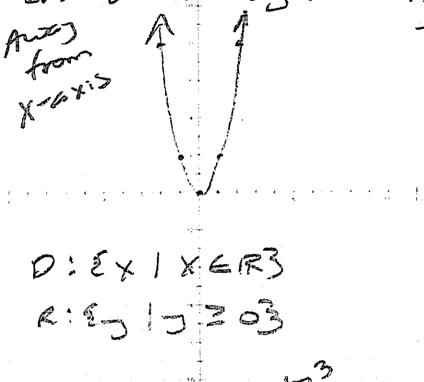


Vertex: (2, 3)
Reflect over x-axis
(opens down)

Stretch or Compress Vertically	Stretch or Compress Horizontally
stretches away from the x-axis or compresses toward the x-axis $y = a \bullet x^2$ $\lvert a \rvert > 1$ is a stretch; $0 < \lvert a \rvert < 1$ is a compression $y = x^2$ parent graph $y = ½(x)^2$ vertical compression $y = 4(x)^2$ vertical stretch 	*stretches away from the y-axis or compresses toward the y-axis* $y = (a \bullet x)^2$ $\lvert a \rvert > 1$ is a compression by factor of $1/a$; $0 < \lvert a \rvert < 1$ is a stretch by factor of $1/a$ $y = x^2$ parent graph $y = (¼x)^2$ horizontal stretch $y = (4x)^2$ horizontal compression 

16) Graph $y = 2x^2$ V: (0,0)

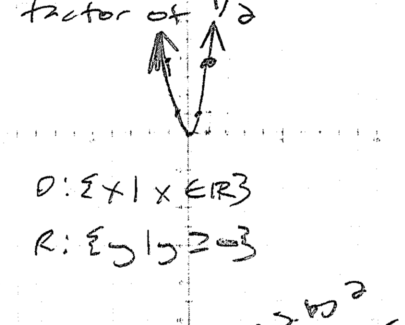
Vert Stretch by 2 Away from x-axis



D: {x | x ∈ ℝ}
R: {y | y ≥ 0}

17) Graph $y = (2x)^2$ V:(0,0)

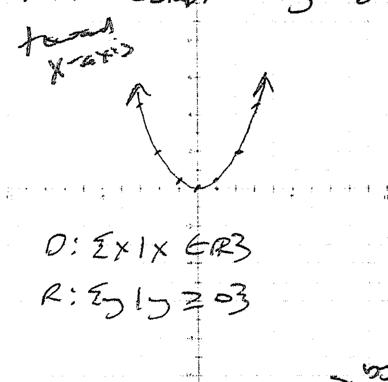
Horz. compression toward y-axis by factor of ½



D: {x | x ∈ ℝ}
R: {y | y ≥ 0}

18) Graph $y = \frac{1}{2}x^2$ V: (0,0)

Vert. Comp. by ½ toward x-axis

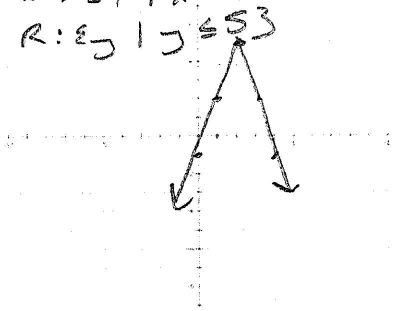


D: {x | x ∈ ℝ}
R: {y | y ≥ 0}

19) Graph $y = -3|x-2|+5$

↓ ↗ V.S. by 3 ↗ Right 2 ↗ up 5

D: {x | x ∈ ℝ}
R: {y | y ≤ 5}

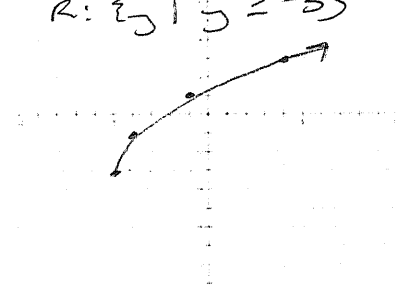


V: (2, 5)
Opens Down

20) Graph $y = 2\sqrt{x+5} - 3$

↗ V.S. by 2 ↗ Left 5 ↗ Down 3

D: {x | x ≥ −5}
R: {y | y ≥ −3}

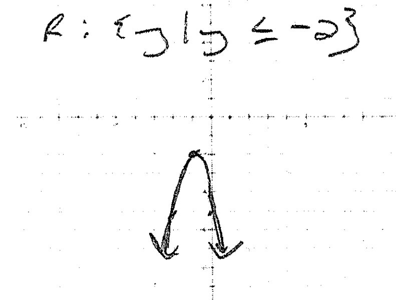


V: (−5, −3)

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

↗ V.S. by 3 ↗ Left 1 ↗ Down 2

D: {x | x ∈ ℝ}
R: {y | y ≤ −2}



V: (−1, −2)
Opens Down