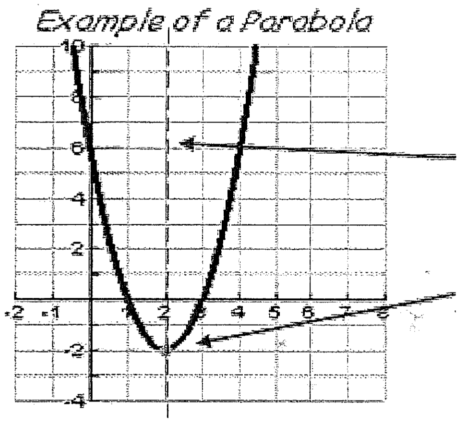
CCGPS Analytic Geometry Notes: Graphing Quadratics in Standard Form (Mon) Feb 2, 2015

<u>Definitions</u>

The following graph is of a quadratic function of the form $y = ax^2 + bx + c$ where $a \neq 0$. It is a **parabola** that has been transformed from the Quadratic Parent Function.



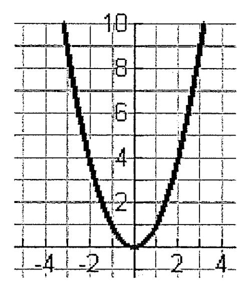
______________________: the lowest or highest point of a parabola.

____________________________: the line through the vertex that divides the parabola into two parts that are mirror images of each other.

Three forms of quadratic function: ____.

***Standard Form of a quadratic function:** ______________________________

Quadratic Parent Function: A function of the form __________ where $a \neq 0$.



The graph makes a U-Shape called a ______________.

Example: Fill in characteristics of the Parent Quadratic Graph $f(x) = x^2$

Vertex: _____ a = _____ Opens: _______ Max / Min / None (Circle one)

AOS: _______ x – intercept(s): __________ y – intercept: ____________

Domain: ________ Range: _______ Avg. Rate of Change[-2, 0]: ___________

End Behavior: As $x \to \infty, f(x) \to$ _______ Increasing: __________ Positive: ____________

As $x \to -\infty, f(x) \to$ _______ Decreasing: __________ Negative: ____________

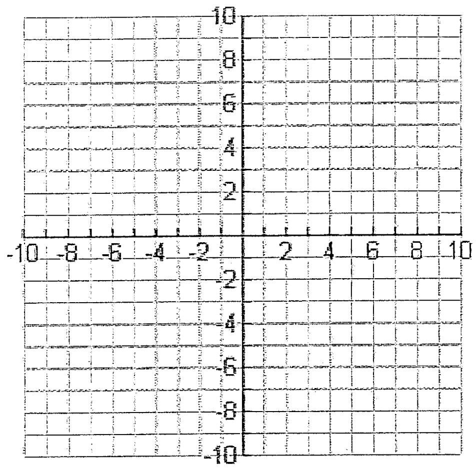
<u>Characteristics of the graph</u>

- If "a" is _________ the parabola opens _______. If "a" is _________ the parabola opens _______.
  - The **x-coordinate** of the vertex is located at $\boxed{x = \frac{-b}{2a}}$. Substitute this value for x into the function and solve for y. These values locate the vertex.
  - The **axis of symmetry** is the vertical line x = $x = \frac{-b}{2a}$
  - To get other points on the graph, make a table by choosing 2 values for x on one side of the vertex's x-coordinate and use the given equation to find the corresponding y-values. Use symmetry to graph the other side.
  - Graph the vertex and other points along with the axis of symmetry. Connect the points with a smooth, U–shaped curve.

*To find x-value of the vertex, $x = \frac{-b}{2a}$ *To find A.O.S , let $x = \frac{-b}{2a}$ *To find Avg R.O.C. find slope between endpoints

Example 1: Graph $y = 2x^2 - 8x + 6$ a= ____ b = ____ Opens: ____

Vertex: ________



Max / Min / None (Circle one)   AOS: _________

x – intercept(s): ______   y – intercept: _____________

Avg. Rate of Change [3, 4]: _______

Domain: _____________   Range: ______________

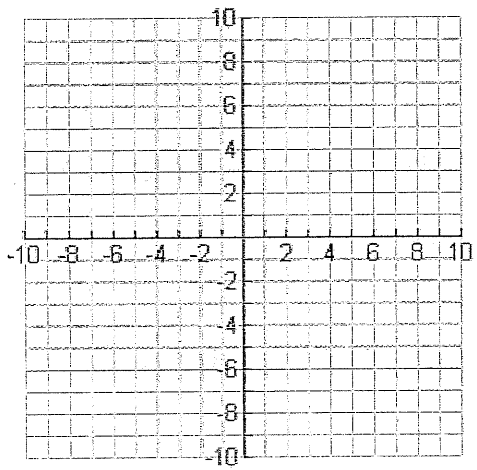
End Behavior:

As $x \to \infty, f(x) \to$ ______ Increasing: ________ Positive: ______

As $x \to -\infty, f(x) \to$ ______ Increasing: ________ Positive: ______

Example 2: Graph $y = -3x^2 + 5$ a= ____ b = ____ Opens: ____

Vertex: ________



Max / Min / None (Circle one)   AOS: _________

Avg. Rate of Change [-1, 0]: _______

x – intercept(s): ______   y – intercept: _____________

Domain: _____________   Range: ______________

End Behavior:

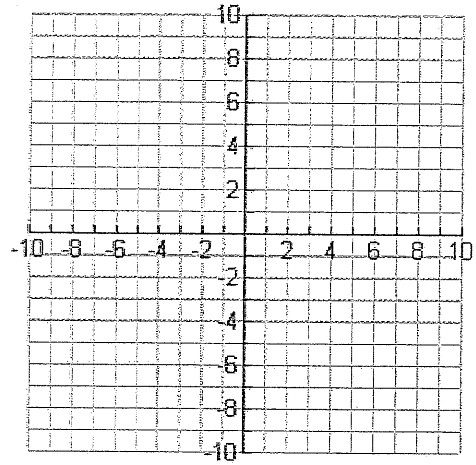
As $x \to \infty, f(x) \to$ ______ Increasing: ________ Positive: ______

As $x \to -\infty, f(x) \to$ ______ Increasing: ________ Positive: ______

Homework: **Graphing Quadratics in Standard Form** **(Mon) Feb 2, 2015**

*To find x-value of the vertex, $x = \frac{-b}{2a}$ *To find A.O.S , let $x = \frac{-b}{2a}$ *To find Avg R.O.C. find slope between endpoints

1: Graph $y = 2x^2 - 12x + 19$ a= ____ b = ____ Opens: ____



Vertex: ________

Max / Min / None (Circle one) AOS: __________

x – intercept(s): ______ y – intercept: _____________

Domain: ______________ Range: ______________

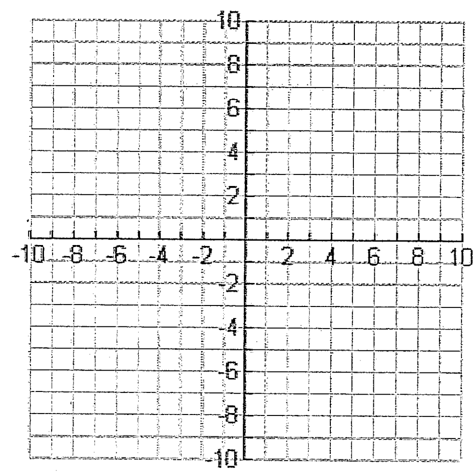
Avg. Rate of Change [1, 3]: ________

End Behavior:

As $x \to \infty, f(x) \to$ ______ Increasing: ________ Positive: ______

As $x \to -\infty, f(x) \to$ ______ Increasing: ________ Positive: ______

2: Graph $y = 2x^2 + 3$ a= ____ b = ____ Opens: ____



Vertex: ________

Max / Min / None (Circle one) AOS: __________

Avg. Rate of Change [1, 2]: ________

x – intercept(s): ______ y – intercept: _____________

Domain: ______________ Range: ______________

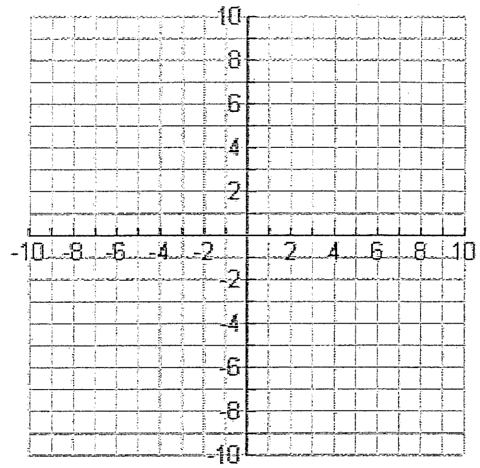
End Behavior:

As $x \to \infty, f(x) \to$ ______ Increasing: ________ Positive: ______

As $x \to -\infty, f(x) \to$ ______ Increasing: ________ Positive: ______

3: Graph $y = x^2 - 8x + 5$ a= ____b = ____ Opens:____

Vertex: ________



Max / Min / None (Circle one) AOS: __________

x – intercept(s): ______ y – intercept: _____________

Avg. Rate of Change [0, 4]: ________

Domain: _____________ Range: ______________

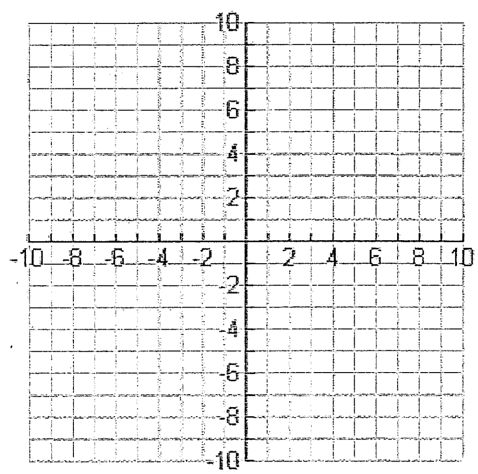
End Behavior:

As $x \to \infty, f(x) \to$ ______ Increasing: _________Positive:_______

As $x \to -\infty, f(x) \to$ ______ Increasing: _________Positive:______

4: Graph $y = -2x^2 + 8$ a= ____b = ____ Opens:____

Vertex: ________



Max / Min / None (Circle one) AOS: __________

Avg. Rate of Change [-2, 0]: ________

x – intercept(s): ______ y – intercept: _____________

Domain: _____________ Range: ______________

End Behavior:

As $x \to \infty, f(x) \to$ ______ Increasing: _________Positive:_______

As $x \to -\infty, f(x) \to$ ______ Increasing: _________Positive:______

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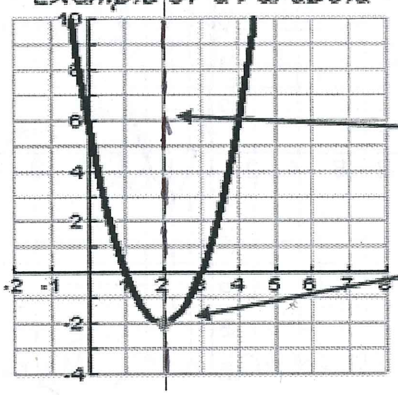
Key

Definitions

The following graph is of a quadratic function of the form $y = ax^2 + bx + c$ where $a \neq 0$. It is a **parabola** that has been transformed from the Quadratic Parent Function.

Example of a Parabola



Axis of symmetry

vertex

vertex: the lowest or highest point of a parabola.

Axis of symmetry (AOS): the line through the vertex that divides the parabola into two parts that are mirror images of each other.

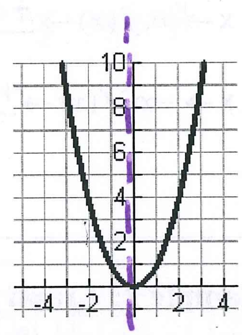
Three forms of quadratic function: ① standard, ② intercept, and ③ vertex.

***Standard Form of a quadratic function:** $y = ax^2 + bx + c$

Quadratic Parent Function: A function of the form ax^2 where $a \neq 0$.

The graph makes a U-Shape called a parabola.

Example: Fill in characteristics of the Parent Quadratic Graph $f(x) = x^2$



Vertex: (0,0) a = 1   Opens: up   Max / Min / None (Circle one)

AOS: $x = 0$ x – intercept(s): (0,0)   y – intercept: (0,0)

Domain: $(-\infty, \infty)$ Range: $[0, \infty)$ Avg. Rate of Change[-2, 0]: slope of (-2, 3) (0, 0) $ARoC = \frac{3-0}{-2-0} = \boxed{-\frac{3}{2}}$

End Behavior: As $x \to \infty, f(x) \to +\infty$ Increasing: $(0, \infty)$ Positive: $(-\infty, 0) \cup (0, \infty)$

As $x \to -\infty, f(x) \to +\infty$ Decreasing: $(-\infty, 0)$ Negative: none

Characteristics of the graph

- If "a" is positive the parabola opens up. If "a" is negative the parabola opens down.
  - The **x-coordinate** of the vertex is located at $\boxed{\mathbf{x = \frac{-b}{2a}}}$. Substitute this value for x into the function and solve for y. These values locate the vertex.
  - The **axis of symmetry** is the vertical line x = $\mathbf{x = \frac{-b}{2a}}$
  - To get other points on the graph, make a table by choosing 2 values for x on one side of the vertex's x-coordinate and use the given equation to find the corresponding y-values. Use symmetry to graph the other side.
  - Graph the vertex and other points along with the axis of symmetry. Connect the points with a smooth, U-shaped curve.

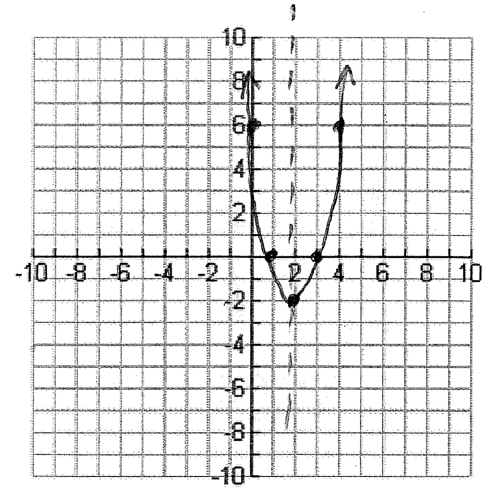
*To find x-value of the vertex, $x = \frac{-b}{2a}$ *To find A.O.S , let $x = \frac{-b}{2a}$ *To find Avg R.O.C. find slope between endpoints

Example 1: Graph y = 2x² – 8x + 6 a= 2 b = -8 Opens: up

Vertex: (2, -2) $x = \frac{-b}{2a} = \frac{8}{2(2)} = \frac{8}{4} = 2$

$y = 2(2)^2 - 8(2) + 6 = -8 + 6 = -2$

x	y
0	6
1	0
2	-2
3	0
4	6



Max / Min / None (Circle one) AOS: x = 2

x – intercept(s): (3, 0) (1, 0) y – intercept: (0, 6)

Domain: (-∞, ∞) Range: [-2, ∞)

Avg. Rate of Change [3, 4]: 6

(3, 0) and (4, 6)

$m = \frac{6-0}{4-3} = \frac{6}{1} = \boxed{6}$

End Behavior:

As $x \to \infty$, $f(x) \to$ +∞ Increasing: (2, ∞) Positive: (-∞, 1) ∪ (3, ∞)

As $x \to -\infty$, $f(x) \to$ +∞ ~~Increasing~~ Dec: (-∞, 2) ~~Positive~~ Neg.: (1, 3)

Example 2: Graph y = -3x² + 5 a= -3 b = 0 Opens: down

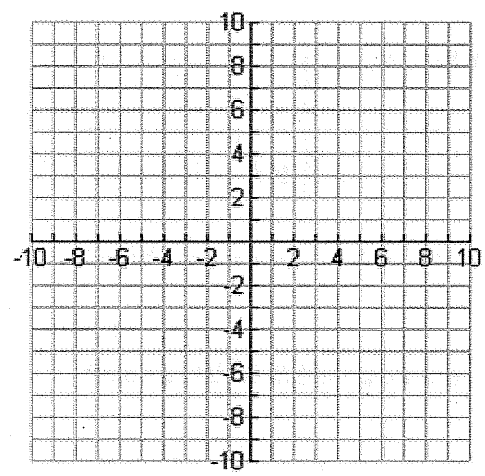
Vertex: (0, 5) $x = \frac{-b}{2a} = \frac{0}{2(-3)} = 0$

x	y
-2	-7
-1	2
0	5
1	2
2	-7

$-3x^2 + 5 = 0$

$-3x^2 = -5$

$x^2 = 5/3$ $x = \pm\sqrt{5/3}$



Max / Min / None (Circle one) AOS: ________

x – intercept(s): $(\pm\sqrt{5/3}, 0)$ y – intercept: (0, 5)

Domain: (-∞, ∞) Range: (-∞, 5]

Avg. Rate of Change [-1, 0]: 3

(-1, 2) and (0, 5)

$m = \frac{2-5}{-1-0} = \frac{-3}{-1} = 3$

End Behavior:

As $x \to \infty$, $f(x) \to$ -∞ Increasing: (-∞, 0) Positive: $(-\sqrt{5/3}, \sqrt{5/3})$

As $x \to -\infty$, $f(x) \to$ -∞ ~~Increasing~~ Dec: (0, ∞) ~~Positive~~ Neg: $(-\infty, -\sqrt{5/3}) \cup (\sqrt{5/3}, \infty)$

Homework: Graphing Quadratics in Standard Form (Mon) Feb 2, 2015

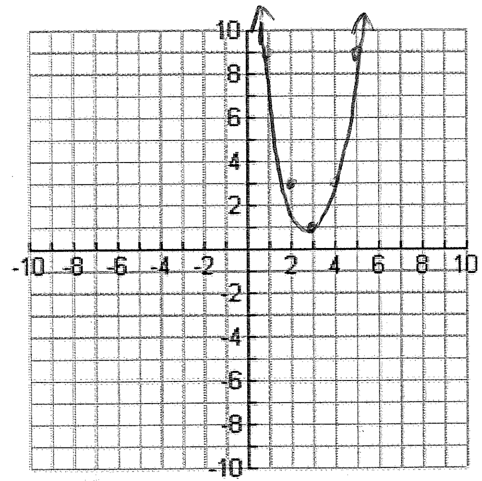
*To find x-value of the vertex, $x = \frac{-b}{2a}$ *To find A.O.S , let $x = \frac{-b}{2a}$ *To find Avg R.O.C. find slope between endpoints

1: Graph $y = 2x^2 - 12x + 19$ a= 2 b = -12 Opens: up

Vertex: (3, -) $x = \frac{12}{2(2)} = \frac{12}{4} = 3$

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

x	y
1	9
2	3
3	1
4	3
5	9



Max / Min / None (Circle one) AOS: x=3

x – intercept(s): none y – intercept: (0, 19)

Domain: (-∞, ∞) Range: [1, ∞)

End Behavior:

As $x \to \infty, f(x) \to$ ∞ Increasing: (3, ∞) Positive: (-∞, ∞)

As $x \to -\infty, f(x) \to$ ∞ ~~Increasing~~ Dec: (-∞, 3) ~~Positive~~ Neg: — none

Avg. Rate of Change [1, 3]: -4

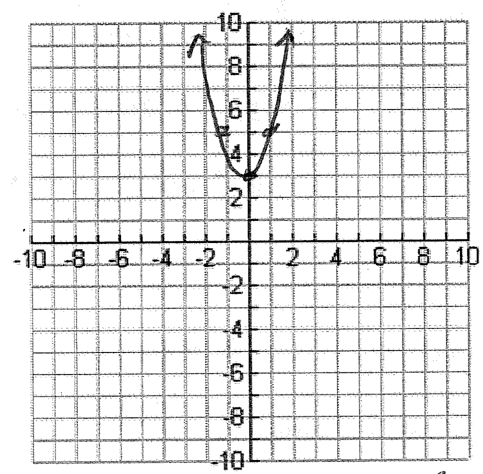
(1, 9) and (3, 1)

$m = \frac{1-9}{3-1} = \frac{-8}{2} = -4$

2: Graph $y = 2x^2 + 3$ a= 2 b = 0 Opens: up

Vertex: (0, 3) $x = \frac{-b}{2a} = \frac{-0}{2(2)} = 0$

x	y
-2	11
-1	5
0	3
1	5
2	11



Max / Min / None (Circle one) AOS: x = 0

x – intercept(s): none y – intercept: (0, 3)

Domain: (-∞, ∞) Range: [3, ∞)

End Behavior:

As $x \to \infty, f(x) \to$ ∞ Increasing: (0, ∞) Positive: (-∞, ∞)

As $x \to -\infty, f(x) \to$ ∞ ~~Increasing~~ Dec: (-∞, 0) ~~Positive~~ Neg: none

Avg. Rate of Change [1, 2]: 6

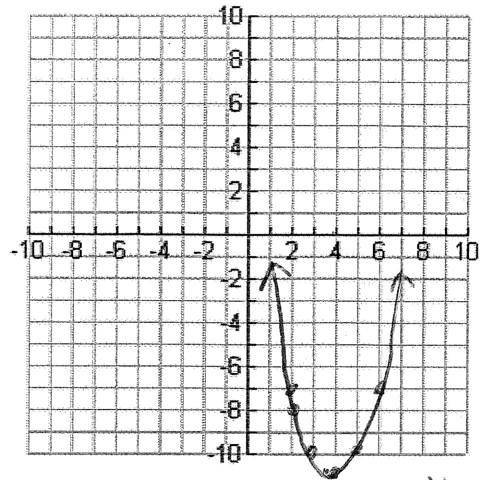
(1, 5)
(2, 11)

$\frac{11-5}{2-1} = \frac{6}{1}$

3: Graph $y = x^2 - 8x + 5$ a= 1 b = -8 Opens: up

Vertex: 4, -11 $\frac{8}{2(1)}$

x	y
2	-7
3	-10
4	-11
5	-10
6	-7



Max / Min / None (Circle one) AOS: $x = 4$

x – intercept(s): $(4 \pm \sqrt{11}, 0)$ y – intercept: (0, 5)

Domain: $(-\infty, \infty)$ Range: $[-11, \infty)$

Avg. Rate of Change [0, 4]: -4

(0, 5) (4, -11)

$\frac{-11-5}{4-0} = \frac{-16}{4} = -4$

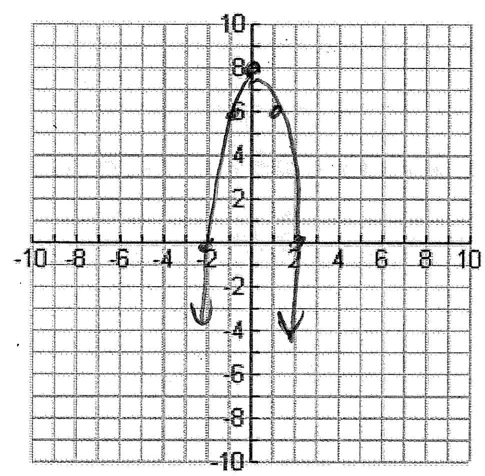
End Behavior:
As $x \to \infty, f(x) \to$ ∞ Increasing: $(4, \infty)$ Positive:______

As $x \to -\infty, f(x) \to$ ∞ Dec ~~Increasing~~: $(-\infty, 4)$ Neg ~~Positive~~:______

4: Graph $y = -2x^2 + 8$ a= -2 b = 0 Opens: down

Vertex: 0, 8 $\frac{-0}{2(-2)} = 0$

x	y
-2	0
-1	6
0	8
1	6
2	0



Max / Min / None (Circle one) AOS: $x = 0$

x – intercept(s): (-2, 0) (2, 0) y – intercept: (0, 8)

Domain: $(-\infty, \infty)$ Range: $(-\infty, 8]$

Avg. Rate of Change [-2, 0]: 4

(-2, 0) (0, 8)

$\frac{8-0}{0+2} = \frac{8}{2} = 4$

End Behavior:
As $x \to \infty, f(x) \to$ $-\infty$ Increasing: $(-\infty, 0)$ Positive: $(-2, 2)$

As $x \to -\infty, f(x) \to$ $-\infty$ Dec ~~Increasing~~: $(0, \infty)$ Neg ~~Positive~~: $(-\infty, -2) \cup (2, \infty)$