ALG I - §9-1 NOTES.

Algebra I Notes

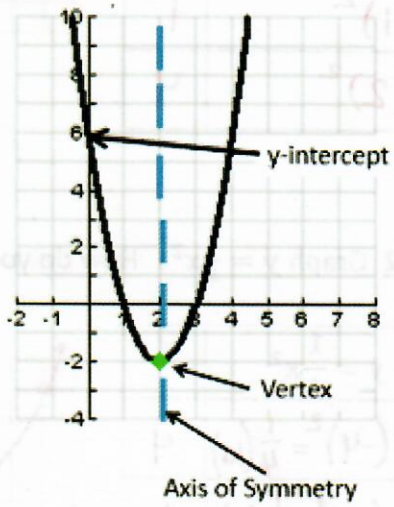
9.1 Quadratic Graphs and Their Properties

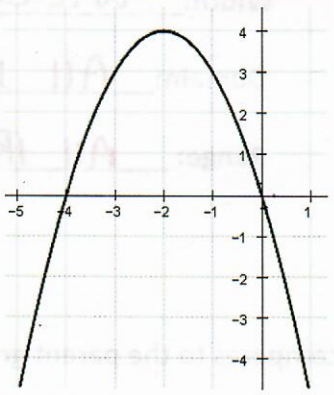
Objective: To graph quadratic functions in the form $y = ax^2 and\ y = ax^2 + c$

PARABOLA – the "U" shaped graph of a quadratic function

Standard Equation: $y = ax^2 + bx + c$

- If a > 0 → parabola opens up (min)
  If a < 0 → parabola opens down (max)
- Vertex $(-\frac{b}{2a}, y)$ - the point where the parabola changes direction
- Axis of Symmetry- $(x = -\frac{b}{2a})$ the vertical line through the vertex that cuts the parabola in half
- Y-intercept (c) – where the parabola crosses the y-axis





a < 0

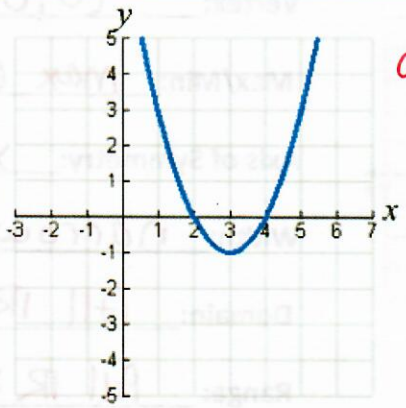
Vertex: (-2, 4)

Max/Min: max @ 4

Axis of Symmetry: x = -2

Domain: All ℝ ; (-∞, ∞)

Range: All ℝ ≤ 4 ; (-∞, 4]



a > 0

Vertex: (3, -1)

Max/Min: min @ -1

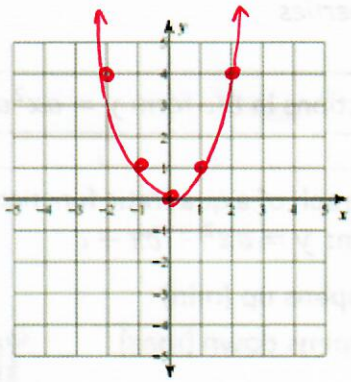
Axis of Symmetry: x = 3

Domain: All ℝ , (-∞, ∞)

Range: All ℝ ≥ -1 [-1, ∞)

Example 1 Graph $y = x^2$. This is referred to as the "parent graph."

x	$y = x^2$	y
-2	$(-2)^2$	4
-1	$(-1)^2$	1
0	$(0)^2$	0
1	$(1)^2$	1
2	$(2)^2$	4



Vertex: (0,0)

Max/Min: min @ 0

Axis of Symmetry: X = 0

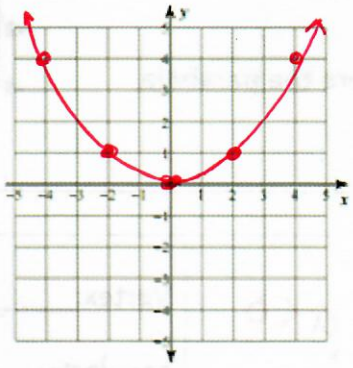
Width: Standard

Domain: All IR

Range: All IR ≥ 0

Example 2 Graph $y = \frac{1}{4}x^2$. How do you think this graph compares to the parent graph?

x	$y = \frac{1}{4}x^2$	y
-4	$\frac{1}{4}(-4)^2 = \frac{1}{4}(16)$	4
-2	$\frac{1}{4}(-2)^2 = \frac{1}{4}(4)$	1
0	$\frac{1}{4}(0)^2 = \frac{1}{4}(0)$	0
2	$\frac{1}{4}(2)^2 = \frac{1}{4}(4)$	1
4	$\frac{1}{4}(4)^2 = \frac{1}{4}(16)$	4



Vertex: (0, 0)

Max/Min: min @ 0

Axis of Symmetry: X = 0

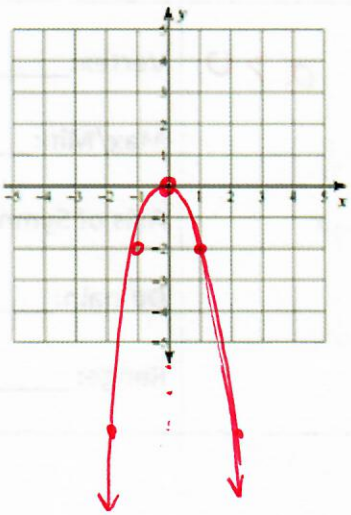
Width: wider

Domain: All IR

Range: All IR ≥ 0

Example 3 Graph $y = -2x^2$. How do you think this graph compares to the parent graph?

x	$y = -2x^2$	y
-2	$-2(-2)^2 = -2(4)$	-8
-1	$-2(-1)^2 = -2(1)$	-2
0	$-2(0)^2$	0
1	$-2(1)^2$	-2
2	$-2(2)^2 = -2(4)$	-8



Vertex: (0,0)

Max/Min: max @ 0

Axis of Symmetry: X = 0

Width: narrower

Domain: All IR

Range: All IR ≤ 0

|bigger #| ⟹ narrower

Example 4 Order each set of functions from the widest to the narrowest function.

a) $y = -3x^2,\ y = -5x^2,\ y = -x^2$

② ③ ①

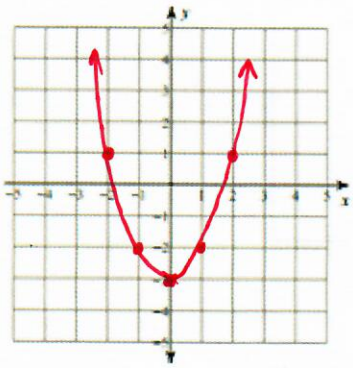
b) $y = \frac{1}{6}x^2,\ y = \frac{1}{4}x^2,\ y = \frac{1}{2}x^2$

① ② ③

Example 5 Graph each function of the form $y = ax^2 + c$

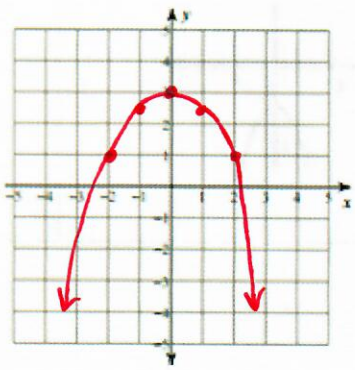
a) $y = x^2 - 3$ $a = 1$; $c = -3$

x	$y = x^2 - 3$	y
-2	$(-2)^2 - 3 = 4 - 3$	1
-1	$(-1)^2 - 3 = 1 - 3$	-2
0	$(0)^2 - 3 = 0 - 3$	-3
1	$(1)^2 - 3 = 1 - 3$	-2
2	$(2)^2 - 3 = 4 - 3$	1



b) $y = -\frac{1}{2}x^2 + 3$ $a = -\frac{1}{2}$; $c = 3$

x	$y = -\frac{1}{2}x^2 + 3$	y
-2	$-\frac{1}{2}(-2)^2 + 3 = -2 + 3$	1
-1	$-\frac{1}{2}(-1)^2 + 3 = -\frac{1}{2} + 3$	$2\frac{1}{2}$
0	$-\frac{1}{2}(0)^2 + 3 = 0 + 3$	3
1	$-\frac{1}{2}(1)^2 + 3 = -\frac{1}{2} + 3$	$2\frac{1}{2}$
2	$-\frac{1}{2}(2)^2 + 3 = -2 + 3$	1



How does the "a" value affect the graph?

"a" changes the width;

$a > 0$ graph opens up

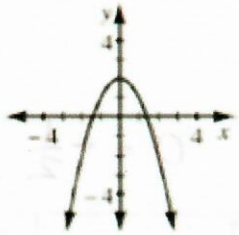
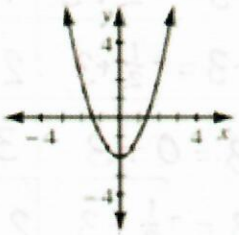
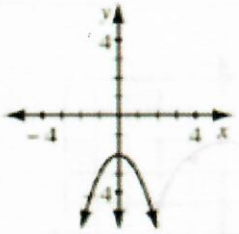
$a < 0$ graph opens down

How does the "c" value affect the graph?

"c" changes the y-intercept

Example 6 Match each function with its graph.

A. $y = -x^2 + 2$ B. $y = -x^2 - 2$ C. $y = x^2 - 2$

	A
	C
	B