## 10.1: Graph $y = ax^2 + c$

**Goals:** *Graph quadratic functions by making a table
*Identify the vertex of a parabola
*Identify whether a quadratic function will have minimum or maximum point without graphing
*Identify characteristics of a parabola based on a quadratic equation

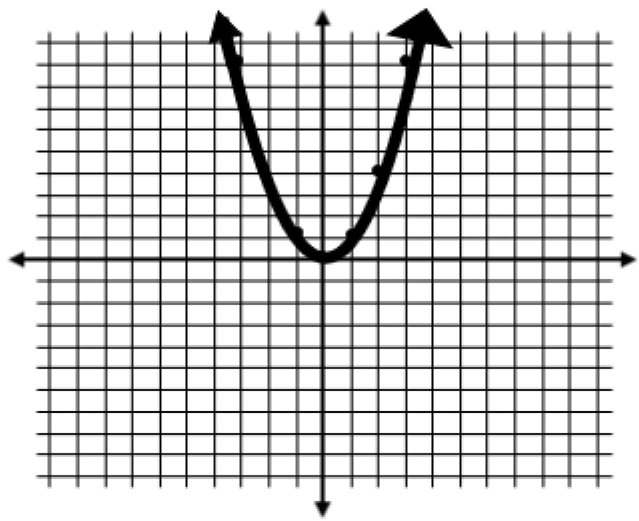
---

***RECALL (from Ch. 9)*** **quadratic function:** $y = ax^2 + bx + c$

**parabola:** U-shaped graph obtained by graphing a quadratic equation

**Ex:** Graph $y = x^2$ by making a table:

| $x$ | –3 | –2 | –1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| $y$ | 9 | 4 | 1 | 0 | 1 | 4 | 9 |



$y = x^2$ is called the "Parent quadratic function"
you compare all other quadratic functions to it.

**vertex:** The highest (maximum) or lowest (minimum) point on a parabola

**axis of symmetry:** The **LINE** that passes through the vertex and divides the parabola into two symmetrical parts

## *OBSERVATIONS*

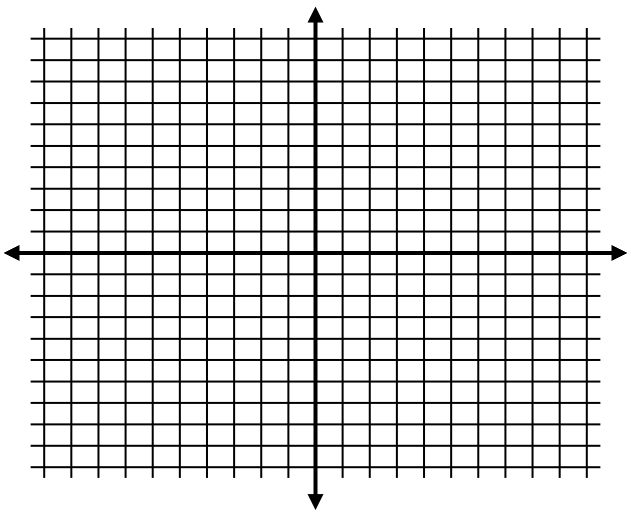
a) **Graph the following quadratic functions. Graph the odds by making a table and graph the evens by using a graphing calculator and copying it onto the graph provided.**
b) **For each parabola identify the vertex and axis of symmetry.**
c) **Compare each parabola to $y = x^2$ and begin to come up with some observations about characteristics of parabolas as they compare to their quadratic equations. (Ex: Direction it is facing/opening, narrowness/wideness, vertex)**

**1.** $y = 2x^2$

| $x$ | –3 | –2 | –1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| $y$ | 18 | 8 | 2 | 0 | 2 | 8 | 18 |

**Vertex: __(0, 0)_________**

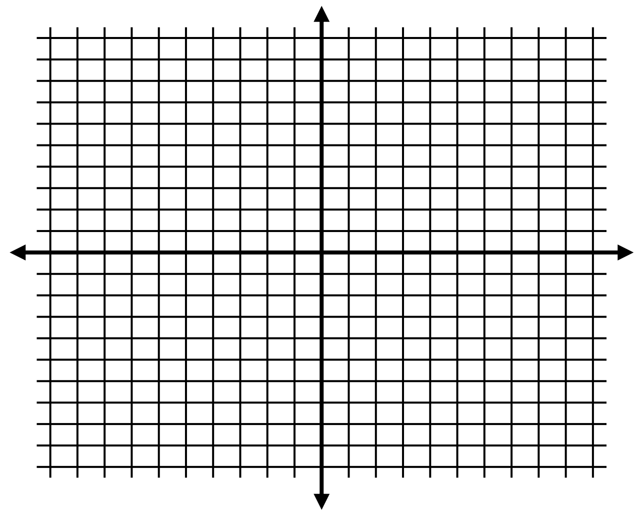
**Axis of Symmetry: _____$x$ = 0_________**



**2.** $y = 3x^2$

**Vertex: __(0, 0)______**

**Axis of Symmetry: ___ $x$ = 0_____**

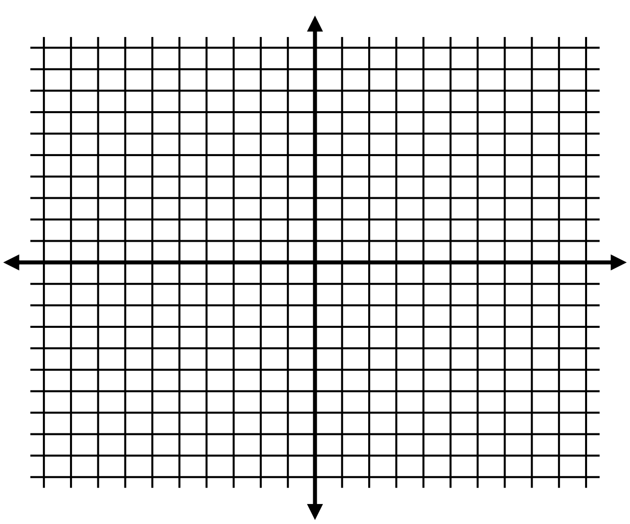


**3.** $y = -2x^2$

| $x$ | –3 | –2 | –1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| $y$ | –18 | –8 | –2 | 0 | –2 | –8 | –18 |

**Vertex: ____(0, 0)________**

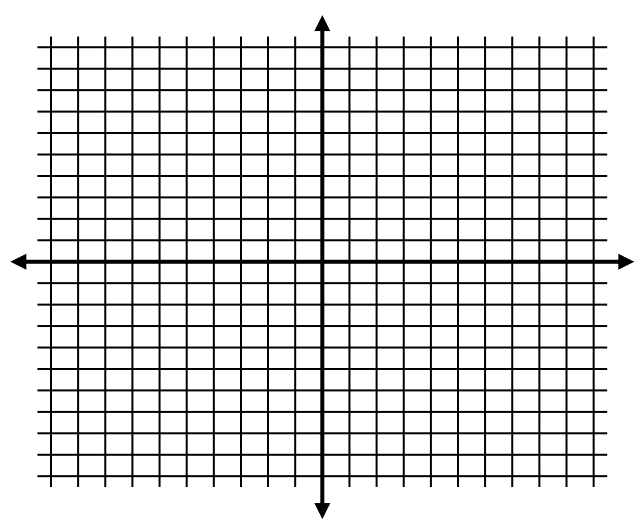
**Axis of Symmetry: ___$x$ = 0_________**



**4.** $y = -3x^2$

**Vertex: ______(0, 0)______**

**Axis of Symmetry: _$x$ = 0______**

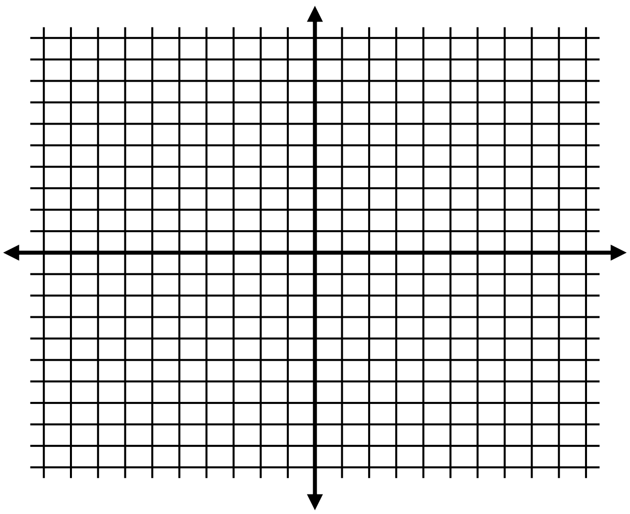


**5.** $y = \frac{1}{2}x^2$

| $x$ | –6 | –4 | –2 | 0 | 2 | 4 | 6 |
|---|---|---|---|---|---|---|---|
| $y$ | 18 | 8 | 2 | 0 | 2 | 8 | 18 |

**Vertex: ____(0, 0)_________**

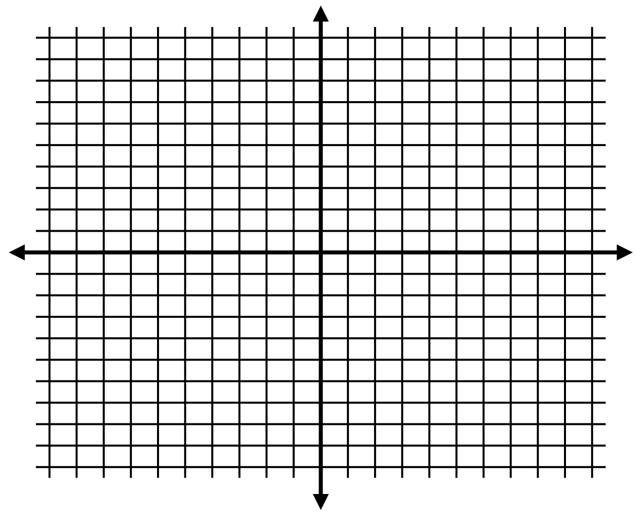
**Axis of Symmetry: ____*x* = 0__________**



**6.** $y = \frac{1}{4}x^2$

**Vertex: _______(0, 0)_______**

**Axis of Symmetry: _*x* = 0______**

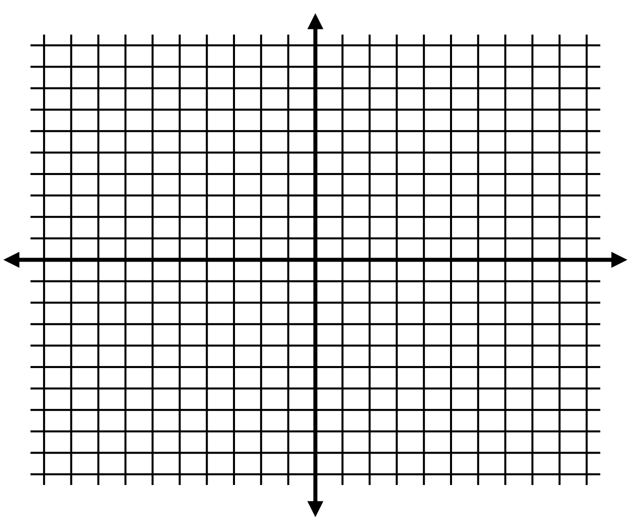


**7.** $y = 5x^2$

| $x$ | –3 | –2 | –1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| $y$ | 45 | 20 | 5 | 0 | 5 | 20 | 45 |

**Vertex: ____(0, 0)_________**

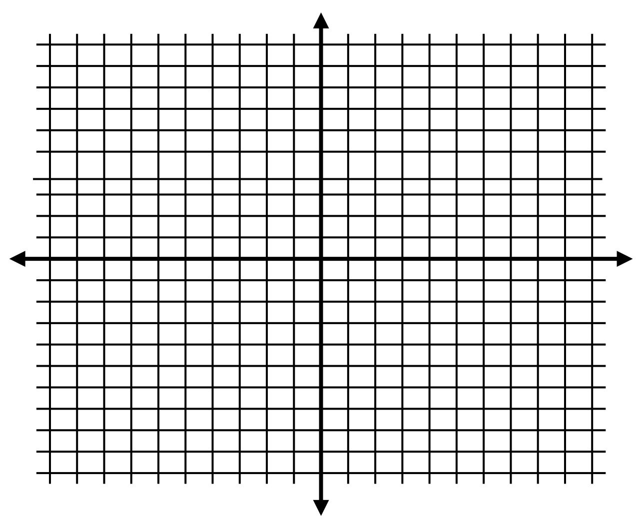
**Axis of Symmetry: ____*x* = 0__________**



**8.** $y = -4x^2$

**Vertex: _______(0, 0)_______**

**Axis of Symmetry: _*x* = 0______**

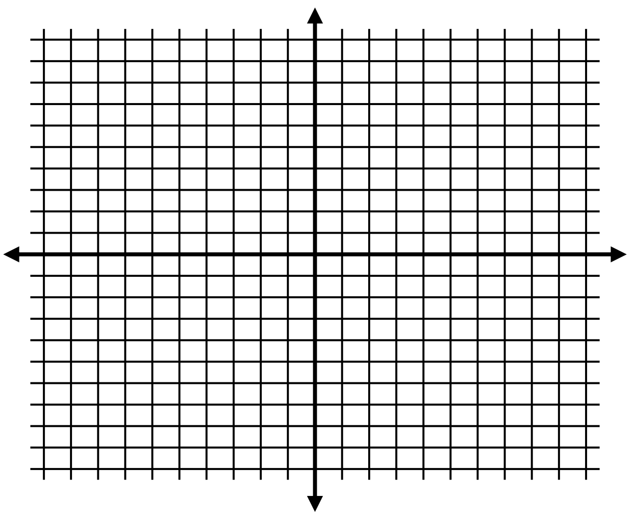


**9.** $y = x^2 + 5$

| $x$ | –3 | –2 | –1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| $y$ | 14 | 9 | 6 | 5 | 6 | 9 | 14 |

**Vertex: ___(0, 5)________**

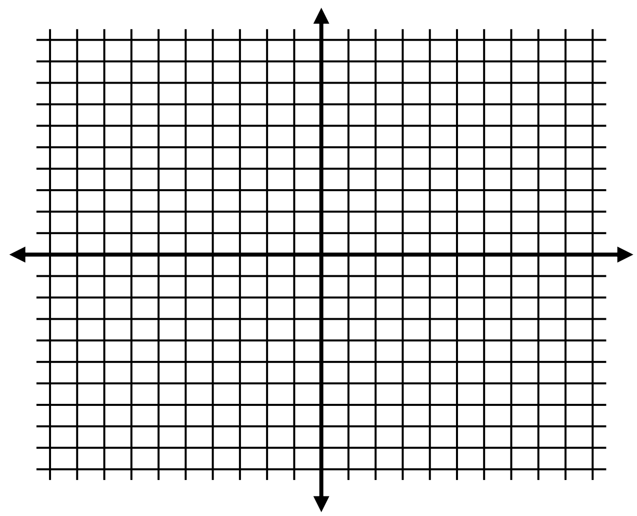
**Axis of Symmetry: _____*x* = 0__________**



**10.** $y = x^2 - 1$

**Vertex: __(0, –1)__________**

**Axis of Symmetry: _____*x* = 0_____**

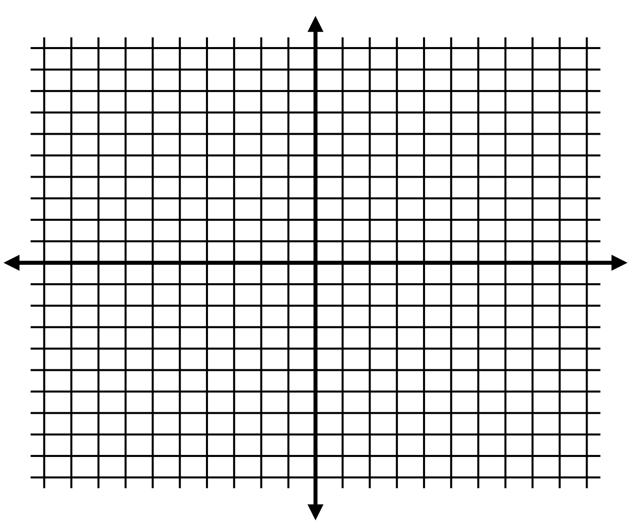


**11.** $y = x^2 + 4$

| $x$ | –3 | –2 | –1 | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| $y$ | 13 | 8 | 5 | 4 | 5 | 8 | 13 |

**Vertex: __(0, 4)__________**

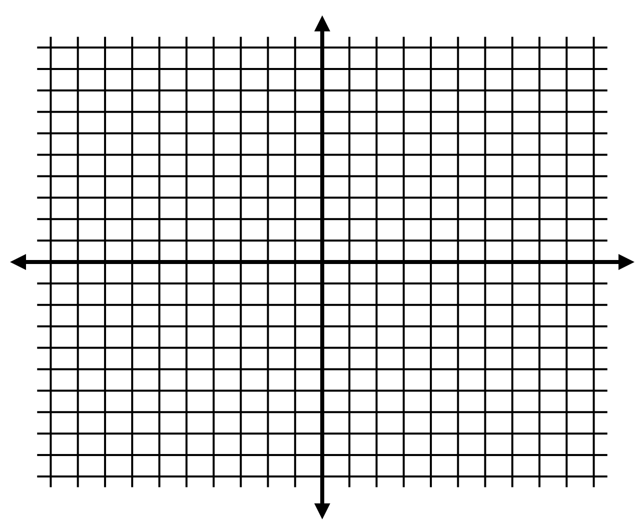
**Axis of Symmetry: ___*x* = 0___________**



**12.** $y = x^2 - 2$

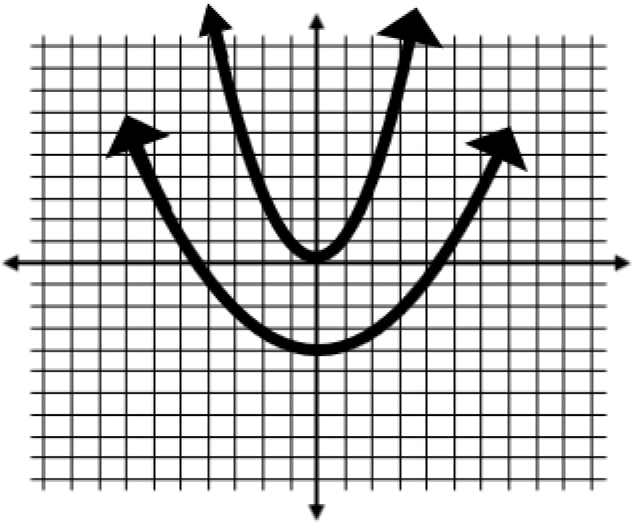
**Vertex: __(0, –2)__________**

**Axis of Symmetry: ______*x* = 0____**

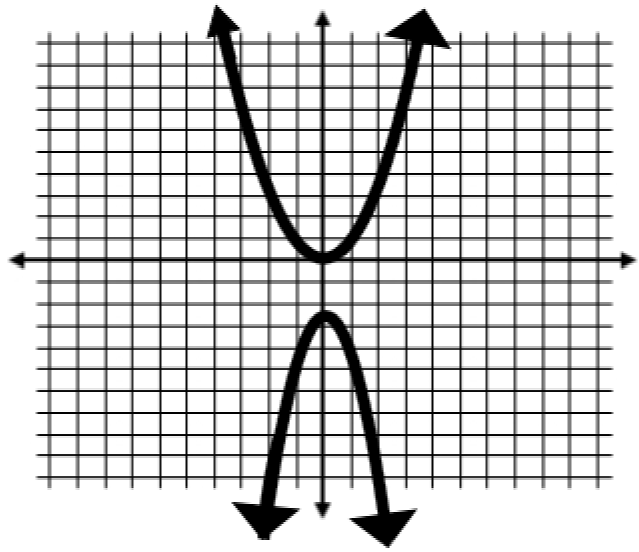


Now use your observations to <u>sketch</u> the graphs of the following quadratic functions:

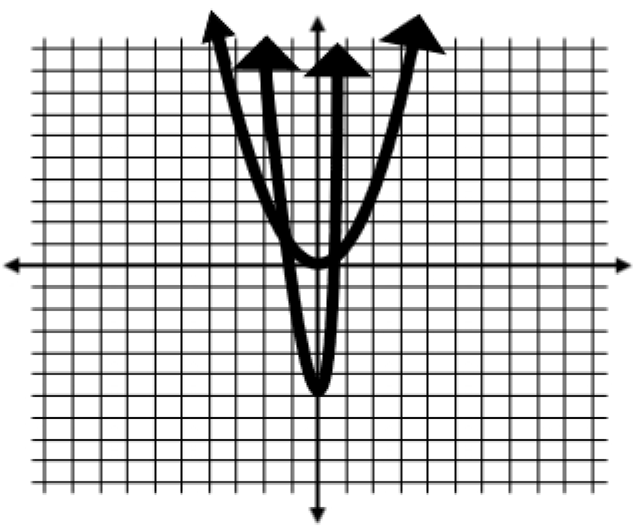
**1.** $y = \frac{1}{2}x^2 - 4$



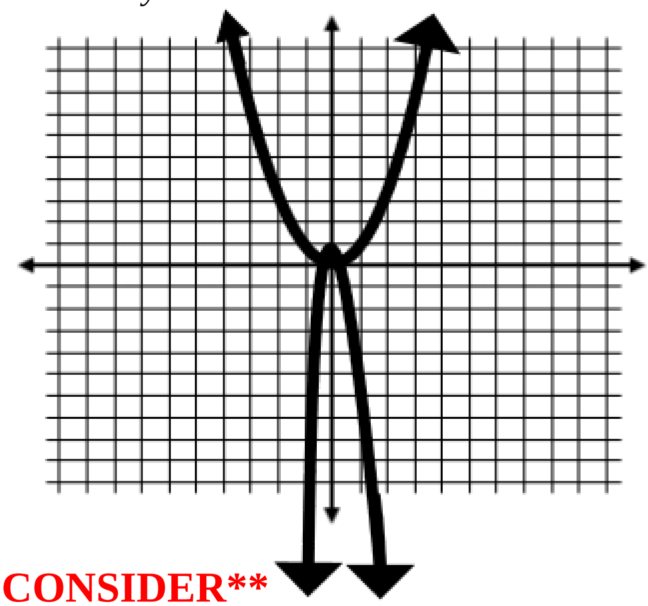
**2.** $y = -\frac{3}{2}x^2 - 2$



**3.** $y = 3x^2 - 6$



**4.** $y = -5x^2 + 1$



## **THOUGHTS TO CONSIDER**

- **What makes a parabola narrower? If $|a| > 1$, then the parabola will be narrower**
- **What makes a parabola wider? If $|a| < 1$, then the parabola will be wider**
- **What makes a parabola open facing upward (U- shaped)? If $a > 0$, the parabola opens upward**
- **What makes a parabola open facing downward (∩ -shaped)? If $a < 0$, the parabola opens downward**

- **What shifts a parabola up on the *y*-axis? If *c* is being added (positive), then the parabola shifts up**

- **What shifts a parabola down on the *y*-axis? If *c* is being subtracted (negative) then the parabola shifts down**