**Algebra 2**

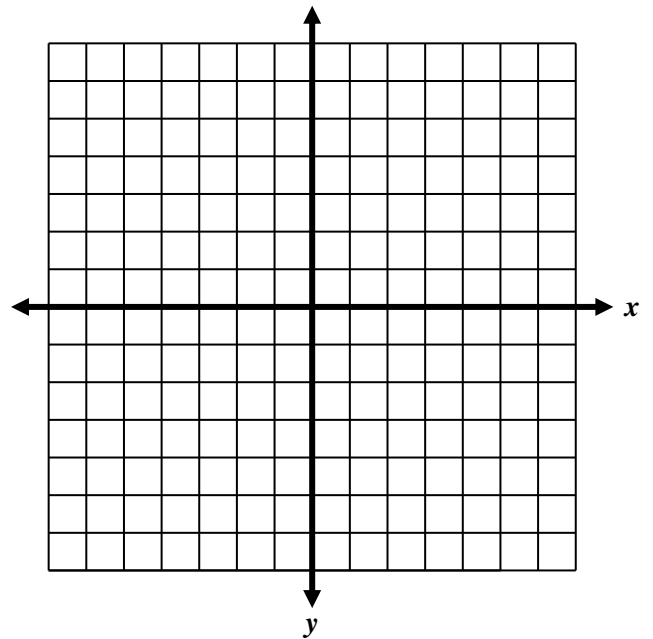**Notes: 2.1 Transformations of Quadratic Functions**

Name_____

Date_____Block_____

Make a table of values and use it to graph the following functions on the same coordinate plane. Use the same *x*-values for each function. Describe how the graphs of the last three functions differ from the graph of $f(x) = x^2$.
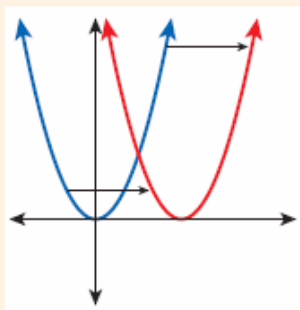
$f(x) = x^2$

| $x$ | $f(x)$ |
|-----|--------|
|     |        |
|     |        |
|     |        |
|     |        |
|     |        |

$g(x) = (x - 1)^2$

| $x$ | $g(x)$ |
|-----|--------|
|     |        |
|     |        |
|     |        |
|     |        |
|     |        |

$h(x) = 2x^2$

| $x$ | $h(x)$ |
|-----|--------|
|     |        |
|     |        |
|     |        |
|     |        |
|     |        |

$p(x) = x^2 + 1$

| $x$ | $p(x)$ |
|-----|--------|
|     |        |
|     |        |
|     |        |
|     |        |
|     |        |

## Translations of Quadratic Functions

| Horizontal Translations | Vertical Translations |
| --- | --- |
| **Horizontal Shift of $\lvert h \rvert$ Units** | **Vertical Shift of $\lvert k \rvert$ Units** |
|  $f(x) = x^2$ $f(x - h) = (x - h)^2$ Moves left for |  $f(x) = x^2$ $f(x) + k = x^2 + k$ Moves down for $k < 0$ |
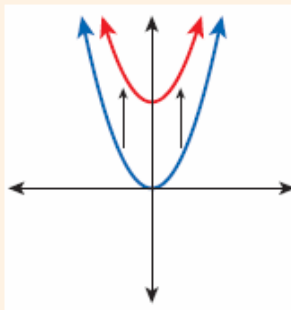
**Use the graph of $f(x) = x^2$ as a guide, describe the transformations of each function.**
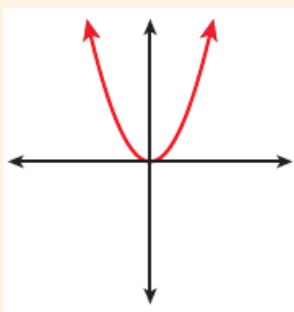
1. $g(x) = (x - 2)^2 + 4$        2. $g(x) = (x + 2)^2 - 3$        3. $g(x) = x^2 - 5$
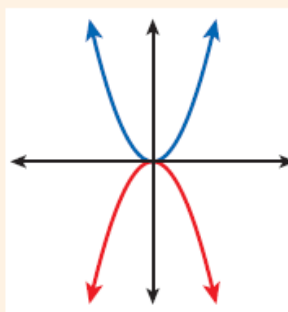
## Reflections

| Reflection Across $y$-axis | Reflection Across $x$-axis |
| --- | --- |
|  Input values change. $f(x) = x^2$ $f(-x) = (-x)^2 = x^2$ |  Output values change. $f(x) = x^2$ $-f(x) = -(x^2)$ $= -x^2$ |

### Stretches and Compressions

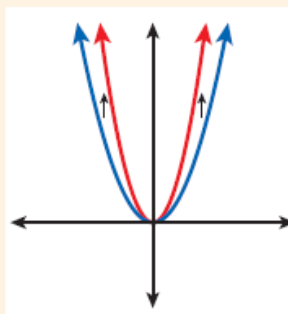| Horizontal Stretch/Compression by a Factor of $\lvert b \rvert$ | Vertical Stretch/Compression by a Factor of $\lvert a \rvert$ |
| --- | --- |
|  Input values change. $f(x) = x^2$ $f\left(\dfrac{1}{b}x\right) = \left(\dfrac{1}{b}x\right)^2$ |  Output values change. $f(x) = x^2$ $a \cdot f(x) = ax^2$ |
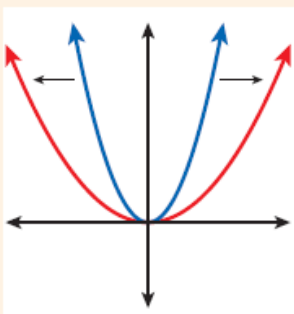
**Use the graph of $f(x) = x^2$ as a guide, describe the transformations of each function.**

4. $g(x) = -\dfrac{1}{4}x^2$

5. $g(x) = (3x)^2$

6. $g(x) = (2x)^2$

7. $g(x) = -\dfrac{1}{2}x^2$

If a parabola opens upward, it has a lowest point. If a parabola opens downward, it has a highest point. This lowest or highest point is the _____.

The parent function $f(x) = x^2$ has its vertex at the _____. You can identify the vertex of other quadratic functions by analyzing the function in *vertex form*. The **vertex form** of a quadratic function is

_____, where *a, h,* and *k* are constants.

**Vertex Form of a Quadratic Function**

$$f(x) = a(x - h)^2 + k$$

Because the vertex is translated *h* horizontal units and *k* vertical from the origin, **the vertex of the parabola is at _____.**

**Use the description to write the quadratic function in vertex form.**

8. The parent function $f(x) = x^2$ is vertically stretched by a factor of $\dfrac{4}{3}$ and then translated 2 units left and 5 units down to create *g*.

9. The parent function $f(x) = x^2$ is vertically compressed by a factor of $\dfrac{2}{3}$ and then translated 2 units right and 4 units down to create *g*.

10. The parent function $f(x) = x^2$ is reflected across the *x*-axis and translated 5 units left and 1 unit up to create *g*.