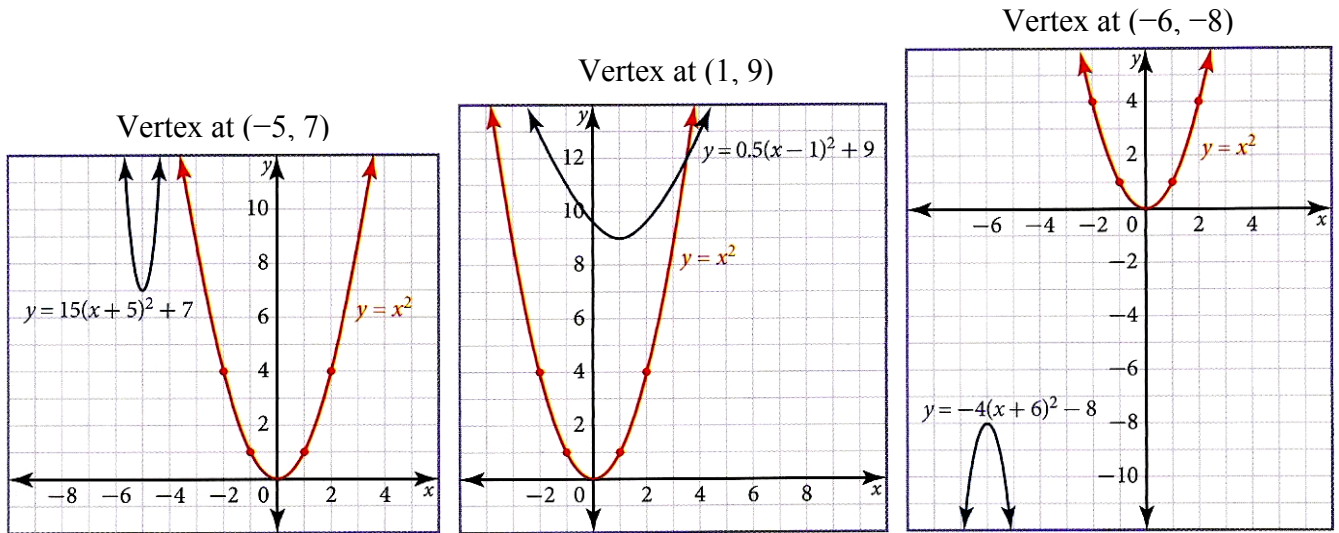


Summary of Transformations in Quadratic Relations

For any quadratic relation of the form $y = a(x - h)^2 + k$:

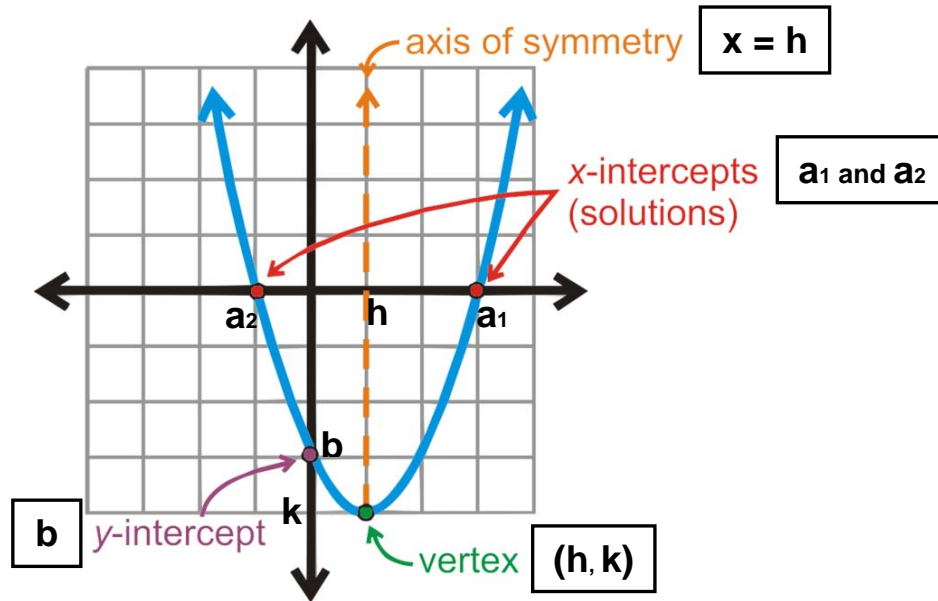


- The value of a determines the orientation (**upward or downward**) and shape (**stretch or compression**) of the parabola relative to the graph of $y = x^2$.
 - If $a > 0$ (a is greater than 0), the parabola opens upward.
 - If $a < 0$ (a is less than 0), the parabola opens downward, and is a reflection of $y = x^2$ in the x -axis.
 - If $-1 < a < 1$ (a is between -1 and 1), the parabola is vertically compressed relative to the graph of $y = x^2$.
 - If $a > 1$ or $a < -1$ (a is greater than 1 or less than -1), the parabola is vertically stretched relative to the graph of $y = x^2$.

- The value of k determines the **vertical position** of the parabola.
 - If $k > 0$ (k is greater than 0), the parabola is vertically translated upward by k units relative to the graph of $y = x^2$, and the vertex of the parabola is k units above the x -axis.
 - If $k < 0$ (k is less than 0), the parabola is vertically translated downward by k units relative to the graph of $y = x^2$, and the vertex of the parabola is k units below x -axis.

- The value of h determines the **horizontal position** of the parabola.
 - If $h > 0$ (h is greater than 0), the vertex of the parabola is horizontally translated to the right of the y -axis by h units, relative to the graph of $y = x^2$.
 - If $h < 0$ (h is less than 0), the vertex of the parabola is horizontally translated to the left of the y -axis by h units, relative to the graph of $y = x^2$.

- The coordinates of the **vertex** of the parabola are (h, k) .



For the quadratic function $f(x) = -3(x - 2)^2 + 9$:

(a) describe in words the transformation relative to the graph of $f(x) = x^2$.

(b) write the coordinates of the vertex.

(c) write the equation of the axis of symmetry.