The roles of a, h & k in $y = a(x-h)^2 + k$

Based on class discussion, complete the following graphic organizer to summarize the roles of a, h and k.

Role of a:

Direction of Opening (Reflection):

- When a is positive, the parabola opens upwards
- When a is negative, the parabola opens downwards.

Shape (Vertical Stretch or Compression):

- If $a > 1$ or $a < -1$, then the graph of $y = a(x-h)^2 + k$ is vertically stretched, which means it has a thinner opening than $y = 1(x-h)^2 + k$.
- If a is between -1 and 1, then the graph of $y = a(x-h)^2 + k$ is vertically compressed, which means it has a wider opening than $y = 1(x-h)^2 + k$.

Role of h:

Properties (Horizontal Translation):

- If $h > 0$, then the graph of $y = a(x-h)^2 + k$ is translated **horizontally** h units to the right.
- If $h < 0$, then the graph of $y = a(x-h)^2 + k$ is translated **horizontally** h units to the left.

Relation to the Vertex:

- The value of h is the x - coordinate of the vertex.

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

Vertex (h, k)

Role of k:

Properties (Vertical Translation):

- If $k > 0$, then the graph of $y = a(x-h)^2 + k$ is translated **vertically** k units up.
- If $k < 0$, then the graph of $y = a(x-h)^2 + k$ is translated **vertically** k units down.

Relation to the Vertex:

- The value of k is the y - coordinate of the vertex.

Example: $y = -2(x-3)^2 + 5$

State:

- Direction of opening: down
- Coordinates of the vertex: $V(3, 5)$
- Transformations (NOTE: there are 4):

horizontal translation 3 units right

vertical translation of 5 units up

Stretched vertically by a factor of 2

reflected in the x-axis