# Conic Sections Reference Sheet

- Any parabola (opening up or down) can be put into the standard form $(x-p)^2 = 4a(y-q)$. Then:
  - The vertex is at $(p, q)$
  - The the focal length is $|a|$
  - The focus and directrix are distance $|a|$ from the vertex (in the $y$ direction)
  - The axis is the line through the focus and vertex

  *Note: you can switch $x$ and $y$ to learn about a parabola opening right or left.*

- Any ellipse can be put into the standard form $\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$. If $a > b$, we have the following:
  - The length of the major axis is $2a$
  - The coordinates of the vertices on the major axis are $(h \pm a, k)$
  - The length of the minor axis is $2b$
  - The coordinates of the vertices on the minor axis are $(h, k \pm b)$
  - The coordinates of the foci are $(h \pm c, k)$, where $c^2 = a^2 - b^2$

  *Note: if $a < b$, switch $a$ and $b$ in each statement above.*

- Any hyperbola (opening left and right) can be put into the standard form $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$. Then:
  - The center is at $(h, k)$
  - The vertices are $(h \pm a, k)$
  - The foci are $(h \pm c, k)$, where $c^2 = a^2 + b^2$
  - The asymptotes are the lines $y = k \pm \frac{b}{a}(x-h)$

  *Note: for a hyperbola opening up and down, we switch $x$ and $y$ in the standard form; asymptotes are then $y = k \pm \frac{a}{b}(x-h)$.*