Conic Section Formula Sheet

General Formulas

Midpoint
$\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

Distance
$\sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$

Slope
$\frac{y_2-y_1}{x_2-x_1}$

Slope-Intercept
$y = mx + b$

Point-slope
$y - y_1 = m(x - x_1)$

Parabola

Vertical: Opens up or down

Equation: $(x-h)^2 = 4p(y-k)$

Vertex: (h,k)
Focus: $(h, k+p)$
Directrix: $y = k - p$
Axis of Symetry: $x = h$
If $p > 0$ parabola opens up, if $p < 0$ parabola opens down

Horizontal: Opens right or left

Equation: $(y-k)^2 = 4p(x-h)$

Vertex: (h,k)
Focus: $(h+p, k)$
Directrix: $x = h - p$
Axis of Symetry: $y = k$
If $p > 0$ parabola opens right, if $p < 0$ parabola opens left

Ellipse

Horizontal: Major Axis Parallel to x - axis

Equation: $\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1$

Center: (h,k)
Vertices: $(h \pm a, k)$
Co-vertices: $(h, k \pm b)$
Foci: $(h \pm c, k)$; where $c^2 = a^2 - b^2$

Vertical: Major Axis Parallel to y - axis

Equation: $\frac{(x-h)^2}{b^2} + \frac{(y-k)^2}{a^2} = 1$

Center: (h,k)
Vertices: $(h, k \pm a)$
Co-vertices: $(h \pm b, k)$
Foci: $(h, k \pm c)$; where $c^2 = a^2 - b^2$

Hyperbola

Horizontal: Transverse Axis Parallel to x - axis

Equation: $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$

Center: (h,k)
Vertices: $(h \pm a, k)$
Foci: $(h \pm c, k)$; where $c^2 = a^2 + b^2$
Asymptotes: $y = \pm \frac{b}{a}(x-h) + k$

Vertical: Transverse Axis Parallel to y - axis

Equation: $\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$

Center: (h,k)
Vertices: $(h, k \pm a)$
Foci: $(h, k \pm c)$; where $c^2 = a^2 + b^2$
Asymptotes: $y = \pm \frac{a}{b}(x-h) + k$

Circle

Equation: $(x-h)^2 + (y-k)^2 = r^2$

Center: (h,k)
Radius: r

Identifying Conic Sections

To identify conic sections of the equation $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$ where A, B, and C do not all equal zero:

Circle:	If $B^2 - 4AC < 0$, with $B = 0$ and $A = C$
Ellipse:	If $B^2 - 4AC < 0$, with $B \neq 0$ or $A \neq C$
Hyperbola:	If $B^2 - 4AC > 0$
Parabola:	If $B^2 - 4AC = 0$