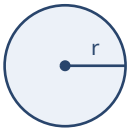
Conic Sections Formula Sheet

Circle from center and radius

Center (h,k), radius r	$(x - h)^2 + (y - k)^2 = r^2$
Example	$(x + 3)^2 + (y - 2)^2 = 25$
Read the center and radius	$(-3,2)$, $r = 5$

Complete the square in x and y to convert from expanded form. Use r > 0.



Ellipse: major axis and foci

Horizontal major axis	$(x - h)^2/a^2 + (y - k)^2/b^2 = 1$
Vertical major axis	$(x - h)^2/b^2 + (y - k)^2/a^2 = 1$
Focal distance	$c = \sqrt{(a^2 - b^2)}$
Eccentricity	$e = c/a$

Here a > b > 0. Vertices are a units and foci are c units from the center along the major axis.

Parabola: focus and directrix

Vertical axis	$(x - h)^2 = 4p(y - k)$
Horizontal axis	$(y - k)^2 = 4p(x - h)$
Vertical focus and directrix	$(h,k + p)$; $y = k - p$
Horizontal focus and directrix	$(h + p,k)$; $x = h - p$

The vertex is (h,k). The nonzero signed p points from vertex to focus.

Hyperbola: axes and foci

Horizontal transverse axis

$(x - h)^2/a^2 - (y - k)^2/b^2 = 1$

Vertical transverse axis	$(y - k)^2/a^2 - (x - h)^2/b^2 = 1$
Focal distance	$c = \sqrt{(a^2 + b^2)}$
Eccentricity	$e = c/a$

Foci lie c from the center on the transverse axis. Asymptote slopes are ±b/a (horizontal), ±a/b (vertical).

Classify an expanded conic

Quadratic part	$Ax^2 + Bxy + Cy^2$
Discriminant	$D = B^2 - 4AC$
D < 0, D = 0, D > 0	ellipse, parabola, hyperbola

This classifies nondegenerate real conics. An ellipse can be a circle. Check degenerate cases separately.