

General Form

$$Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$$

- Parabola** x or y is squared, but not both
- Circle** x & y have the same coefficient
- Ellipse** x & y have the same signs
- Hyperbola** x & y have different signs

Rotation angle, $\theta = \frac{1}{2} \arctan(B/(A - C))$

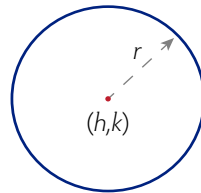
To get new equation in rotated coordinate system, substitute:

$$x = x' \cos \theta - y' \sin \theta \quad y = x' \sin \theta + y' \cos \theta$$

Circle

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

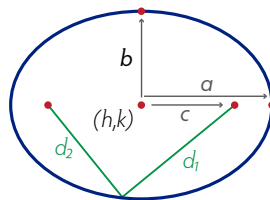
- eccentricity = $c/a = 0$



Ellipse

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

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



- a is always the larger number (and therefore the longer axis).
- $d_1 + d_2$ is a constant
- $c^2 = a^2 - b^2$
- $0 < \text{eccentricity} < 1$

Terminology

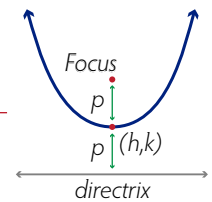
- c & $-c$ Distance to the **focus** (plural: *foci*)
- Long axis **Major axis**
 a Major radius, **semi-major axis**
- Short axis **Minor axis**
 b Minor radius, **semi-minor axis**

Parabola

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

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

- Vertex \rightarrow focus =
Vertex \rightarrow directrix



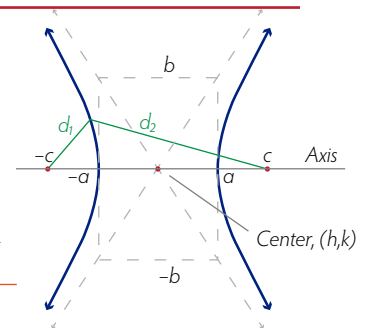
- eccentricity = 1

Hyperbola

Horizontal axis

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

Asympt: $y = \pm \frac{b}{a}(x - h) + k$



Vertical axis

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

Asympt: $y = \pm \frac{a}{b}(x - h) + k$

The slope is always the square root of the y denominator over the x .

Notes

- a is always under the positive element
- Vertical if y is positive
Horizontal if x is positive
- $c^2 = a^2 + b^2$