# Parabolas

| | **Faces Up/Down** (Along the vertical axis) | **Faces Left/Right** (Along the horizontal axis) |
|---|---|---|
| Equation | $(x - h)^2 = 4p(y - k)$ | $(y - k)^2 = 4p(x - h)$ |
| Vertex | (h, k) | (h, k) |
| Axis of Symmetry | $x = h$ | $y = k$ |
| Directrix | $y = k - p$ | $x = h - p$ |

A line perpendicular to the axis of symmetry p units under/over or right/left of the vertex. This line does not cut the parabola.

| | | |
|---|---|---|
| Focus | (h, k + p) | (h + p, k) |
| Latus Rectum | $\| 4p \|$ | $\| 4p \|$ |

This is a line segment from one side of the parabola to the other through the focus. The distance from the focus to the parabola is | 2p |. This is also called the **focal length** of the parabola

| | | |
|---|---|---|
| p | $p > 0$ opens up<br>$p < 0$ opens down | $p > 0$ opens right<br>$p < 0$ opens left |

This is the distance from the focus to the vertex and from the vertex to the directrix

# Ellipses

**Major Axis is Horizontal**

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

**Major Axis is Vertical**

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

**Note:** a > b; that's what makes the distinction between the a & the b!

| | Horizontal | | Vertical | |
|---|---|---|---|---|
| Center | | (h, k) | | (h, k) |
| Vertex | (h + a, k) | (h – a, k) | (h, a + k) | (h, k – a) |
| Focus<br>$c^2 = a^2 - b^2$ | (c + h, k) | (h – c, k) | (h, c + k) | (h, k – c) |
| Major Axis | | 2a | | 2a |

This is a line segment from one vertex to the other through the foci.

| | | |
|---|---|---|
| Minor Axis | 2b | 2b |

This is a line segment from one side of the ellipse to the other through the center.

| | | |
|---|---|---|
| Eccentricity | $e = {}^{c}/_{a}$ | $e = {}^{c}/_{a}$ |

$0 < e < 1$

*Closer to 0 is a more circle like

# Hyperbolas

| | Opens Left & Right | Opens Up & Down |
|---|---|---|
| | $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$ | $\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$ |
| **Center** | (h, k) | (h, k) |
| **Vertices** | (h+a, k) (h–a, k) | (h, a+k) (h, k–a) |
| **Transverse Axis**<br>A line between the vertices through the center | Horizontal: 2a | Vertical: 2a |
| **Asymptotes** | $y - k = {}^{b}/_{a}(x - h)$ and $y - k = -{}^{b}/_{a}(x - h)$ | $y - k = {}^{a}/_{b}(x - h)$ and $y - k = -{}^{a}/_{b}(x - h)$ |
| **Foci**<br>$c^2 = a^2 + b^2$ in this case | (h+c, k) (h–c, k) | (h, c+k) (h, k–c) |
| **Central Box**<br>Between "parabolas" | Box thru vertices & asymptote<br>(a+h, b+k), (a+h, k-b),<br>(h-a, k+b) (h-a, k-b) | Box thru vertices & asymptote<br>(b+h, a+k), (b+h, k-a),<br>(h-b, a+k), (h-b, k-a) |