THEOREM 9.1 Standard Equation of a Parabola

The **standard form** of the equation of a parabola with vertex *(h, k)* and the directrix $y = k - p$ is

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

For directrix $x = h - p$, the equation is

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

The focus lies on the axis *p* units (*directed distance*) from the vertex.

THEOREM 9.3 Standard Equation of an Ellipse

The standard form of the equation of an ellipse, with center (*h*, *k*) and major and minor axes of lengths 2*a* and 2*b*, where *a* > *b*, is

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

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

The foci lie on the major axis, *c* units from the center, with $c^2 = a^2 - b^2$.

THEOREM 9.5 Standard Equation of a Hyperbola

The standard form of the equation of a hyperbola with center at (*h*, *k*) is

$$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$$ Traverse axis is horizontal.

or

$$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$$ Traverse axis is vertical.

The vertices are *a* units from the center, and the foci are *c* units from the center. Moreover, $c^2 = a^2 + b^2$.