

Parabola:

$$\text{dist}(P, F) = \text{dist}(P, D)$$

Focus $(0, p)$ and Directrix $y = -p$ give equation

$$x^2 = 4py$$

Ellipse:

$$\text{dist}(P, F_1) + \text{dist}(P, F_2) = 2a$$

Foci $(\pm c, 0)$ give equation

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

where $b^2 = a^2 - c^2$

Hyperbola:

$$\text{dist}(P, F_1) - \text{dist}(P, F_2) = \pm 2a$$

Foci $(\pm c, 0)$ give equation

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

where $c^2 = a^2 + b^2$ and the asymptotes are $y = \pm \frac{b}{a}x$

Unified treatment:

$$\frac{\text{dist}(P, F)}{\text{dist}(P, D)} = e$$

ellipse if $e < 1$

parabola if $e = 1$

hyperbola if $e > 1$

Polar curve equation:

$$r = \frac{ed}{1 \pm e \cos(\theta)} \quad \text{or} \quad r = \frac{ed}{1 \pm e \sin(\theta)}$$