

Properties of parabolas

Axis of symmetry	<ul style="list-style-type: none">• passes through focus and vertex• perpendicular to directrix
Vertex	<ul style="list-style-type: none">• midpoint between focus and directrix along axis of symmetry
p	<ul style="list-style-type: none">• directed distance from vertex to focus
Equation	<ul style="list-style-type: none">• vertical directrix $\Rightarrow y^2 = 4px$ if vertex at origin• horizontal directrix $\Rightarrow x^2 = 4py$ if vertex at origin• use transformations to shift equation by co-ordinates of vertex if not at origin
Distance	<ul style="list-style-type: none">• distance from any point on parabola to focus = (perpendicular) distance from point to directrix

Properties of ellipses

Axes of symmetry	<ul style="list-style-type: none">• major axis passes through center, foci and vertices• minor axis perpendicular to major axis, passes through center
Vertices	<ul style="list-style-type: none">• endpoints of major axis
Foci	<ul style="list-style-type: none">• along major axis• closer to center than vertices are
Center	<ul style="list-style-type: none">• intersection of major and minor axes• midpoint of both major and minor axes• midpoint of foci• midpoint of vertices
Equation	<ul style="list-style-type: none">• $\frac{x^2}{(\text{"semi-horizontal" axis})^2} + \frac{y^2}{(\text{"semi-vertical" axis})^2} = 1$• use transformations to shift equation by co-ordinates of center if not at origin
Identity	<ul style="list-style-type: none">• $(\text{semi-major axis})^2 = (\text{semi-minor axis})^2 + (\text{"semi-focal length"})^2$ where "semi-focal length" = $\frac{1}{2}$ distance between foci = distance from center to focus
Distance	<ul style="list-style-type: none">• sum of distances from any point on ellipse to foci = major axis

Properties of hyperbolas

Axes of symmetry	<ul style="list-style-type: none">• transverse axis passes through center, foci and vertices• conjugate axis perpendicular to major axis, passes through center
Vertices	<ul style="list-style-type: none">• endpoints of transverse axis
Foci	<ul style="list-style-type: none">• along transverse axis• farther from center than vertices are
Center	<ul style="list-style-type: none">• intersection of transverse and conjugate axes• midpoint of both transverse and conjugate axes• midpoint of foci• midpoint of vertices
Asymptotes	<ul style="list-style-type: none">• intersection of asymptotes• pass through center• slope = $\pm \frac{\text{vertical axis}}{\text{horizontal axis}} = \pm \frac{\text{semi-vertical axis}}{\text{semi-horizontal axis}}$
Equation	<ul style="list-style-type: none">• opens left & right $\Rightarrow \frac{x^2}{(\text{"semi-horizontal" axis})^2} - \frac{y^2}{(\text{"semi-vertical" axis})^2} = 1$ if center at origin• opens up & down $\Rightarrow \frac{y^2}{(\text{"semi-vertical" axis})^2} - \frac{x^2}{(\text{"semi-horizontal" axis})^2} = 1$ if center at origin• use transformations to shift equation by co-ordinates of center if not at origin
Identity	<ul style="list-style-type: none">• $(\text{"semi-focal length"})^2 = (\text{semi-transverse axis})^2 + (\text{semi-conjugate axis})^2$ where "semi-focal length" = $\frac{1}{2}$ distance between foci = distance from center to focus
Distance	<ul style="list-style-type: none">• difference of distances from any point on hyperbola to foci = transverse axis

NOTE: All properties above are true even if the conic is rotated, except those marked with a red dot (●).