

Conic Section: Formulae & Important Notes

	Position of the plane	Section
1.	Parallel to a generator but not passing through the vertex.	A Parabola
2.	Oblique to the axis	An Ellipse
3.	Parallel to the axis	A hyperbola

Comparative Study of the Four Parabolas

	Parabola	$y^2 = 4ax$	$y^2 = -4ax$	$x^2 = 4by$	$x^2 = -4by$
1.	Focus	(a,0)	(- a,0)	(0,b)	(0,- b)
2.	Directrix	$x + a = 0$	$x - a = 0$	$y + b = 0$	$y - b = 0$
3.	Axis	x - axis	x - axis	y - axis	y - axis
4.	Vertex	origin	origin	origin	origin
5.	Latus Rectum	4a	4a	4b	4b
6.	Ends of Latus Rectum	(a, 2a), (a, -2a)	(-a, 2a) (- a, - 2a)	(2b, b) (- 2b, b)	(2b, - b) (- 2b, - b)
7.	Lies in	I and IV quadrants	II and III quadrants	I and II quadrants	III and IV quadrants

Comparative Study of the Two Ellipses

	Ellipse	$x^2/a^2 + y^2/b^2 = 1, (a > b)$	$x^2/a^2 + y^2/b^2 = 1, (b > a)$
1.	Center	(0, 0)	(0, 0)
2.	Foci	S(ae, 0), S'(- ae, 0)	S(0, be), S'(0, - be)
3.	Directrices	$d \equiv x = a/e, d' \equiv x = -a/e$	$d \equiv y = b/e, y = -b/e$
4.	Vertices	A (a, 0), A' (- a, 0), B(0, b), B' (0, - b)	A (a, 0), A' (- a, 0) B(0, b), B' (0, - b)
5.	Axes	Major axis, AA' = 2a Minor axis, BB'=2b	Minor axis, BB'=2b Major axis, AA' = 2a
6.	Latus Rectum	$\frac{2b^2}{a}$	$\frac{2a^2}{b}$
7.	Relation between a, b and e	$b^2 = a^2(1 - e^2)$	$a^2 = b^2(1 - e^2)$

Comparative Study of the Two Hyperbolas

	Hyperbola	$x^2/a^2 - y^2/b^2 = 1$	$y^2/b^2 - x^2/a^2 = 1$
1.	Center	(0, 0)	(0, 0)
2.	Foci	S(ae, 0), S'(- ae, 0)	S(0, be), S'(0, - be)
3.	Directrices	$d \equiv x = a/e, d' \equiv x = -a/e$	$d \equiv y = b/e, d' \equiv y = -b/e$
4.	Vertices	A (a, 0), A' (- a, 0) B(0, b), B' (0, - b)	B(0, b)B'(0, - b) B(0, b), B' (0, - b)
5.	Axes	Transverse axis, AA' = 2a Conjugate axis, BB' = 2b	Transverse axis, BB'=2b Conjugate axis, AA'=2a
6.	Latus Rectum	$\frac{2b^2}{a}$	$\frac{2a^2}{b}$
7.	Relation between a, b and e	$b^2 = a^2(e^2 - 1)$	$a^2 = b^2(e^2 - 1)$

Comparative study of Standard Equation of Parabola, Ellipse and Hyperbola

		Parabola	Ellipse	Hyperbola
1.	Standard Equation	$y^2 = 4ax$	$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$
2.	Eccentricity	$e = 1$	$e < 1$	$e > 1$
3.	Relation between a^2 and b^2	-	$b^2 = a^2(1 - e^2)$	$b^2 = a^2(e^2 - 1)$
4.	Centre	-	(0, 0)	(0, 0)
5.	Vertices	(0, 0)	(a, 0) (- a, 0) (0, b) (0, - b)	(a, 0) (- a, 0) (0, b) (0, - b)
6.	Foci	(a, 0)	(ae, 0), (- ae, 0)	(ae, 0), (- ae, 0)
7.	Equation of directrices	$x + a = 0$	$x = \pm \frac{a}{e}$	$x = \pm \frac{a}{e}$
8.	Axis	x – axis	Major Axis = 2a (along x – axis) Minor Axis = 2b (along y – axis)	Transverse Axis = 2a(along x – axis) Conjugate Axis = 2b (along y – axis),
9.	Length of Latus Rectum	4a	$\frac{2b^2}{a}$	$\frac{2b^2}{a}$
10.	Symmetry	About x – axis	About origin and both axes	About origin and both axes
11.	Distance between Foci	-	2 ae	2 ae
12.	Distance between directrices	-	$\frac{2a}{e}$	$\frac{2a}{e}$

Standard Equations

	Curve	Cartesian Form	Parametric Form
1.	Circle	$x^2 + y^2 = a^2$	$x = a \cos \theta, y = a \sin \theta$
2.	Parabola	$y^2 = 4ax$	$x = at^2, y = 2at$
3.	Ellipse	$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	$x = a \cos \theta, y = b \sin \theta$
4.	Hyperbola	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	$x = a \sec \theta, y = b \tan \theta$

Equations of tangents

	Curve	Cartesian Form	Parametric Form	Slope Form
1.	Circle	$xx_1 + yy_1 = a^2$	$x \cos \theta + y \sin \theta = a$	$y = mx + a \sqrt{1+m^2}$
2.	Parabola	$yy_1 = 2a(x + x_1)$	$yt = x + at^2$	$y = mx + \frac{a}{m}$
3.	Ellipse	$\frac{xx_1}{a^2} + \frac{yy_1}{b^2} = 1$	$\frac{x}{a} \cos \theta + \frac{y}{b} \sin \theta = 1$	$y = mx + \sqrt{a^2 m^2 + b^2}$

4.	Hyperbola	$\frac{xx_1}{a^2} - \frac{yy_1}{b^2} = 1$	$\frac{x}{a} \sec \theta - \frac{y}{b} \tan \theta = 1$	$y = mx + \sqrt{a^2 m^2 - b^2}$
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