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$$L_2 = \frac{R}{1 - \epsilon} \quad \text{or} \quad L_2 = \frac{R}{1 - \sqrt{|K|}} \quad (4.3)$$

## Polar Equations of Conics

The graph of a conic in polar form is given by the following equations:

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

where  $e$ =eccentricity and  $|p|$  is the distance between the focus (pole) and directrix

- If  $e < 1$  – conic is an ellipse
- If  $e = 1$  – conic is a parabola
- If  $e > 1$  – conic is a hyperbola

### Conics Summary

Conic Section	Standard Form	Other Info.
<b>Circle</b> Centre $(h, k)$ Radius $r$	$(x - h)^2 + (y - k)^2 = r^2$	Derived from the distance formula. $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = d$
<b>Parabola - Vertex <math>(h, k)</math></b> Focus $(h, k + p)$ Directrix at $y = k - p$	$(x - h)^2 = 4p(y - k)$	$p > 0$ opens up, $p < 0$ opens down
Foci $(h + p, k)$ Directrix at $x = h - p$	$(y - k)^2 = 4p(x - h)$	$p > 0$ opens right, $p < 0$ opens left
<b>• Ellipse - Centre <math>(h, k)</math></b>  • Horizontal major axis: $a > b$ Vertices: $(h \pm a, k)$ Foci: $(h \pm c, k)$  • Vertical major axis: $a > b$ Vertices: $(h, k \pm a)$ Foci: $(h, k \pm c)$	$\frac{(x - h)^2}{a^2} + \frac{(y - k)^2}{b^2} = 1$  $\frac{(y - k)^2}{a^2} + \frac{(x - h)^2}{b^2} = 1$	• The longer axis is called the major axis, the shorter axis is called the minor axis. • 'a' is the distance from the centre to each vertex (the end of the major axis). • 'b' is the distance from the centre to the end of the minor axis. • 'c' is the distance from the centre to each focus. $c^2 = a^2 - b^2$ • Length of major axis = $2a$ • Length of minor axis = $2b$
<b>• Hyperbola - Centre <math>(h, k)</math></b>  • Horizontal transverse axis (x coefficient is positive) Vertices: $(h \pm a, k)$ Foci: $(h \pm c, k)$  • Vertical transverse axis (y coefficient is positive) Vertices: $(h, k \pm a)$ Foci: $(h, k \pm c)$	$\frac{(x - h)^2}{a^2} - \frac{(y - k)^2}{b^2} = 1$  $\frac{(y - k)^2}{a^2} - \frac{(x - h)^2}{b^2} = 1$	• 'a' is the distance from the centre to each vertex. • 'b' is a point on the conjugate axis but is not a point on the hyperbola (it helps determine asymptotes) • 'c' is the distance from the centre to each focus. $c^2 = a^2 + b^2$ • Note: The transverse axis is <u>not</u> necessarily the longer axis but is associated with whichever variable is positive
$Ax^2 + Cy^2 + Dx + Ey + F = 0$	• If $A * C < 0$ • ELLIPSE	• If $A * C > 0$ • HYPERBOLA
	• If $A * C = 0$ • PARABOLA	• If $A = C$ • CIRCLE

### Hyperbolas

Equation	$\frac{(x - h)^2}{a^2} - \frac{(y - k)^2}{b^2} = 1$	$\frac{(y - k)^2}{a^2} - \frac{(x - h)^2}{b^2} = 1$
Center	$(h, k)$	$(h, k)$
Focal Length Equation	$a^2 + b^2 = c^2$	$a^2 + b^2 = c^2$
Foci	$(h \pm c, k)$	$(h, k \pm c)$
Vertices	$(h \pm a, k)$	$(h, k \pm a)$
Slopes of the Asymptotes	$\pm \frac{b}{a}$	$\pm \frac{a}{b}$
Direction of Opening	Left and Right	Up and Down
Eccentricity	$\frac{c}{a}$	$\frac{c}{a}$
Transverse Axis	$y = k$	$x = h$
Conjugate Axis	$x = h$	$y = k$

Forms of the hyperbola	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$
Coordinates of centre	$(0, 0)$	$(0, 0)$
Coordinates of vertices	$(\pm a, 0)$	$(0 \pm a)$
Coordinates of foci	$(\pm ae, 0)$	$(0, \pm ae)$
Length of transverse axis	$2a$	$2a$
Length of conjugate axis	$2b$	$2b$
Equation of directrices	$x = \pm a/e$	$y = \pm a/e$
Eccentricity	$e = \sqrt{\frac{a^2 + b^2}{a^2}}$	$e = \sqrt{\frac{a^2 + b^2}{a^2}}$
Length of latusrectum	$2b^2/a$	$2b^2/a$
Equation of transverse axis	$y = 0$	$x = 0$
Equation of conjugate axis	$x = 0$	$y = 0$



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