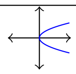
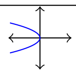
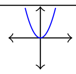
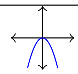
Conics

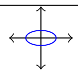
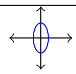
Parabola

A parabola is the locus of a point which moves so that its distance from a fixed point (Focus) is equal to its distance from a fixed straight line (Directrix). e = 1

Graph				
Type	**Right**	**Left**	**Upwards**	**Downwards**
Equation	$y^2 = 4ax$	$y^2 = -4ax$	$x^2 = 4ay$	$x^2 = -4ay$
Axis	$y = 0$	$y = 0$	$x = 0$	$x = 0$
Directrix	$x = -a$	$x = a$	$y = -a$	$y = a$
Vertex	$(0, 0)$			
Focus	$(a, 0)$	$(-a, 0)$	$(0, a)$	$(0, -a)$
Tangent at Vertex	$x = 0$		$y = 0$	
Length of Latus Rectum	$4a$			
Equation of LR	$x = a$	$x = -a$	$y = a$	$y = -a$

Ellipse

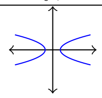
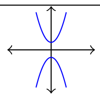
An ellipse is the locus of a point which moves so that its distance from a fixed point (Focus) bears a constant ratio (eccentricity 'e'), which is less than unity, to its distance from a fixed line (Directrix).

Graph		
Type	**Horizontal**	**Vertical**
Equation	$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	$\frac{y^2}{a^2} + \frac{x^2}{b^2} = 1$
Center	$(0, 0)$	
Foci	$(\pm ae, 0)$	$(0, \pm ae)$
Major Vertices	$(\pm a, 0)$	$(0, \pm a)$
Minor Vertices	$(0, \pm b)$	$(\pm b, 0)$
Length of Major Axis	$2a$	
Length of Minor Axis	$2b$	
Equations of Directrices	$x = \pm\frac{a}{e}$	$y = \pm\frac{a}{e}$
Length of Latus Rectum	$\frac{2b^2}{a}$	

$b^2 = a^2(1 - e^2)$

Hyperbola

A hyperbola is the locus of a point which moves so that its distance from a fixed point (Focus) bears the a constant ratio (eccentricity 'e'), which is greater than unity, to its distance from a fixed line (Directrix).

Graph		
Type	**Horizontal**	**Vertical**
Equation	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$
Center	$(0, 0)$	
Foci	$(\pm ae, 0)$	$(0, \pm ae)$
Vertices	$(\pm a, 0)$	$(0, \pm a)$
Length of Transverse Axis	$2a$	
Length of Conjugate Axis	$2b$	
Equations of Directrices	$x = \pm\frac{a}{e}$	$y = \pm\frac{a}{e}$
Equation of Transverse Axis	$y = 0$	$x = 0$
Equation of Conjugate Axis	$x = 0$	$y = 0$
Length of Latus Rectum	$\frac{2b^2}{a}$	
Focal Radii	$ex \pm a$	$ey \pm a$

$$b^2 = a^2(e^2 - 1)$$

Tangency

Line	Curve	Condition	Tangent	Point Of Contact
$y = mx + c$	$y^2 = 4ax$	$c = \frac{a}{m}$	$y = mx + \frac{a}{m}$	$\left(\frac{a}{m^2}, \frac{2a}{m}\right)$
$y = mx + c$	$y^2 = -4ax$	$c = \frac{-a}{m}$	$y = mx - \frac{a}{m}$	$\left(\frac{-a}{m^2}, \frac{-2a}{m}\right)$
$y = mx + c$	$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	$c^2 = a^2m^2 + b^2$	$y = mx \pm \sqrt{a^2m^2 + b^2}$	$\left(\frac{\pm a^2m}{\sqrt{a^2m^2 + b^2}}, \frac{\mp b^2}{\sqrt{a^2m^2 + b^2}}\right)$
$y = mx + c$	$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	$c^2 = a^2m^2 - b^2$	$y = mx \pm \sqrt{a^2m^2 - b^2}$	$\left(\frac{\pm a^2m}{\sqrt{a^2m^2 - b^2}}, \frac{\pm b^2}{\sqrt{a^2m^2 - b^2}}\right)$