Conic section

	Description	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	**Parametric representation**	$\begin{cases} x = at^2 \\ y = 2at \end{cases}$ where $-\infty<t<\infty$	$\begin{cases} x = a\cos\theta \\ y = b\sin\theta \end{cases}$ where $0 \le \theta < 2\pi$	$\begin{cases} x = a\sec\theta \\ y = b\tan\theta \end{cases}$ where $0 \le \theta < 2\pi$
3	**Eccentricity**	$e = 1$	$0 < e = \frac{\sqrt{a^2 - b^2}}{a} < 1$	$e = \frac{\sqrt{a^2 + b^2}}{a} > 1$
4	**Focus**	$(a , 0)$	$(\pm\sqrt{a^2 - b^2},0) = (\pm ae,0)$	$(\pm\sqrt{a^2 + b^2},0) = (\pm ae,0)$
5	**Vertices**	$(0, 0)$	$(\pm a, 0), (0, \pm b)$	$(\pm a, 0)$
6	**Directrix**	$x + a = 0$	$x \pm \frac{a}{e} = 0$	$x \pm \frac{a}{e} = 0$
7	**Length of latus rectum**	$4a$	$\frac{2b^2}{a}$	$\frac{2b^2}{a}$
8	**Diameter (m denotes the slope of the parallel chords)**	$y = \frac{2a}{m}$	$y = -\frac{b^2}{a^2 m}x$	$y = \frac{b^2}{a^2 m}x$
9	**Relation between slopes of two conjugate diameters**		$mm' = -\frac{b^2}{a^2}$	$mm' = \frac{b^2}{a^2}$
10	**Chord having mid-point (x_0, y_0)**	$2ax - y_0 y - 2ax_0 + y^2 = 0$	$\frac{x_0 x}{a^2} + \frac{y_0 y}{b^2} = \frac{x_0^2}{a^2} + \frac{y_0^2}{b^2}$	$\frac{x_0 x}{a^2} - \frac{y_0 y}{b^2} = \frac{x_0^2}{a^2} - \frac{y_0^2}{b^2}$
11	**Tangent at a point on the curve**	$y_1 y = 2a(x_1 + x)$	$\frac{x_1 x}{a^2} + \frac{y_1 y}{b^2} = 1$	$\frac{x_1 x}{a^2} - \frac{y_1 y}{b^2} = 1$
		$x - ty + at^2 = 0$	$\frac{x\cos\theta}{a} + \frac{y\sin\theta}{b} = 1$	$\frac{x\cos\theta}{a} - \frac{y\sin\theta}{b} = 1$
12	**Normal at a point on the curve**	$y - y_1 = -\frac{y_1}{2a}(x - x_1)$	$\frac{a^2 x}{x_1} - \frac{b^2 y}{y_1} = a^2 - b^2$	$\frac{a^2 x}{x_1} + \frac{b^2 y}{y_1} = a^2 + b^2$
		$tx + y = 2at + at^3$	$\frac{ax}{\cos\theta} - \frac{by}{\sin\theta} = a^2 - b^2$	$\frac{ax}{\sec\theta} + \frac{by}{\tan\theta} = a^2 + b^2$

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13	**Tangent with slope m**	$y = mx + \frac{a}{m}$	$y = mx \pm \sqrt{a^2m^2 + b^2}$	$y = mx \pm \sqrt{a^2m^2 - b^2}$
14	**Chord joining two points on the curve**	$4ax - (y_1 + y_2)y + y_1y_2 = 0$	$\frac{x}{a^2}(x_1 + x_2) + \frac{y}{b^2}(y_1 + y_2) = \frac{x_1x_2}{a^2} + \frac{y_1y_2}{b^2} + 1$	$\frac{x}{a^2}(x_1 + x_2) - \frac{y}{b^2}(y_1 + y_2) = \frac{x_1x_2}{a^2} - \frac{y_1y_2}{b^2} + 1$
		$2x - (t_1 + t_2)y + 2at_1t_2 = 0$	$\frac{x}{a}\cos\frac{\theta + \phi}{2} + \frac{y}{b}\sin\frac{\theta + \phi}{2} = \cos\frac{\theta - \phi}{2}$	$\frac{x}{a}\cos\frac{\theta - \phi}{2} + \frac{y}{b}\sin\frac{\theta + \phi}{2} = \cos\frac{\theta + \phi}{2}$
15	**Condition for $lx + my + n = 0$ to be a tangent**	$am^2 = ln$	$a^2l^2 + b^2m^2 = n^2$	$a^2l^2 - b^2m^2 = n^2$
16	**Pair of tangents from a point $P(x_1,y_1)$**	$(y_1^2 - 4ax_1)(y^2 - 4ax) = [y_1y - 2a(x_1 + x)]^2$	$\left(\frac{x_1^2}{a^2} + \frac{y_1^2}{b^2} - 1\right)\left(\frac{x^2}{a^2} + \frac{y^2}{b^2} - 1\right) = \left(\frac{x_1x}{a^2} + \frac{y_1y}{b^2} - 1\right)^2$	$\left(\frac{x_1^2}{a^2} - \frac{y_1^2}{b^2} - 1\right)\left(\frac{x^2}{a^2} - \frac{y^2}{b^2} - 1\right) = \left(\frac{x_1x}{a^2} - \frac{y_1y}{b^2} - 1\right)^2$
17	**Chord of contact of tangents from $P(x_1,y_1)$**	$y_1y = 2a(x_1 + x)$	$\frac{x_1x}{a^2} + \frac{y_1y}{b^2} = 1$	$\frac{x_1x}{a^2} - \frac{y_1y}{b^2} = 1$
18	**Asymptote**			$bx \pm ay = 0$
19	**Condition for concyclic points**	$t_1 + t_2 + t_3 + t_4 = 0$	$\theta_1 + \theta_2 + \theta_3 + \theta_4 = 2n\pi$ where n is an integer.	
20	**Condition for conormal points**	$t_1 + t_2 + t_3 = 0$	$\theta_1 + \theta_2 + \theta_3 + \theta_4 = (2n + 1)\pi$ where n is an integer.	$\theta_1 + \theta_2 + \theta_3 + \theta_4 = (2n + 1)\pi$ where n is an integer.