Improper Integrals

$$\int_a^{+\infty} f(x)dx = \lim_{l\to+\infty}\int_a^l f(x)dx$$

$$\int_{-\infty}^{b} f(x)dx = \lim_{l\to-\infty}\int_l^b f(x)dx$$

Indeterminate Forms

$\frac{0}{0}$ $\quad\frac{\infty}{\infty}$ $\quad 0\cdot\infty$

0^0 $\quad\infty^0$ $\quad 1^\infty$

$\infty-\infty$

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Taylor polynomial for f about $x=a$ (for n^{th} Maclaurin polynomial for f, let $a=0$)

$$p_n(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \frac{f'''(a)}{3!}(x-a)^3 + \ldots + \frac{f^{(n)}(a)}{n!}(x-a)^n$$

Taylor series for f about $x=a$ (for Maclaurin series for f, let $a=0$)

$$\sum_{k=0}^{\infty}\frac{f^{(k)}(a)}{k!}(x-a)^k = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \ldots + \frac{f^{(k)}(a)}{k!}(x-a)^k + \ldots$$

Taylor's formula with remainder

$$f(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \ldots + \frac{f^{(n)}(a)}{n!}(x-a)^n + \frac{f^{(n+1)}(c)}{(n+1)!}(x-a)^{n+1}$$

Common Maclaurin series

$$e^x = \sum_{k=0}^{\infty}\frac{x^k}{k!}, \quad -\infty < x < \infty$$

$$(1+x)^m = \sum_{k=0}^{\infty}\frac{m(m-1)\ldots(m-k+1)}{k!}x^k, \quad -1 < x < 1$$

$$\sin x = \sum_{k=0}^{\infty}\frac{(-1)^k x^{2k+1}}{(2k+1)!}, \quad -\infty < x < \infty$$

$$\cos x = \sum_{k=0}^{\infty}\frac{(-1)^k x^{2k}}{(2k)!}, \quad -\infty < x < \infty$$

Rectangular to Polar

$r^2 = x^2 + y^2$

$\tan\theta = \frac{y}{x}$

Polar to Rectangular

$x = r\cos\theta$

$y = r\sin\theta$

Vertical line through $(a,0)$

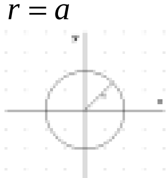
$r\cos\theta = a$

Horizontal line through $(0,b)$

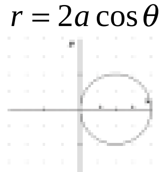
$r\sin\theta = b$

Circles in polar coordinates

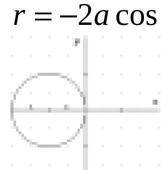
$r=a$



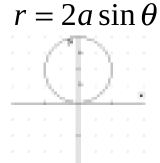
$r = 2a\cos\theta$



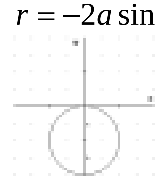
$r = -2a\cos\theta$



$r = 2a\sin\theta$



$r = -2a\sin\theta$



Limacons

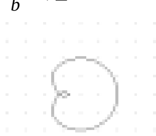
$r = a + b\sin\theta$

$r = a - b\sin\theta$

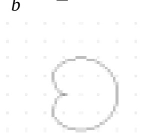
$r = a + b\cos\theta$

$r = a - b\cos\theta$

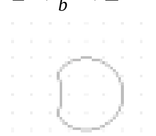
$\frac{a}{b} < 1$



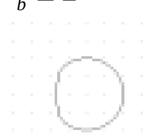
$\frac{a}{b} = 1$



$1 < \frac{a}{b} < 2$



$\frac{a}{b} \geq 2$



Lemniscates $(a>0)$

$r^2 = a^2\cos 2\theta$ $\quad r^2 = -a^2\cos 2\theta$ $\quad r^2 = a^2\sin 2\theta$ $\quad r^2 = -a^2\sin 2\theta$

Roses (n petals if n is odd, 2n petals if n is even)

$r = a\sin n\theta$ $\quad r = a\cos n\theta$

Spiral of Archimedes

$r = a\theta, \quad (\theta \text{ in radians})$

Area in polar coordinates

$$A = \int_\alpha^\beta \tfrac{1}{2}[f(\theta)]^2 d\theta$$

Slope of Tangents to Polar Curves

$$\frac{dy}{dx} = \frac{r\cos\theta + \sin\theta\frac{dr}{d\theta}}{-r\sin\theta + \cos\theta\frac{dr}{d\theta}}$$

Arc-Length for Parametric Curves

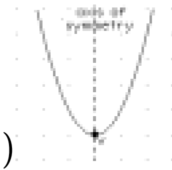
$$L = \int_a^b \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\,dt$$

Arc-Length for Polar Curves

$$L = \int_\alpha^\beta \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2}\,d\theta$$

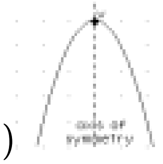
$(x-h)^2 = 4p(y-k)$

vertex (h,k)

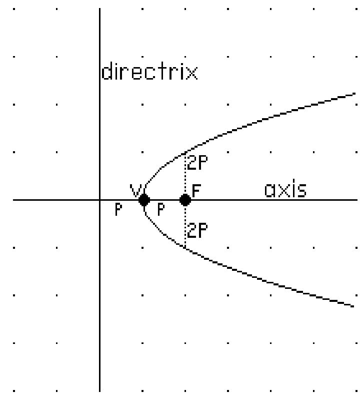


$(x-h)^2 = -4p(y-k)$

vertex (h,k)

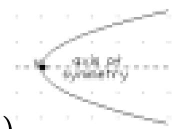


General Sketch



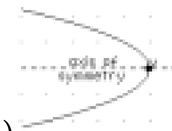
$(y-k)^2 = 4p(x-h)$

vertex (h,k)

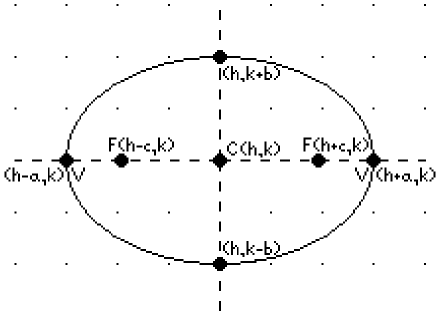


$(y-k)^2 = -4p(x-h)$

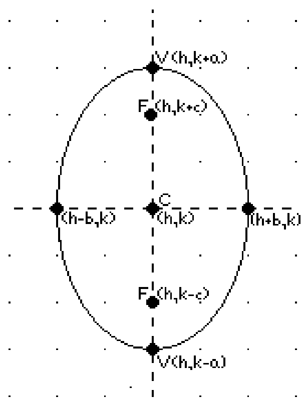
vertex (h,k)



$\frac{(x-h)^2}{a^2} + \frac{(y-k)^2}{b^2} = 1 \qquad a \ge b$

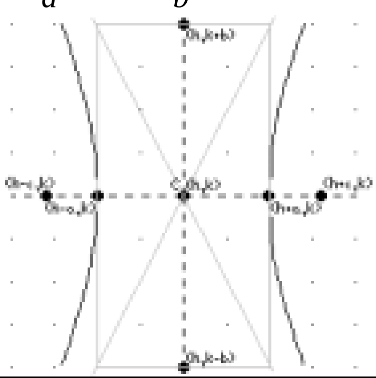


$\frac{(x-h)^2}{b^2} + \frac{(y-k)^2}{a^2} = 1 \qquad a \ge b$

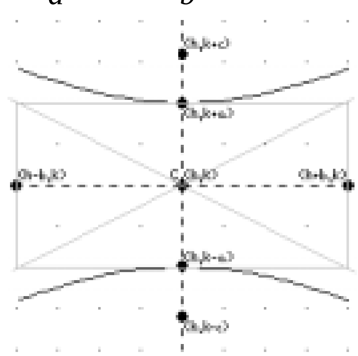


$a = \sqrt{b^2 + c^2}$	$b = \sqrt{a^2 - c^2}$	$c = \sqrt{a^2 - b^2}$	Eccentricity $\sqrt{(x-c)^2 + y^2} = e\left(\frac{a}{e} - x\right)$

$\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$, asymptotes $y = \pm \frac{b}{a} x$



$\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$, asymptotes $y = \pm \frac{a}{b} x$



$a = \sqrt{c^2 - b^2}$	$b = \sqrt{c^2 - a^2}$	$c = \sqrt{a^2 + b^2}$	Eccentricity $\sqrt{(x-c)^2 + y^2} = e\left(x - \frac{a}{e}\right)$

Rotation of Axes $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$	$x = x'\cos\theta - y'\sin\theta$ $y = x'\sin\theta + y'\cos\theta$	$\cot 2\theta = \frac{A-C}{B}$

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