$$\int uv\,dx = u\int v\,dx - \int\left[\frac{d}{dx}(u)\int v\,dx\right]dx$$ LIATE

$$\int \sin^n x\,dx = -\frac{1}{n}\sin^{n-1}x\cos x + \frac{n-1}{n}\int \sin^{n-2}x\,dx$$

$$\int \cos^n x\,dx = \frac{1}{n}\cos^{n-1}x\sin x + \frac{n-1}{n}\int \cos^{n-2}x\,dx$$

$$\int \tan^n x\,dx = \frac{\tan^{n-1}x}{n-1} - \int \tan^{n-2}x\,dx$$

$$\int \sec^n x\,dx = \frac{\sec^{n-2}x\tan x}{n-1} + \frac{n-2}{n-1}\int \sec^{n-2}x\,dx$$

$$\int \cot^n x\,dx = -\frac{\cot^{n-1}x}{n-1} - \int \cot^{n-2}x\,dx$$

$$\int \csc^n x\,dx = -\frac{\csc^{n-2}x\cot x}{n-1} + \frac{n-2}{n-1}\int \csc^{n-2}x\,dx$$

$$\int \tan x\,dx = \ln|\sec x|$$

$$\int \cot x\,dx = \ln|\sin x|$$

$$\int \sec x\,dx = \ln|\sec x + \tan x|$$

$$A = \int_a^b [f(x) - g(x)]\,dx$$

$$V = \pi\int_a^b [f(x)^2 - g(x)^2]\,dx$$

$$L = \int_a^b \sqrt{1 + f'(x)^2}\,dx$$

$\cancel{\frac{d}{dx}(\tan^{-1}x}$

$$\int \frac{1}{a^2+x^2}\,dx = \frac{1}{a}\tan^{-1}\frac{x}{a}$$

$$\int \frac{dx}{x\sqrt{x^2-a^2}} = \frac{1}{a}\sec^{-1}\frac{x}{a}$$

$$\int \frac{dx}{\sqrt{a^2-x^2}} = \sin^{-1}\frac{x}{a}$$

$$\int \sin^n x \, dx = \frac{-\sin^{n-1} x \cos x}{n} + \frac{n-1}{n} \int \sin^{n-2} x \, dx$$

$$\int \cos^n x \, dx = \frac{\cos^{n-1} x \sin x}{n} + \frac{n-1}{n} \int \cos^{n-2} x \, dx$$

$$\int \tan^n x \, dx = \frac{\tan^{n-1} x}{n-1} - \int \tan^{n-2} x \, dx$$

$$\int \sec^n x \, dx = \frac{\sec^{n-2} x \tan x}{n-1} + \frac{n-2}{n-1} \int \sec^{n-2} x \, dx$$

Cos: $e^x = \frac{e^x + e^{-x}}{2} + \frac{e^x - e^{-x}}{2} = \cosh x + \sinh x$ $\qquad \cosh^2 x - \sinh^2 x = 1$

$\frac{d}{dx}(\sin x) = \cos x$

$\frac{d}{dx}(\cos x) = -\sin x$

$\frac{d}{dx}(\tan x) = \sec^2 x$

$\frac{d}{dx}(\cot x) = -\operatorname{cosec}^2 x$

$\frac{d}{dx}(\sec x) = \sec x \tan x$

$\frac{d}{dx}(\operatorname{cosec} x) = -\operatorname{cosec} x \cot x$

$\frac{d}{dx}(\sinh x) = \cosh x$

$\frac{d}{dx}(\cosh x) = \sinh x$

$\frac{d}{dx}(\tanh x) = \operatorname{sech}^2 x$

$\frac{d}{dx}(\coth x) = -\operatorname{cosech}^2 x$

$\frac{d}{dx}(\operatorname{sech} x) = -\operatorname{sech} x \tanh x$

$\frac{d}{dx}(\operatorname{cosech} x) = -\operatorname{cosech} x \coth x$

$$A = \int_a^b [f(x) - g(x)]\,dx$$

$$V = \pi \int_a^b [f(x)^2 - g(x)^2]\,dx$$

$$L = \int_a^b \sqrt{1 + [f'(x)]^2}\,dx$$

$$\frac{d}{dx}\left(\sin^{-1} ax\right) = \frac{1}{\sqrt{a^2 - x^2}}$$

$$\frac{d}{dx}\left(\cos^{-1} ax\right) = \frac{-1}{\sqrt{a^2 - x^2}}$$

$$\frac{d}{dx}\left(\tan^{-1} ax\right) = \frac{1}{a^2 + x^2}$$

$$\frac{d}{dx}\left(\cot^{-1} ax\right) = \frac{-1}{a^2 + x^2}$$

$$\frac{d}{dx}\left(\sec^{-1} ax\right) = \frac{1}{x\sqrt{x^2 - a^2}}$$

$$\frac{d}{dx}\left(\csc^{-1} ax\right) = \frac{-1}{x\sqrt{x^2 - a^2}}$$

$$\frac{d}{dx}\left(\sinh^{-1} ax\right) = \frac{1}{\sqrt{a^2 + x^2}}$$

$$\frac{d}{dx}\left(\cosh^{-1} ax\right) = \frac{1}{\sqrt{x^2 - a^2}}$$

$$\frac{d}{dx}\left(\tanh^{-1} ax\right) = \frac{1}{a^2 - x^2}, \; x < 1$$

$$\frac{d}{dx}\left(\coth^{-1} ax\right) = \frac{1}{a^2 - x^2}, \; x > 1$$

$$\frac{d}{dx}\left(\text{sech}^{-1} ax\right) = \frac{-1}{x\sqrt{a^2 - x^2}}$$

$$\frac{d}{dx}\left(\text{csch}^{-1} ax\right) = \frac{-1}{x\sqrt{a^2 + x^2}}$$

$$A = \int_a^b [f(x) - g(x)]\,dx = \int_c^d [f(y) - g(y)]\,dy$$

Arc length, $L = \int_a^b \sqrt{1 + [f'(x)]^2}\,dx = \int_c^d \sqrt{1 + [g'(y)]^2}\,dy$

Area of a surface of a revolution,

$$S = 2\pi r l$$

$$S = \int_a^b 2\pi f(x) \sqrt{1 + [f'(x)]^2}\,dx \quad , \text{ revolved about } x \text{ axis}$$

$$S = \int_c^d 2\pi g(y) \sqrt{1 + [g'(y)]^2}\,dy \quad , \text{ revolved about } Y \text{ axis}$$

Volume, $V = \pi \int_a^b [f(x)^2 - g(x)^2]\,dx = \pi \int_c^d [f(y)^2 - g(y)^2]\,dy$

(revolved about X axis) (revolved about Y axis

Cylindrical shell,

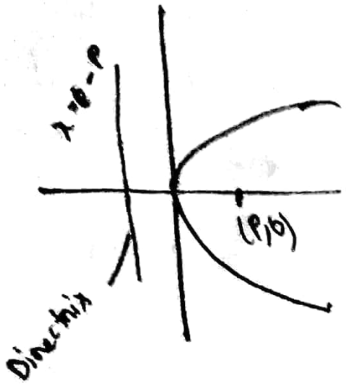
$$V = \int_a^b 2\pi x f(x)\,dx, \text{ revolved about } Y \text{ axis}$$

$$V = \int_c^d 2\pi y g(y)\,dy, \text{ revolved about } X \text{ axis}$$

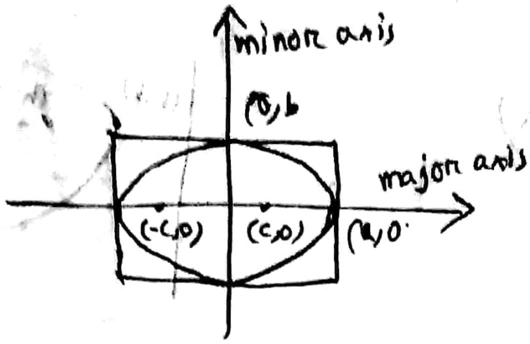
dx - 1L

Parabola

$y^2 = 4px$



Ellipse



Focus $(c,0)$

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

$a^2 = b^2 + c^2$

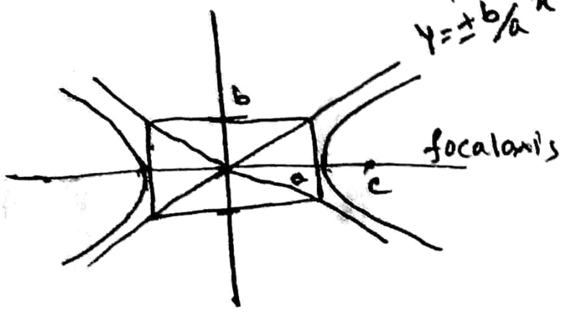
a = major axis

Hyperbola

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

$y = \pm b/a \, x \rightarrow \frac{x^2}{a^2} - \frac{y^2}{b^2} = 0$

$$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$$



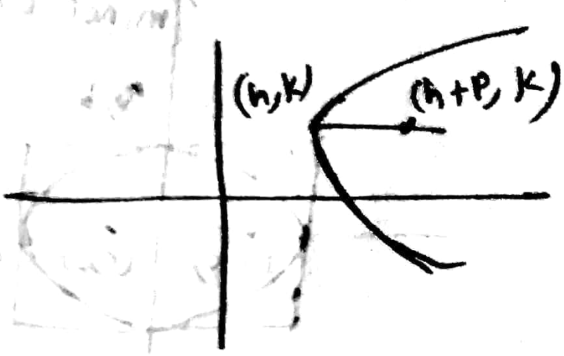
$c^2 = a^2 + b^2$

if x is positive, then x has a focal axis

if y " " , then y " " " "

Parabola with vertex (h,k)

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



Ellipse with vertex (h,k)

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

Hyperbola with vertex (h,k)

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

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

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Conic sections in polar Co-ordinates

eccentricity, $e = \dfrac{\text{distance to the focus}}{\text{distance to the directrix}}$

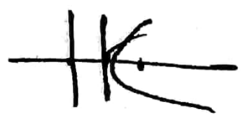
for parabola, $e = 1$, directrix, $x = -P$

for ellipse, $0 < e < 1$ directrix, $x = \dfrac{a^2}{c}$

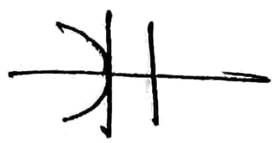
for hyperbola, $e > 1$, directrix, $x = \dfrac{a^2}{c}$

$$r = \frac{ed}{1 + e\cos\theta}$$, d = distance to the directrix

directrix is right for $+e\cos\theta$



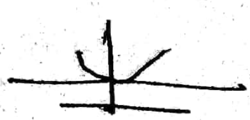
directrix is left for $-e\cos\theta$



$$r = \frac{ed}{1 + e\sin\theta}$$

directrix is above for $+e\sin\theta$

directrix is below for $-e\sin\theta$



For ellipse, $r(\theta) = \frac{ed}{1+e\cos\theta}$ $\theta = 0$, $r_0 = \frac{ed}{1+e\cos 0} = \frac{ed}{1+e}$

$\theta = \pi$, $r_1 = \frac{ed}{1+e\cos\pi} = \frac{ed}{1-e}$

$a = \frac{1}{2}(r_1 + r_0)$ $b = \sqrt{r_1 r_0}$

$c = \frac{1}{2}(r_1 - r_0)$

1. Chapter 10

Slope, $\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}$

For horizontal line, $\frac{dy}{dx} = 0$ i.e $\frac{dy}{dt} = 0$ and $\frac{dx}{dt} \neq 0$

For vertical line, $\frac{dy}{dx} = \infty$, i.e $\frac{dx}{dt} = 0$ and $\frac{dy}{dt} \neq 0$

$$\frac{d^2y}{dx^2} = \frac{d}{dx}(y')$$

$$= \frac{\frac{dy'}{dt}}{\frac{dx}{dt}} \qquad \left[y' = \frac{dy}{dx} \right]$$

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

$(r, \theta+\pi)$ and $(-r, \theta)$ are the polar co-ordinates of the same point

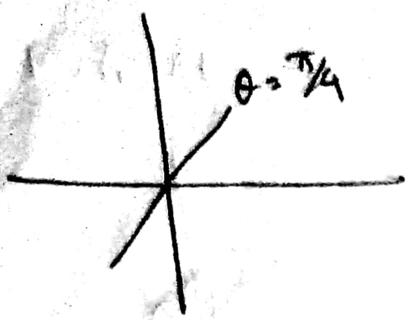
$(r, \theta + 2n\pi) = (r, \theta - 2n\pi)$

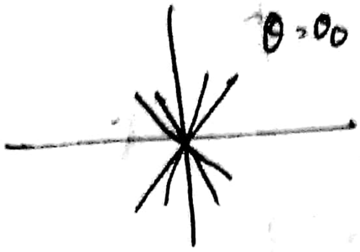
If θ is replace with $\pi-\theta$, the func^n is symmetric with Y axis

If θ " " " $\theta+\pi$

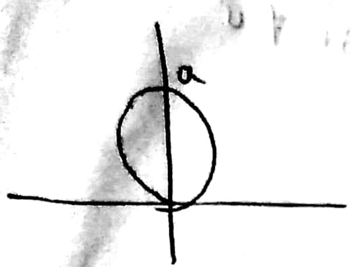
or r is " " $-r$, " " " " " & origin

If θ " " " $-\theta$, " " " " " X axis

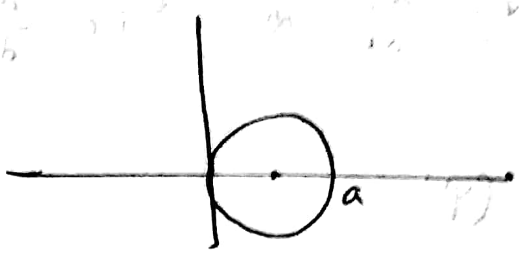




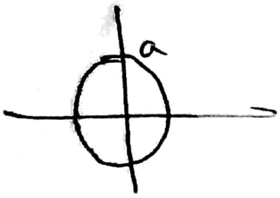
$r = a\sin\theta$



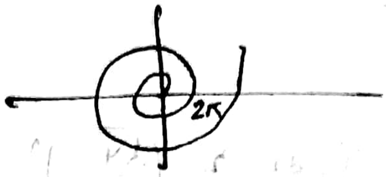
$r = a\cos\theta$



$r = a$

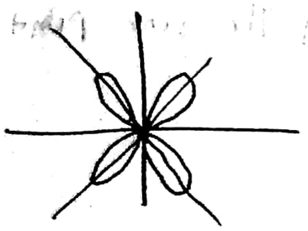


$r = \theta$



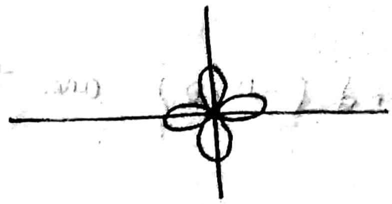
$r = a\sin n\theta$

$r = a\cos n\theta$

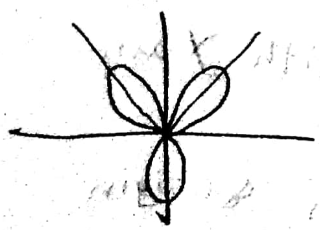


$r = a\sin 2\theta$

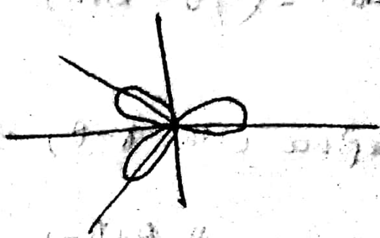
$2 \times 2 = 4$



$r = a\cos 2\theta$

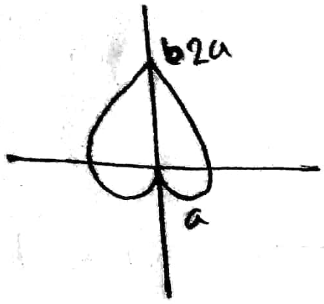


$r = a\sin 3\theta$



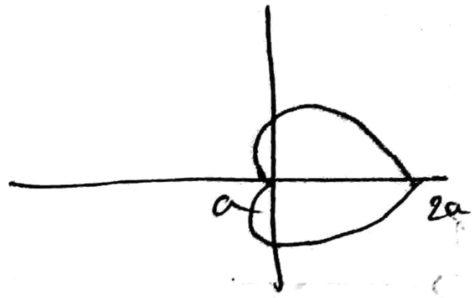
$r = a\cos 3\theta$

$r = a + b\sin\theta$

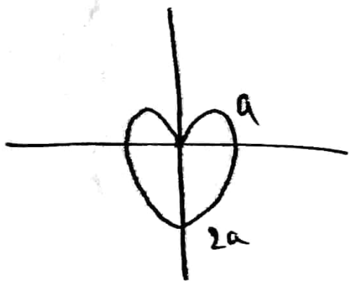


$a = 1$

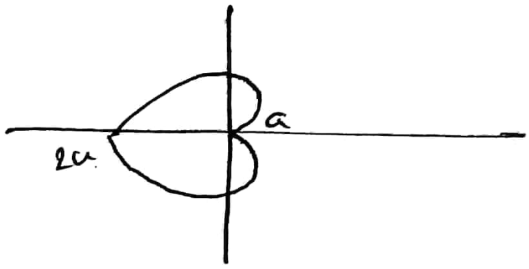
$r = a + a\cos\theta$



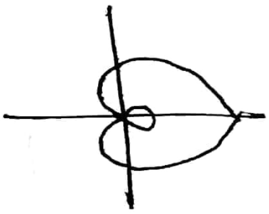
$r = a - b\sin\theta$



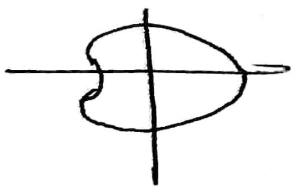
$r = a - a\cos\theta$



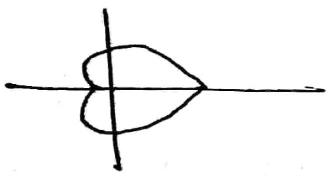
$\frac{a}{b} < 1$



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



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



Area, $A = \int_{\alpha}^{\beta} \frac{1}{2} r^2 \, d\theta$

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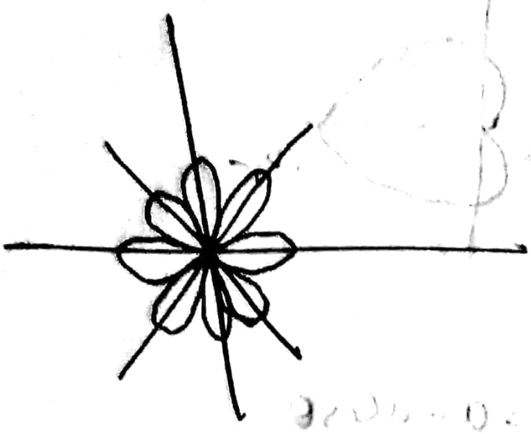
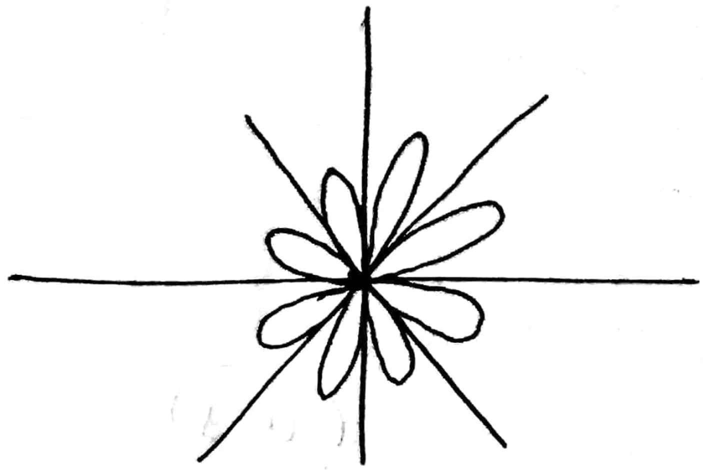
$R = \cos 4\theta$



$R = \sin 4\theta$



$= u'$

$$\frac{*}{(x-1)(x+2)} = \frac{A}{x-1} + \frac{B}{x+2}$$

$$\frac{*}{(x-1)^2(x+2)} = \frac{A}{x+2} + \frac{B}{x-1} + \frac{C}{(x-1)^2}$$

$$\frac{*}{(x^2+1)(x^2+4)} = \frac{Ax+B}{x^2+1} + \frac{Cx+D}{x^2+4}$$

$$\frac{*}{(x+3)(x^2+4)^2} = \frac{A}{x+3} + \frac{Bx+C}{x^2+4} + \frac{Dx+E}{(x^2+4)^2}$$