$\sin x \to \cos x$
$\cos x \to -\sin x$
$\tan x \to \sec^2 x$

$\operatorname{cosec} x \to -\operatorname{cosec} x \cdot \cot x$
$\sec x \to \sec x \cdot \tan x$
$\cot x \to -\operatorname{cosec}^2 x$

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DERIVATIVES

Formulae ('$\cancel{x}$') = degree Radians.

(I) $\displaystyle \lim_{x \to a} \frac{x^n - a^n}{x-a} = n \cdot a^{n-1}$

(II) $\displaystyle \lim_{\cancel{x} \to 0} \frac{\sin(\cancel{x})}{\cancel{x}} = 1$

(III) $\displaystyle \lim_{\cancel{x} \to 0} \frac{\tan(\cancel{x})}{\cancel{x}} = 1$

(IV) $\displaystyle \lim_{\cancel{x} \to 0} \cos(\cancel{x}) = 1$

(V) $\displaystyle \lim_{\cancel{x} \to 0} \frac{a^{\cancel{x}} - 1}{\cancel{x}} = \log a$

(VI) $\displaystyle \lim_{\cancel{x} \to 0} \frac{e^{\cancel{x}} - 1}{\cancel{x}} = \log e = 1$

(VII) $\displaystyle \lim_{\cancel{x} \to 0} \frac{\log(1+\cancel{x})}{\cancel{x}} = 1$

(VIII) $h = (x+h) - x$
$\Rightarrow h = (\sqrt{x+h})^2 - (\sqrt{x})^2$
$\Rightarrow h = (\sqrt{x+h} + \sqrt{x}) \times (\sqrt{x+h} - \sqrt{x})$

TRIGO-Ref.

(I) $\sin C - \sin D$
$= 2\cos\left(\frac{C+D}{2}\right) \cdot \sin\left(\frac{C-D}{2}\right)$

(II) $\cos C - \cos D$
$= 2\sin\left(\frac{C+D}{2}\right) \cdot \sin\left(\frac{D-C}{2}\right)$

(III) $\tan A - \tan B$
$= \frac{\sin A}{\cos A} - \frac{\sin B}{\cos B}$
$= \frac{\sin A \cdot \cos B - \cos A \cdot \sin B}{\cos A \cdot \cos B}$
$= \frac{\sin(A-B)}{\cos A \cdot \cos B}$

(IV) $\cot A - \cot B$
$= \frac{\sin(B-A)}{\sin A \cdot \sin B}$.

→ Derivative at $\boxed{x=a}$ if $R \cdot f'(a) = L \cdot f'(a)$

$\displaystyle R \cdot f'(a) = \lim_{h \to 0} \frac{f(a+h) - f(a)}{h}$

$\displaystyle L \cdot f'(a) = \lim_{h \to 0} \frac{f(a-h) - f(a)}{-h}$

First Principle
= If $R \cdot f'(a) = L \cdot f'(a)$
⇒ Derivatives ✓
else; Derivative ✗ $\left\{ \begin{matrix} \text{at} \\ x=a \end{matrix} \right\}$

$\displaystyle \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \frac{d(y)}{dx}$ ← Derivative of y w.r.t x or Differenciation

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Trignometric Values

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

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

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

Algebraic Values

$$\frac{d(x^n)}{dx} = n \cdot x^{n-1} \qquad \frac{d(\sqrt{x})}{dx} = \frac{1}{2\sqrt{x}} \qquad \frac{d(1/x)}{dx} = -\frac{1}{x^2}$$

$$\frac{d(a^x)}{dx} = a^x \cdot \log a \qquad \frac{d(\log x)}{dx} = \frac{1}{x} \; ; \; x>0$$

$$\frac{d(e^x)}{dx} = e^x \cdot \log e = e^x$$

$$(uv)' = u'v + v'u \qquad \left(\frac{u}{v}\right)' = \frac{u'v - v'u}{v^2}$$

$$(uvw)' = u'vw + uv'w + uvw'$$

~~dfx~~

→ Chain Rule.

$$\log a - \log b = \log\left(\frac{a}{b}\right)$$

$$\lim_{x \to 0} \frac{\log(1+x)}{x} = 1$$

$$\frac{d(kf(x))}{dx} = k\frac{d(f(x))}{dx} \quad ; \quad k \in R - \{0\}$$

Ch-7: Permutation & Combination.

(i) $^nC_r = C(n,r) = \binom{n}{r} = \frac{n!}{(n-r)!\,r!}$

(ii) $^nP_r = P(n,r) = \frac{n!}{(n-r)!}$

(iii) $^nC_r \times r! = {^nP_r}$

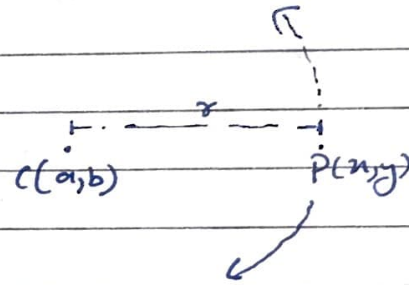
CONIC SECTIONS

CIRCLE:- $(x-a)^2 + (y-b)^2 = r^2$;

for center$(0,0)$; $x^2 + y^2 = r^2$.

*** Completing the Square method.

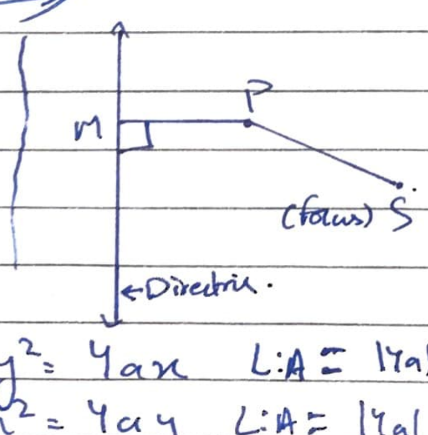
$r > 0$; Radius cannot be negative.



Parametric Form:- $x = a + r\cos\theta$ center: (a,b)

$y = b + r\sin\theta$ Radii: r units.

PARABOLA



$\frac{PS}{PM} = e$ = eccentricity

$e = 1$; $PS = PM$; Parabola.

$0 < e < 1$; Elipse

$e > 1$; Hyperbola.

$e = \sqrt{2}$; Equilateral/Rectangular Hyperbola.

$D^x: y+a=0$ $y^2 = 4ax$ L:A = $|4a|$

$D^y: x+a=0$ $x^2 = 4ay$ L:A = $|4a|$

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ELIPSE:- $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$; $a, b > 0$

$2(b^2/a)$ $a > b$; Major Axis: x-axis ; Directrices: $x \pm a/e = 0$
$2(a^2/b)$ $b > a$; Major Axis: y-axis ; Directrices: $y \pm a/e = 0$

Focus: $(ae, 0)$ $(0, be)$
or $(\pm c, 0)$ $(0, \pm c)$

HYPERBOLA:- $e > 1$

$b^2 = a^2(e^2 - 1)$
$\Rightarrow b^2 = a^2e^2 - a^2$
$\Rightarrow a^2 + b^2 = c^2$

	Transverse Axis.	Focii	LR
$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$	x-axis Vertices:- $(\pm a, 0)$	$(\pm ae, 0)$ $(\pm c, 0)$	$\frac{2b^2}{a}$
$\frac{y^2}{b^2} - \frac{x^2}{a^2} = 1$	y-axis Vertices:- $(0, \pm b)$	$(0, \pm be)$ $(0, \pm c)$	$\frac{2a^2}{b}$

$\frac{|C_1 - C_2|}{\sqrt{A^2 + B^2}}$