Rule of Power:-

1. Power of Non-Zero number is zero then it equal to one. $2^0 = 1$ $e^0 = 1$ $\boxed{\pi^0 = 1}$

2. In Product, if Base is same the Power will add, in division ^{power} Subtract

3. Negative Property $x^n = 1/x^{-n}$

(4.) Fractional Property $(x)^{2/3} = (x^2)^{1/3}$

$e^x = x$ $e^0 = 1$ $\overline{e}^x = 0$ $2^x = x$

$\dfrac{1}{0} = x$; $\dfrac{1}{x} = 0$

$$x^n x^m = x^{n+m}$$
$$\dfrac{x^n}{x^m} = x^{n-m}$$

$\dfrac{1}{x^n} = x^{-n}$

$(x^m)^n = x^{m\times n}$

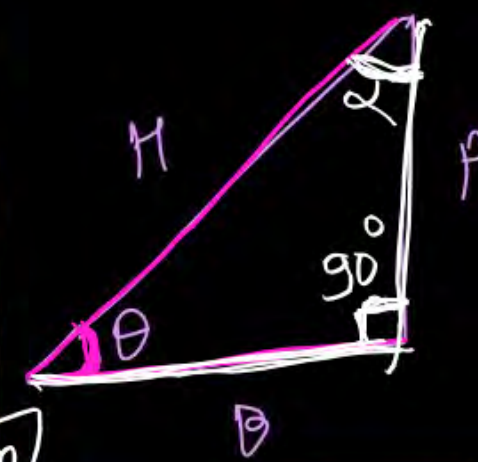$\sin\theta = \dfrac{P}{H} = \dfrac{1}{\csc\theta}$ $\boxed{H = \sqrt{P^2 + B^2}}$

$\cos\theta = \dfrac{B}{H} = \dfrac{1}{\sec\theta}$ $\boxed{\sin^2\theta + \cos^2\theta = 1}$

$\tan\theta = P/B = \cot\theta$ $\sin^2\theta = 1-\cos^2\theta$

$-1 \le \sin\theta \le 1$ $-1 \le \cos\theta \le +1$ $-\infty \le \tan\theta \le +\infty$

	0°	30°	45°	60°	90°	120°	135°	150°	180°
$\sin\theta$	0	1/2	$1/\sqrt{2}$	$\sqrt{3}/2$	1	$\sqrt{3}/2$	$1/\sqrt{2}$	1/2	0
$\cos\theta$	1	$\sqrt{3}/2$	$1/\sqrt{2}$	1/2	0	$-1/2$	$-1/\sqrt{2}$	$-\sqrt{3}/2$	-1
$\tan\theta$	0	$1/\sqrt{3}$	1	$\sqrt{3}$	∞	$-\sqrt{3}$	-1	$\dfrac{1}{\sqrt{3}}$	0

$180° = \pi\, rad$

Trigonometry:-

$+\theta$ (Anticlock)

$-\theta$ (Clockwise)
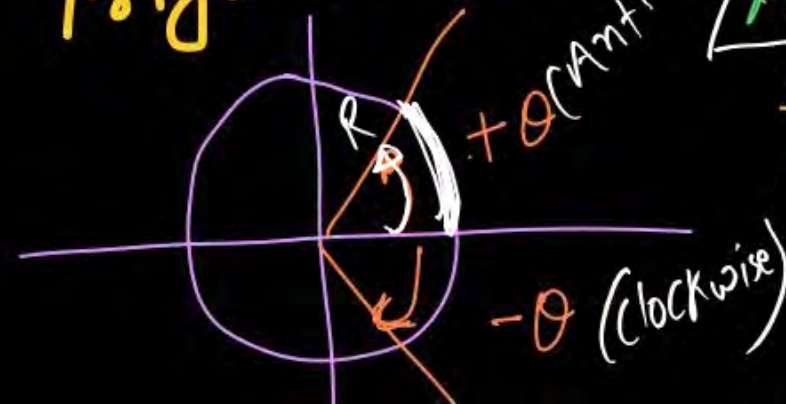
$\boxed{Arc = R\theta}$

SI unit $(\theta) \to$ radian

other unit $\to$ degree
Menutes, Sec.

Dimensionless

$\sin 37° = 3/5$

$\cos 37 = 4/5$

$\tan 37 = 3/4$

$\tan 53° = 4/3$

$\sin 53° = 4/5$

$\sin(270) = -1$
$\sin(90) = +1$
$\cos(0) = +1$
$\cos(0) = -1$
$\cos(180) = -1$

$\dfrac{3\pi}{4}\, rad = \dfrac{3}{4}\left(\overset{45}{180°}\right) = 135°$

$150° = 150\left(\dfrac{\pi\, rad}{180}\right)$

$1° = 60\, mint$

$\sin(A \pm B) = \sin A \cdot \cos B \pm \cos A \cdot \sin B$

$\cos(A \pm B) = \cos A \cdot \cos B \mp \sin A \cdot \sin B$

$\tan(A \pm B) = \dfrac{\tan A \pm \tan B}{1 \mp \tan A \cdot \tan B}$

$\sin(2\theta) = 2\sin\theta \cdot \cos\theta$

$\sin\theta = 2\sin\theta/2 \cdot \cos\theta/2$

$\boxed{\cos(2\theta) = \cos^2\theta - \sin^2\theta}$

$\cos(2\theta) = 1 - 2\sin^2\theta$

$\boxed{\cos(2\theta) = 2\cos^2\theta - 1}$

Small angle approximation
$\theta \to$ small

$\sin\theta = \theta = \tan\theta$ ——

$\cos\theta = 1$

$\boxed{\dfrac{\sin\theta}{\theta} = 1}$
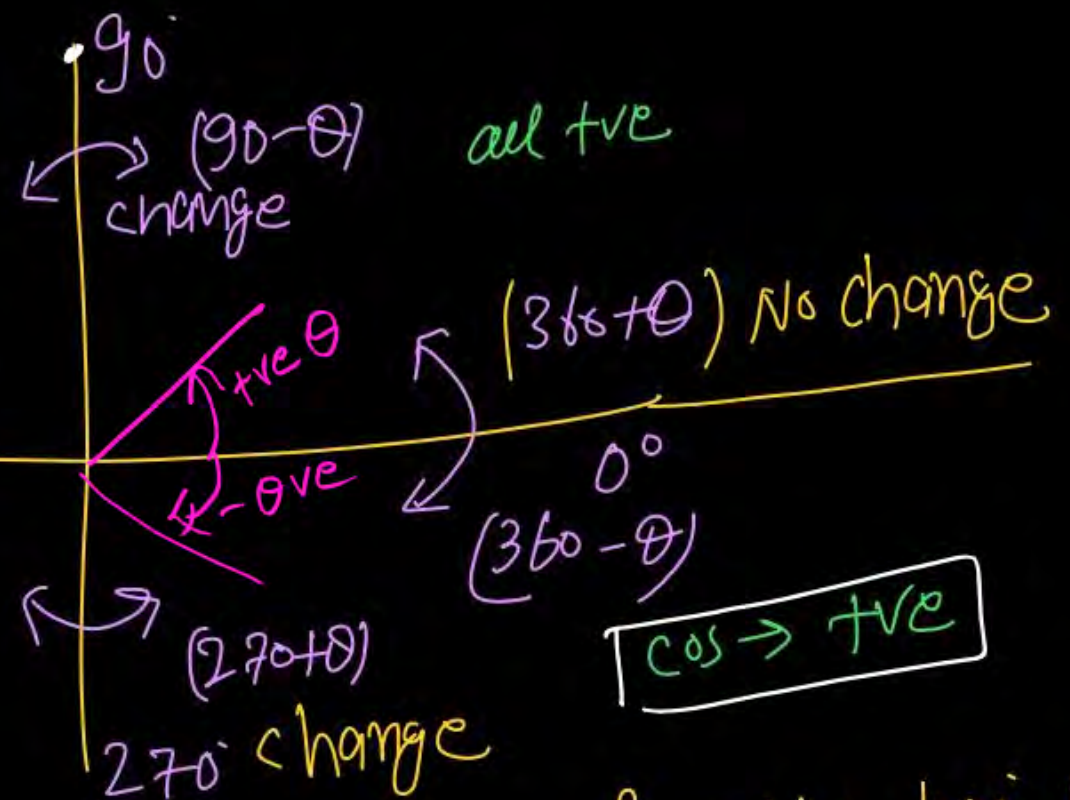
$\boxed{\dfrac{\tan\theta}{\theta} = 1}$

ASTC Rule

$\sin \to +ve$ $(90+\theta)$

$(90-\theta)$ change

all +ve

$(180-\theta)$ functn (No change)

$180°$

$(180+\theta)$

$tan\theta \to +ve$

$+ve\ \theta$

$-ve$

$(360+\theta)$ No change

$0°$

$(360-\theta)$

$(270+\theta)$

$270°$ change

$\cos \to +ve$

$\boxed{\begin{array}{l}\sin(-\theta) = -\sin\theta \\ \cos(-\theta) = \cos\theta \\ \tan(-\theta) = -\tan\theta\end{array}}$

$\cos(120) = \cos(180-60) = -\cos 60 = -\dfrac{1}{2}$

⊛ Koi bhi function hai usko $(180 \pm \theta)$ me likho, then uska sign decide karo, last me same function Karo, Jayga $(180°)$ ke sath rah Jayga function change Nahi Karta

$Y = \{\sin(2\theta)\}$

$Y_{max} = 1$

$\theta = 45°$ ✓

$Y = a\sin\theta + b\cos\theta$

$Y_{max} = \sqrt{a^2+b^2}$

$Y_{min} = -\sqrt{a^2+b^2}$

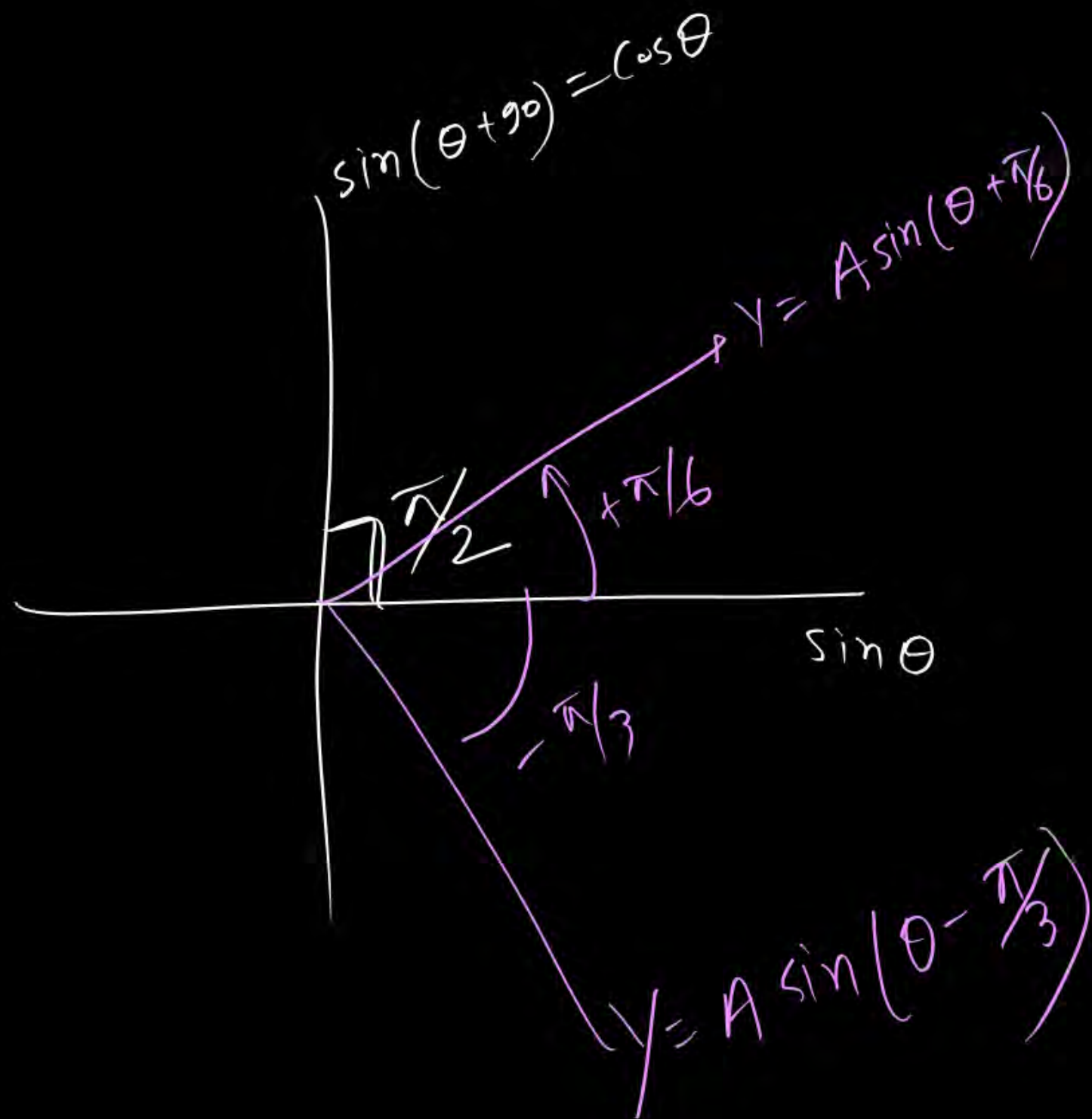$Y = 2\sin\theta \cdot \cos\theta$

$\boxed{Y_{max} = 1}$

$\theta = 45°$

$Y = \sin 2\theta$

$$\sin(180 - \theta) = \sin\theta$$

$$\cos(180 - \theta) = -\cos\theta$$

$$\tan(180 + \theta) = +\tan\theta$$

$$\left[\begin{array}{l}\sin(90 - \theta) = +\cos\theta \\ \cos(90 + \theta) = -\sin\theta\end{array}\right.$$

$=$

Phase

$$y_2 = A\sin(\theta)$$

$$y_2 = A\sin(\theta + \pi/6)$$

आगे by $+\pi/6$

$$\boxed{\Delta\phi = \pi/6 = \phi_2 - \phi_1}$$

$\cos\theta$ ka function $\pi/2$ आगे होता है $\sin\theta$ se.

$$\sin(90 + \theta) = \cos\theta$$

$\boxed{\sin\theta}$

A/P series → Difference b/w any two consective number is constant. that is called Common diffrence.

$$a, \quad a+d, \quad a+2d, \quad a+3d, \quad a+4d$$

$$\boxed{d = (n^{th}\ term) - (n-1)^{th}\ term}$$

Vale n^{th} term $= a + (n-1)d$

Sum of n term $= \dfrac{n}{2}(1^{st}\ term + n\text{-}term)$

$$= \dfrac{n}{2}(2a + (n-1)d)$$

Sum of n- Natural number, $1,2,3,4,5,6,7,8,9,10$

$$\boxed{= \dfrac{n(n+1)}{2}}$$

G/P series → Ratio of any Two consecutive number is constant called common ratio.

$$\boxed{C \cdot r = \dfrac{n^{th}\ term}{(n-1)^{th}\ term}}$$

$$a, \quad ar, \quad ar^2, \quad ar^3, \quad ar^4, \quad ar^5$$

value of nth term $= a \times r^{n-1}$

$$\boxed{Sum = \dfrac{a}{1 - C\cdot r}}$$

all the term

only valid for $\boxed{C\cdot r < 1}$

Binominal

$$(1+x)^n = 1 + nx$$

$$(1-x)^n = 1 - nx$$

$$(1-x)^{-n} = 1 + nx$$
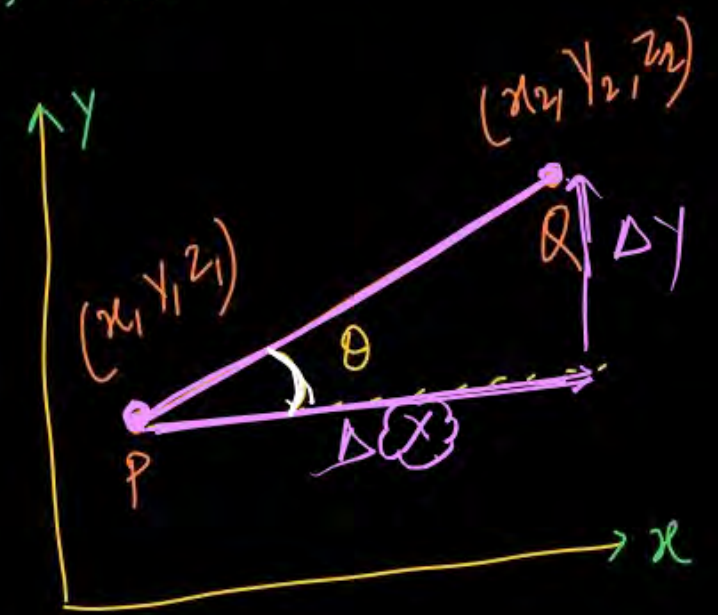
$$(1+x)^{-n} = 1 - nx$$

$$\boxed{where\ x <<< 1}$$

$$(10.02)^2 = (10 + 0.02)^2$$
$$= 10^2(1 + 0.002)^2$$
$$= 10^2(1 + 0.002)$$
$$= 100(1 + 0.004)$$
$$= 100(1.004)$$
$$= 100 \times \dfrac{1.004}{100.4}$$
$$= 100.4$$

Co-ordinate Geometry & Graph

y-axis → a line where value of x is zero
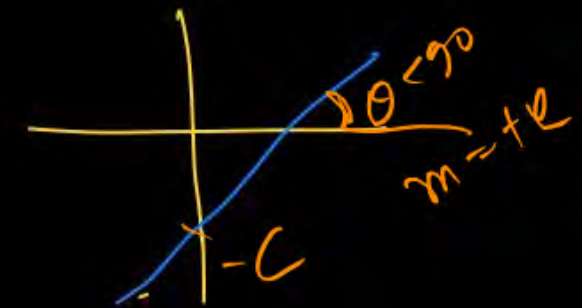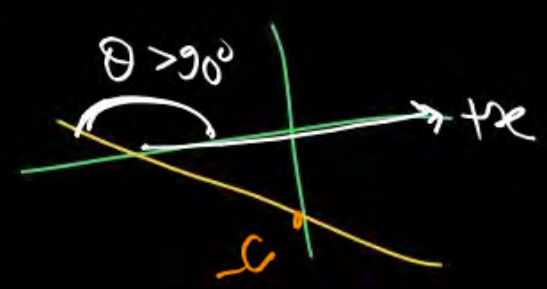
x-axis → a line where value of y is zero

(x_2, y_2, z_2)

$(\text{distance}) = \sqrt{(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2}$

PQ

(x_1, y_1, z_1)

θ

Δy

Δx

P

Q

$\text{Slope} = m = \tan\theta = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{\Delta y}{\Delta x}$

↳ remains same for straight line. θ → Angle b/w +ve x axis and line.
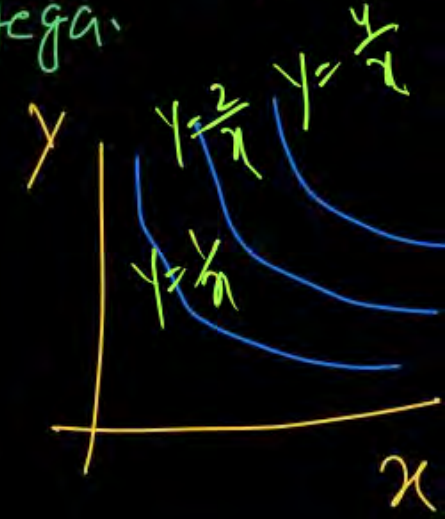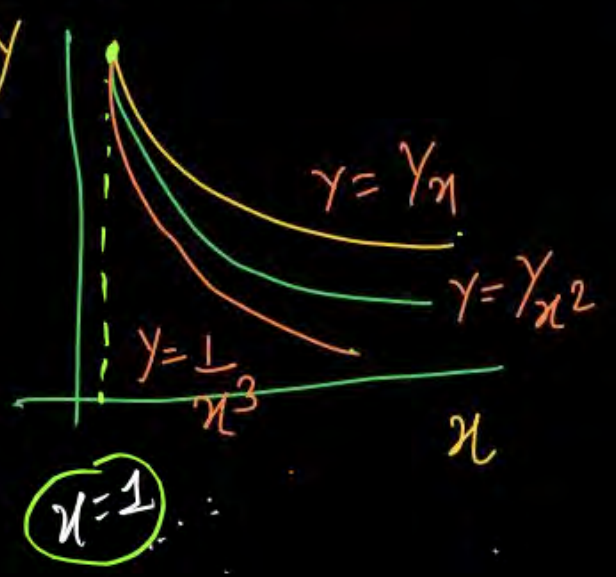
MR* → If Two straight line perpendicular to each other then product of their slope is (−1) ✓

Rectangular hyperbola ✓ $yx = 1$ $y = \dfrac{1}{x}$

Y

x

$(1/x)$

MR* $\boxed{y = \dfrac{1}{x^n}}$ (if n = 1, 2, 3, 4, 5) sare case me graph rectangular hyperbola jaisa hoga. Niche x ki power jitni jayda graph utna jaldi ghatega.

$* \boxed{y = mx + C}$ (C = value of y at x = 0)

Straight line graph ka ek hi nara slope & Intercept fixed ho hamara.

+c

Y

$\theta < 90$

x

+c

x

$\theta > \lambda$

$m = -ve$

Y

$Y = Y_x$

$y = \dfrac{1}{x^3}$

$y = Y_{x^2}$

$x = 1$

Y

$y = \dfrac{2}{x}$ $y = \dfrac{y}{x}$

$y = \dfrac{1}{x}$

x

Slope = $\tan\theta$ = +ve   Acute angle $\theta < 90$

for

Slope = $\tan\theta$ = −ve   obtuse angle $\theta > 90°$

$\theta = 0°$ $m = 0$

$\theta = 90°$ $m = \text{infinite}$ ✓

$\theta > 90°$ +x

−c

$\theta < 90$ $m = +e$ +x

−c

Parabola

$y = x^2$

$y = -x^2 + 4$

$K.E = \dfrac{P^2}{2m}$ (a)

$y = x^2 \cdot \boxed{2m}$

$K.E$
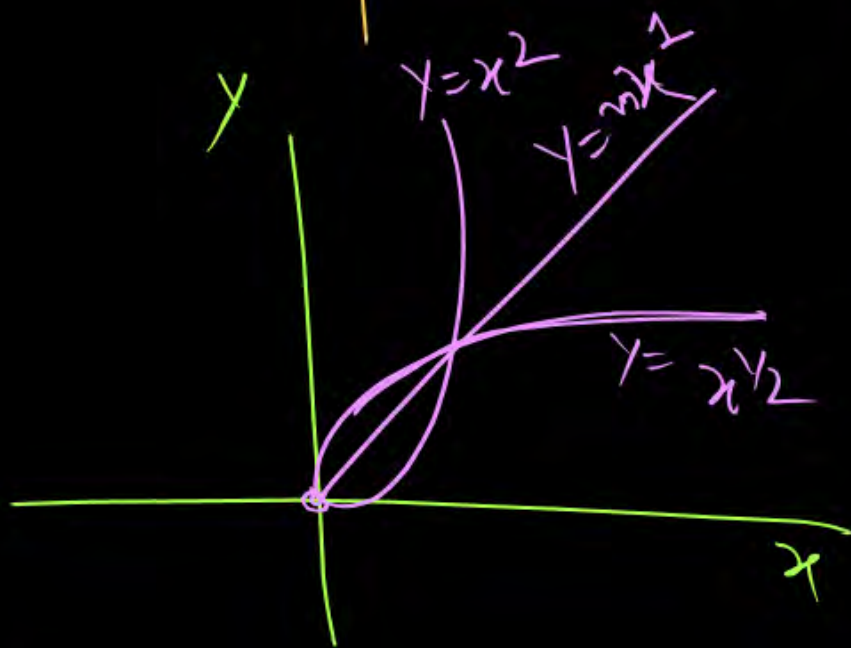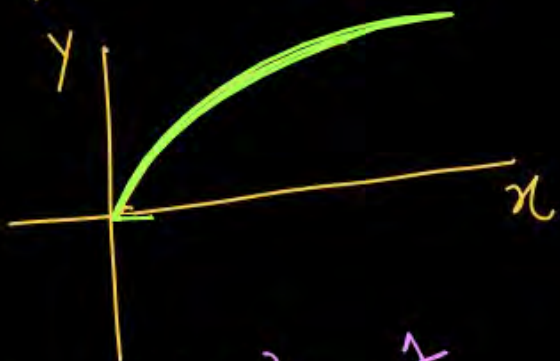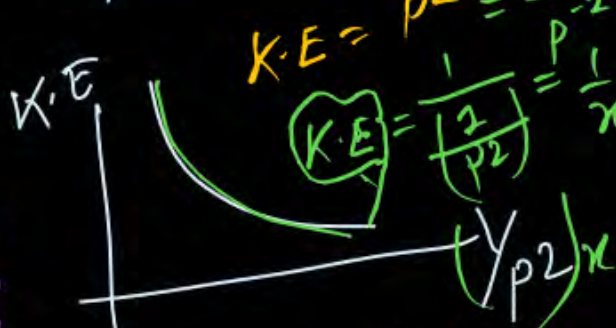
$Y = e^{-x}$ exponential decay

$Y = e^x$

$y = -(x^2)$

$Y = \sqrt{x}$

$K.E$ $y \propto x$

$y = \frac{1}{x}$

$y = e^{-x}$

$x = (1 - e^{-y})$

$\dfrac{dy}{dx} = + e^{-x}$

$Q = Q_0 \, e^{-t}$

Q_0

$y = + x^2 + 4$

$y = x^2$ $y = nx^1$

$y = nx^1$

$K.E = \dfrac{P^2}{\frac{2}{P^2}} = \dfrac{P^1}{x}$

$K.E = \dfrac{1}{\left(\frac{2}{P^2}\right)} = \dfrac{1}{P^{-2}}$

(P^2)

$\left(Y_{P^2}\right) x$

$Y = x^{1/2}$

4

$T = 2\pi \sqrt{\ell/g}$

Centre is at unit

$(x - x_0)^2 + (y - y_0)^2 = R^2$

$\boxed{x^2 + y^2 = R^2}$ centre
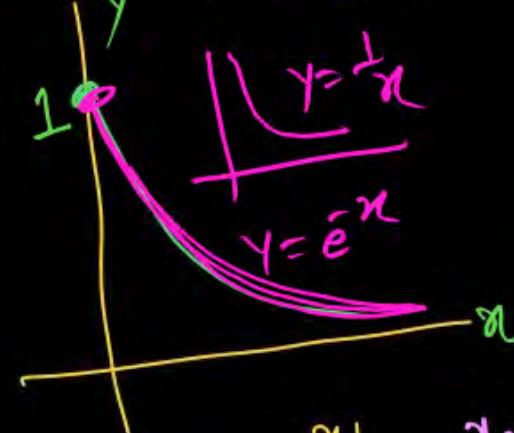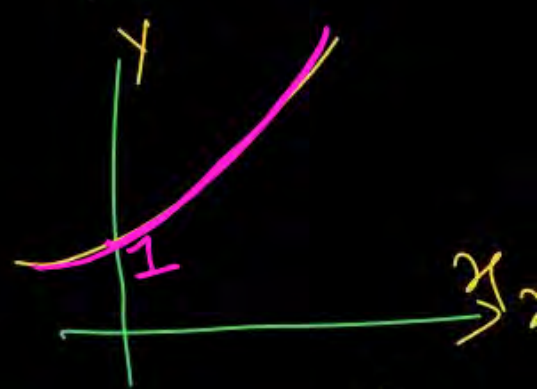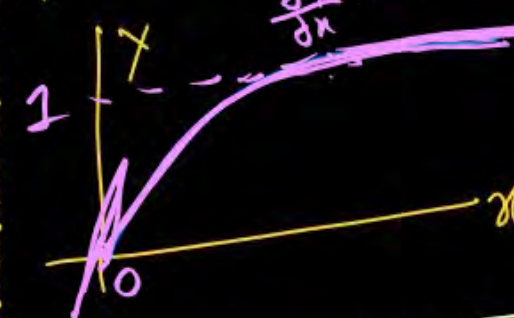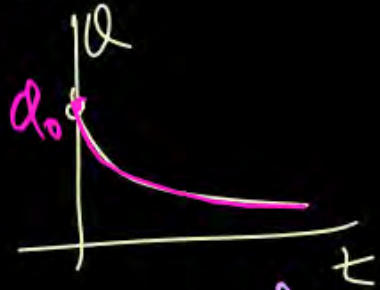
equation of circle
at (x_0, y_0) and r is R

T

ℓ

T

$\sqrt{\ell}$

ellipse

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

$a = $ Radius on x-axis

$b = $ Radius on Y-

Area of ellipse $= \pi a b$

$y = \log e^x = \log e^2 = 0$

y at $(1,0)$, 1

$$y = x^2 - 5x + 6$$

$x_1 = 3 \quad x_2 = 2$
root (value of x) when $y = c$

6, 2, 3, x

y at $(x = 0) = 6$

value of x when $(y = 0)$

$x_1 = 2$ & $x_2 = 3$

Variation of slope

:) Increasing slope — हँसता हुआ Ramlal

:(decreasing slope — रोता हुआ Ramlal.

MR* Kisi bhi point par Tangent draw karo & tangent ka angle x-axis se find karo (θ)

$m = \tan\theta = $ slope

magnitude of slope

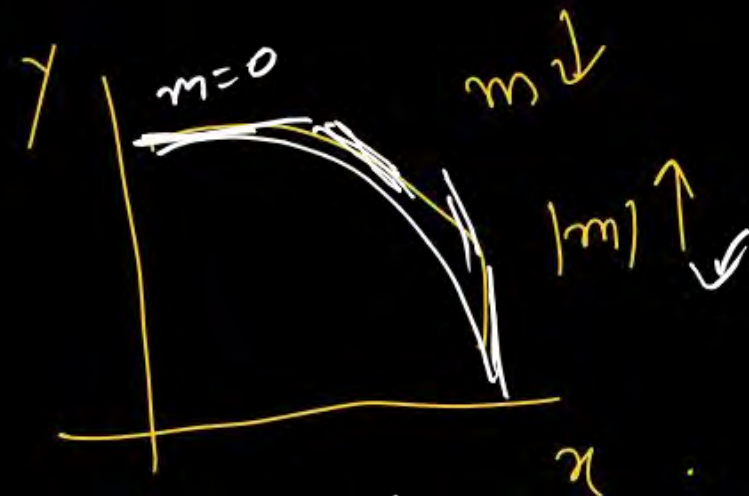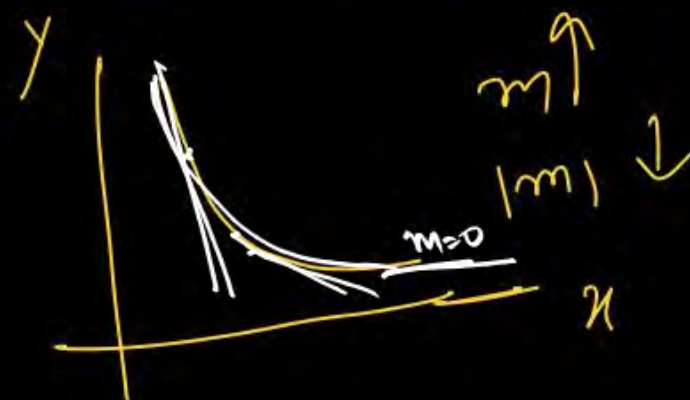यहाँ +ve, -ve slope nahi dekhna. sirf dekho Rekha leti hai to slope kam, Rekha khadi hai to slope jayda.

$m\uparrow$, $|m|\uparrow$, $m = +ve$, $m = 0$, x, y

$m = 0$, $m\downarrow$, $|m|\downarrow$, y, x

$m\uparrow$, $|m|\downarrow$, $m = 0$, y, x

$m = 0$, $m\downarrow$, $|m|\uparrow$, y, x

---
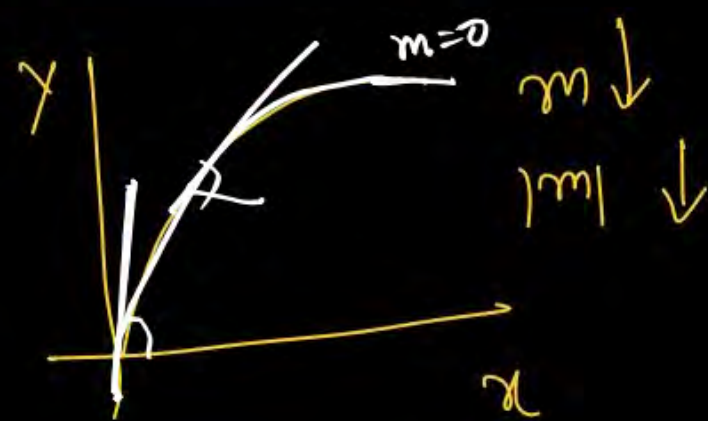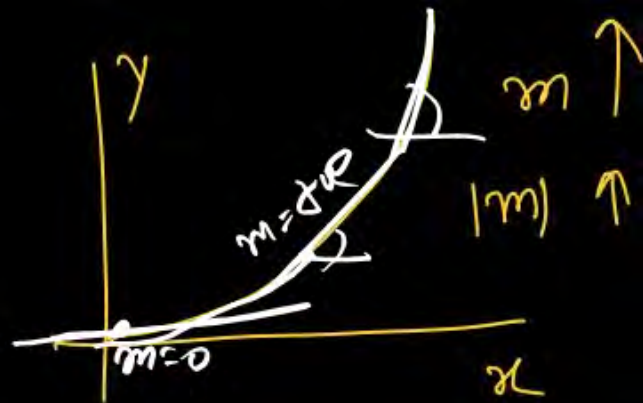
logarithmic

Natural log.

$$\log e^x = mx$$

$$\boxed{\log_{10}^x}$$

$$\log e^x = 2.303 \log_{10}^x$$

MR* $\rightarrow$ Power ke concept me result $\rightleftarrows$ Power ko interchange kar do Base ko same rakhte huye, yahi long ka funda hai.

$2^3 = 8$ (Dab)

$\log_2^8 = 3$

$(10)^2 = 100$

$\log_{10}^{100} = 2$

$(64)^{1/3} = 4$

$\log_{64}^4 = \frac{1}{3}$

$$\log_2{}^x = 4$$

Powr ñ Cu

$$2^4 = x$$

$$x = 16$$

$$\log_2{}^{(8)} = y$$

$$\boxed{8 = 2^y}$$

$$2^3 = 2^y$$

$$y = 3$$

Properties of log :-

$\boxed{\log_{10}^{10} = 1}$

① If log and Base is Same
then result will be one

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

$\log_a^a = 1 \qquad \log_e^e = 1 \qquad \log_{10}^{10} = 1$

② log one on the Base any
number other than (zero or one)
is equal to zero.

$\log_{10}^1 = 0 \qquad \log_e^1 = 0$

③ Product Rule

$\boxed{\log_e(xy) = \log_e^x + \log_e^y}$

④ Division Rule

$\log_e(x/y) = \log_e^x - \log_e^y$

---

⑤ Power of log Rule

$\log_e(x)^n = n \log_e^x$

⑥ Power of Base Rule

$\log_{(e^n)}^x = \frac{1}{n} \log_e^x$

⑦ $\log y^x = \frac{1}{\log_x^y}$

$\boxed{\text{Anti-log}} \rightarrow$ log Ko
Phir se
Power me convert Karo.

$\underset{\text{Part}}{y} = \log_e^x \underset{\text{Base}}{\Rightarrow} \boxed{e^y = x}$

$x = \log_{10}^2 \Rightarrow 10^x = 2 \checkmark$

work $= nRT \log_e\left(\frac{V_2}{V_1}\right)$

$= 2.303\, nRT \log_{10}\left(\frac{V_2}{V_1}\right) \checkmark$

$\log_e^x - \log_e^y = 20$

$\boxed{\log_e\left(\frac{x}{y}\right) = 20} \Rightarrow \boxed{e^{20} = x/y}$

If $L = \log_{10}(I)$ by taking anti log
$\underset{\text{Base}}{}$

we get

$\boxed{I = (10)^L}$. MR* Box

If $\boxed{y = e^x}$ is given then by

taking log→ $\boxed{\log_e^y = \log_e e^x = x}$

Differentiation :→

$\boxed{\frac{d}{dx}}$ = Differential operator

$\frac{d\square}{dx} = $ The rate of change $\square$ w.r.t x

$= $ slope at a point

$\frac{dy}{dx} = $ inst. slope

$\boxed{\text{Avg. slope} = \frac{\Delta y}{\Delta x}}$

Rule of differentiation

(1) Differentiation of Constant is zero

$$\frac{d\pi}{dt} = 0 \qquad \frac{dG}{dx} = 0 \qquad \frac{d\sin 45}{d\theta} = 0$$

(2) Diff^n of **algebric** function

$$\frac{dx^n}{dx} = nx^{n-1} \qquad \frac{dx^2}{dx} = 2x^{2-1} = 2x$$

(3) Diff^n of **Trigonometric / log / e^x**

$$\frac{d\sin\theta}{d\theta} = \cos\theta \qquad \frac{d\cos\theta}{d\theta} = -\sin\theta$$

$$\frac{d\tan\theta}{d\theta} = \sec^2\theta \qquad \frac{d\sec\theta}{d\theta} = \sec\theta\cdot\tan\theta$$

$$\frac{d e^x}{dx} = e^x \qquad * \boxed{\frac{d\log_e x}{dx} = \frac{1}{x}}$$

$$\frac{d\frac{1}{x}}{dx} = -\frac{1}{x^2} = \frac{dx^{-1}}{dx} \qquad \frac{d\left(\frac{1}{x^2}\right)}{dx} = \frac{-2}{x^3}$$

(4) If any Constant is multiplied with Variable it comes out of <u>diffrentiation</u>.

$$y = 4\cdot x^n$$

$$\frac{dy}{dx} = 4\left[\frac{dx^n}{dx}\right] = 4\eta x^{n-1}$$

(5) Addition Rule / Subtraction

$$y = u \pm v$$

$$\left(\frac{dy}{dx}\right) = \frac{du}{dx} \pm \frac{dv}{dx}$$

$$y = x^3 + e^x$$
$$y = \log x - \sin x$$
$$\boxed{y = x^3 \cdot \sin x}$$

(6) Product Rule

$$y = u\cdot v$$

$$\frac{dy}{dx} = \frac{du}{dx}(v) + (u)\frac{dv}{dx}$$

(7) Division Rule

$$y = u/v$$

$$\frac{dy}{dx} = \frac{v\cdot\frac{du}{dx} - u\left(\frac{dv}{dx}\right)}{v^2}$$

(8) $y = \left(\dfrac{\sin x}{x^2}\right)$

$$\frac{dy}{dx} = \frac{x^2(\cos x) - \sin x\,(2x)}{x^4} \checkmark$$

Chain Rule

$$\frac{dy}{dx} = \left(\text{Diff}^n \text{ of } \underline{outer} \atop \text{function keep Inside as it is}\right) \times \left(\text{Diff}^n \text{ of } \underline{Inner} \atop \text{function w.r.t } x\right)$$

$$y = (\sin x)^2$$

$$\frac{dy}{dx} = 2\,(\sin x)^{2-1}\cos x$$
$$= 2\sin x\cdot\cos x = \sin 2x$$

$$\frac{d(y)}{dx} = \text{The Rate of change in } y \text{ w.r.t } x \checkmark$$

$$= \text{diff}^n \text{ of } y \text{ w.r.t } x$$

$$= \text{slope at a point}$$

$$\frac{d^2 y}{dx^2} = \text{The Rate of change in } \left(\frac{dy}{dx}\right) \text{ w.r.t } x$$

$$= \text{The } \underline{\text{slope of slope}} \quad \text{*}$$

$$= \text{Double diff}^n$$

$$= \frac{d}{dx}\left(\boxed{\frac{dy}{dx}}\right) = \text{Do bar single diff}^n.$$

$$\frac{d|y|}{dx} = \text{The rate of change in Magnitude of } y$$

$$\left|\frac{dy}{dx}\right| = \text{Magnitude of Rate of change}$$

$$\text{in } y \text{ w.r.t } \underline{x}$$

$$y = A \underset{\text{Out}}{\cos}\left(\underset{\text{Inn}}{Kx}\right)$$

$$\frac{dy}{dx} = -AK \sin(Kx)$$

$$= A[-\sin(Kx)] \times \frac{d(Kx)}{dx}$$

$$= -AK \sin(Kx)$$

$$y = \underset{\text{Out}}{\sin}\left(\underset{\text{Inn}}{x^2}\right)$$

$$\frac{dy}{dx} = \cos(x^2) \times 2x$$

$$\text{Partial Diff}^n :- \overset{\text{Potent}^n}{V}(x,y,z) = x^2 z + z^2 x + xyz$$

$$\left(\frac{\partial V}{\partial x}\right)_{y \, \& z = \text{cot}^n} + \left(\frac{\partial V}{\partial y}\right)_{x,z=\text{cot}} + \left(\frac{\partial V}{\partial z}\right)_{x,y=\text{cot}h}$$

$$\# \quad \boxed{y = x^n}$$

$$\frac{dy}{dt} = \frac{dx^n}{dt}\left(\frac{dy}{dx}\right) = nx^{n-1}\left(\frac{dy}{dt}\right)$$

$$y = \underset{\text{Out}}{e}^{\left(-5x^2\right)^{\text{Inn}}}$$

$$\frac{dy}{dx} = e^{-5x^2}(-5(2x))$$

$$= -10x \, e^{-5x^2} \checkmark$$

$$y = \sqrt{x^2+y} = (x^2+y)^{1/2}$$

$$\left(\frac{dy}{dx}\right) = \frac{1}{2}(x^2+y)^{-\frac{1}{2}} \times 2x$$

Maxima & minima

Y_{max}

slope↓ $\frac{d^2y}{dx^2} = -ve$

Y_{min}

minim (slope↑)

x_1 x_2 x

$y(x)$

$\frac{dy}{dx} = 0$

x_1 x_2

$y(x_2)$

mR^* Box → gn question
No need to check double diff^n, Put $\left(\frac{dy}{dx} = 0\right)$ ✓
find x & put x in y → and find Y ✓

$$\int x^n \, dx = \frac{x^{n+1}}{n+1} + C$$

Not valid for $(n = -1)$
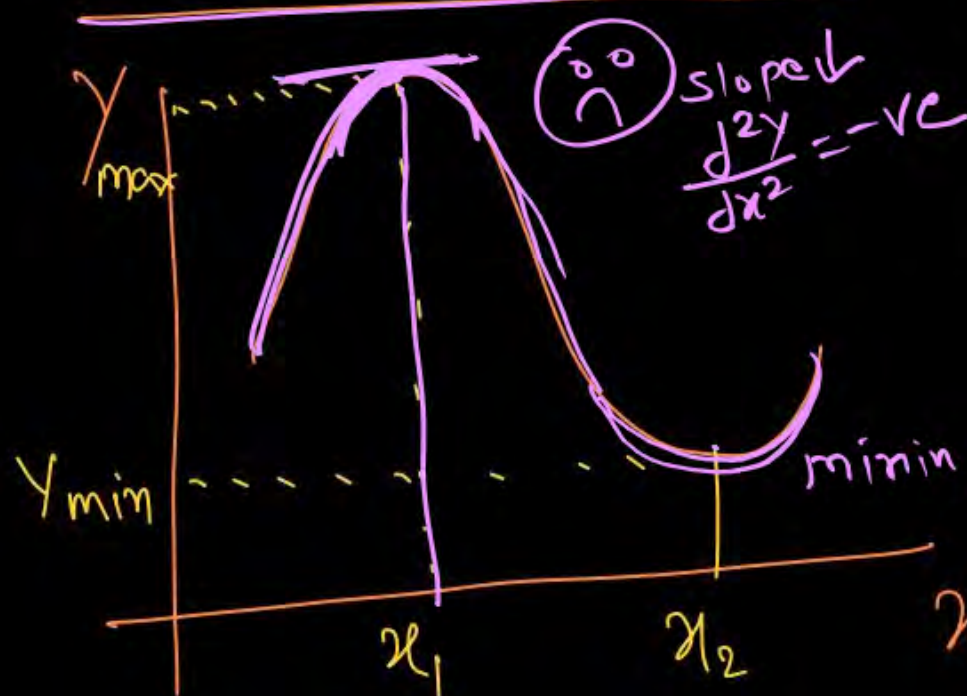
at x_1 (maxima)

* $\frac{dy}{dx} = 0$ ✓

* $\frac{d^2y}{dx^2} = -ve$

at minima (at x_2)

$\left(\frac{dy}{dx} = 0\right)$

$\frac{d^2x}{dx^2} = +ve$

Integration *

Inverse of differentiation is called Integ.✓

method of addition of small terms

$\int y \, dx = $ Area of Y/x curve ✓

$\int \sin\theta \, d\theta = -\cos\theta$

$\int \cos\theta \, d\theta = \sin\theta$

$\int e^x \, dx = e^x$

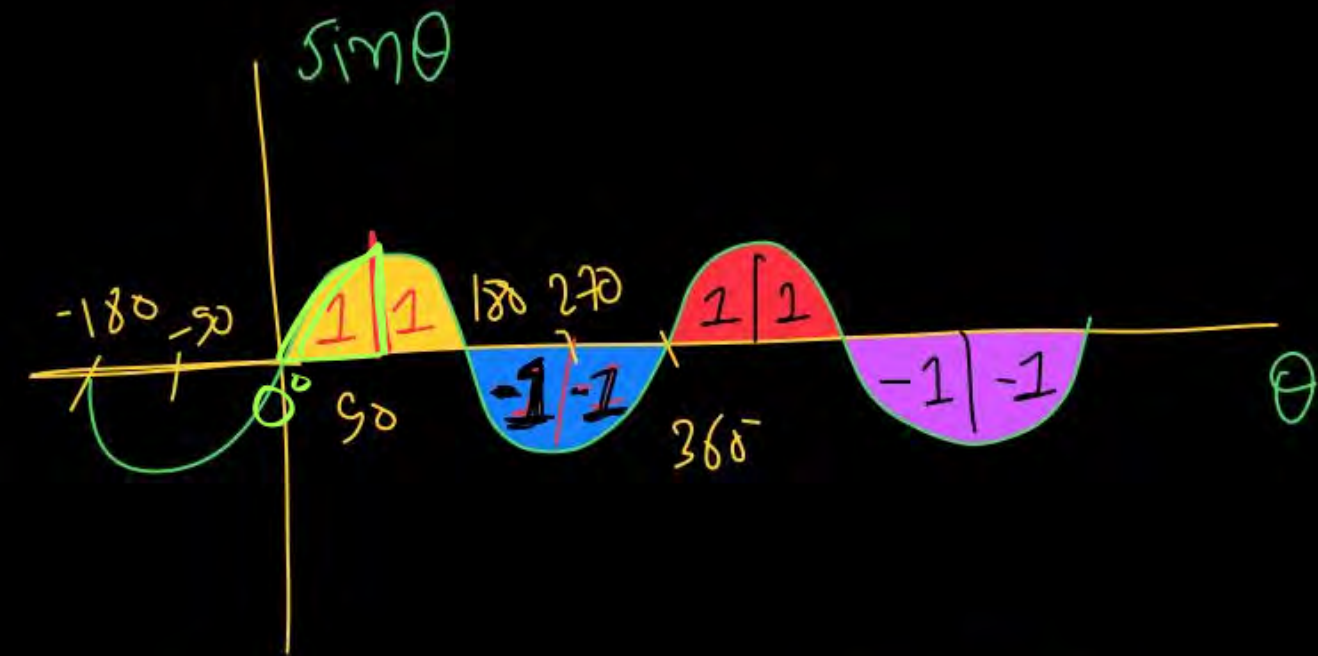$$\int \frac{1}{x} \, dx = \log x$$

chain Rule

$\int (ax+b)^2 \, dx = \frac{(ax+b)^3}{3(a)}$ ✓

$\int \sin(ax+b) \, dx = \frac{-\cos(ax+b)}{a}$ ✓

$\int \frac{1}{(ax+b)^2} \, dx = \frac{\log(ax+b)}{a}$

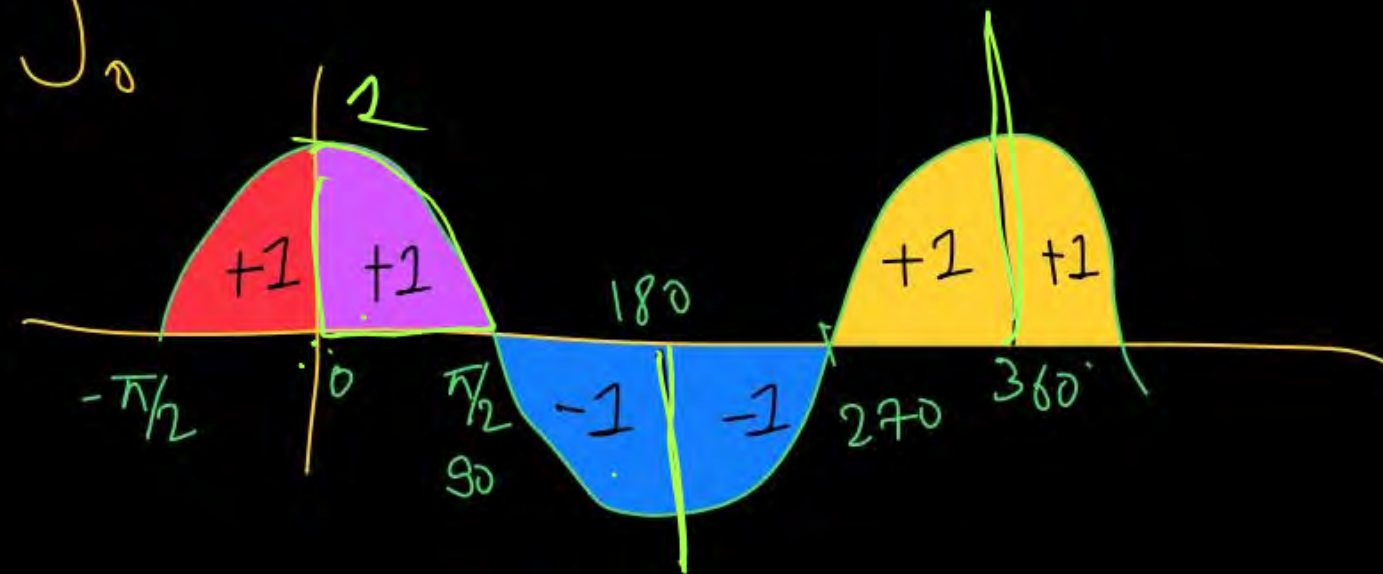$\int e^{(ax+b)} \, dx = \frac{e^{(ax+b)}}{a}$ ✓

$$\int_0^{\pi/2} \sin\theta \, d\theta = 1 \checkmark$$

$$\int_0^{\pi/2} \cos\theta \, d\theta = 1$$

$\sin\theta$

$-180 \quad -90 \quad 180 \quad 270$

$1 \mid 1$

$-1 \mid -1$

90

360

$1 \mid 1$

$-1 \mid -1$

0

θ

2

$+1 \quad +1$

180

$+1 \mid +1$

$-\pi/2$

0

$\pi/2$

$-1 \mid -1$

$270 \quad 360$

90

\# $\int \sin(2\theta) \, d\theta = \dfrac{-\cos(2\theta)}{2} + c$

Time - Average value of Physical quantity x

$$\left\langle \boxed{a} \right\rangle_{time} = \frac{\int \boxed{a} \, dt}{\int dt}$$

MRI $\underline{\text{S.d}}$ Any P.Q. is linearly varial

it Avg $x_{Avg} = \dfrac{x_i + x_f}{2}$

$$\langle v \rangle_{Avge} = \frac{\int v \, dt}{\int dt}$$

Time - Avg velocit

$$\langle v \rangle = \frac{\int v \, dx}{\int dx}$$

space-Avg velocity