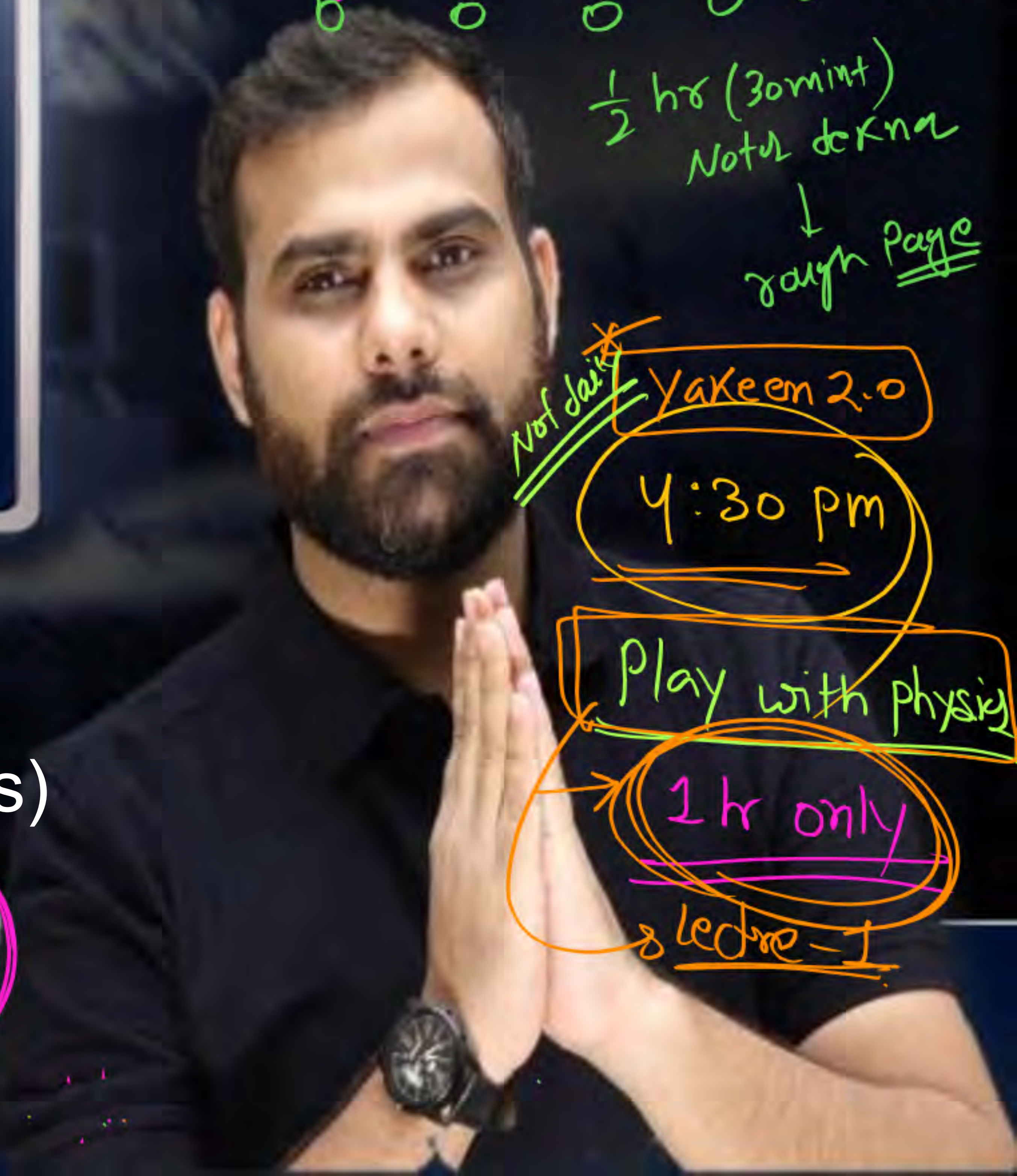
YAKEEN NEET 2.0

2026

Basic Maths and Calculus (Mathematical Tools)

Physics Lecture - 12

By- Manish Raj (MR Sir)



Lecture 01 to 11

$\frac{1}{2}$ hr (30 mint)
Notes dekna
rough page

Not daily
Yakeen 2.0
4:30 pm

Play with physics
1 hr only
lecture-1

Topics to be covered

1. ~~Chain~~ Rule → outside - Inside Rule.

2. Partial diffrention (very useful)

3. Maxima and Minima.

4.

Play with physics → In MR* style

- Live
- Not daily (one or Two lecture in week)
- Topic → random from any - Chapter
- Notes अलग से बनाना है ||
- duration 1 hr
- Todays time → 4:30 PM

$$\frac{dy}{dx} = \text{The rate of change } \boxed{'y'} \text{ w.r.t } 'x'$$

$$\frac{dx}{dy} = \text{The rate of change in } \boxed{x} \text{ w.r.t } 'y'$$

$$\frac{d^2y}{dx^2} = \text{Double diff}^n \text{ of } y$$

$$= \text{Rate of change in } \left(\frac{dy}{dx}\right) \text{ with respect to } x$$

$\left|\frac{dy}{dx}\right|$ = magnitude of Rate of change in y w.r.t. x

$$\boxed{\frac{dA}{dt} = \text{Rate of change in Area w.r.t time.}}$$

$\frac{d|y|}{dx}$ = Rate of change in magnitude of y w.r.t. x.

$$\frac{dx}{dt} = \text{Rate of change in } 'x' \text{ w.r.t } 't'.$$

$\frac{dy^2}{dx}$ = The rate of change in y^2 w.r.t x

$$\frac{dR}{dt} = \text{Rate of change in R w.r.t time}$$

Inst. acceleration $\vec{a}$ = The Rate of change in velocity $\vec{v}$ w.r.t time

$$\vec{a} = \frac{d\vec{v}}{dt}$$

magnitude of acc^n $= |\vec{a}| = \left|\frac{d\vec{v}}{dt}\right|$

magnitude of velocity $|\vec{v}|$

Tangential acc^n $\vec{a}_T$ = The rate of change in (speed) w.r.t. time

$$\vec{a}_T = \frac{d|\vec{v}|}{dt}$$

Function of a Function

अजीब function $\Rightarrow$ 3, 4, 7, 8, 9, 10

simple differentiate नहीं होगा

① $y = \sin x \times e^x$ ✓ (Product Rule)

⑤ $y = \log x \cdot (x^5)$ ✓
Product

② $y = \sin x + \cos(x)$ ✓ (addition Rule)

⑥ $y = x^5 - \tan x$ ✓

⑨ $y = \log(\sin x)$ ✗

③ $y = \sin(e^x)$ ✗ अजीब है ✗

⑦ $y = e^{(4x)}$ ✗

⑩ $y = \sin(\log x)$ ✗

④ $y = \sin(x^2 + 2x)$ ✗ अजीब है ✗

$y = \sin x \times (x^2 + 2x)$ ✓

⑧ $y = (x^2 + 4)^4$ ✗

⑪ $y = e^x \times \sin x$ ✓
Product

feel aa gya ki tumhari aukad kitni hai.

(a) Yes

(b) No

Note

(Q) If $y = \sin(x^2+3x)$ then find $\frac{dy}{dx}$??

Sol^n

$y = \sin(x^2+3x)$

Trigonometric — outer fu^n

algebric

Chain Rule

$x^2+3x = t$ (Let)

differential w.r.t x

$$\frac{dx^2}{dx} + 3\frac{dx}{dx} = \frac{dt}{dx}$$

$$2x+3 = \frac{dt}{dx} \quad -(1)$$

Putting value of 't' in main eq^n

$y = \sin(t)$

diff^n of y w.r.t 't'

$$\frac{dy}{dt} = \frac{d(\sin(t))}{dt}$$

$$\frac{dy}{dt} = \cos t$$

Puting value of 't' & 'dt'

$$dy = \cos(x^2+3x) \times dt$$

$$= \cos(x^2+3x) \times (2x+3)\,dx$$

$$\left(\frac{dy}{dx}\right) = \cos(x^2+3x) \times (2x+3)$$

Note

~~Chain Rule~~

✓ **(Outside) – (Inside) Rule (MR*)**

$$\frac{dy}{dx} = \left(\text{diffrentiation of outer function keep Inside as it as}\right) \times \left(\text{diff}^n \text{ of inner functi wrt } x\right)$$

Note —

$$\boxed{y = A\cos(kx)}$$

Coeffⁿ

outer function

Inner

[redacted]

$$\frac{dy}{dt} = A\left(-\sin(kx) \times \frac{d(kx)}{dx}\right)$$

$$= -A\sin(kx)\,K$$

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

[redacted]

$$\boxed{\frac{d\cos(PoPu)}{dx} = -\sin(PoPu) \times \frac{d(PoPu)}{dx}}$$

Note

$$y = A e^{(5x)}$$

$$\frac{dy}{dx} = A \frac{d e^{5x}}{dx}$$

$$= A \times e^{(5x)} \times \left(\frac{d\,5x}{dx}\right)$$

$$= A e^{5x} \times 5$$

$$\# \quad \boxed{\frac{dy}{dx} = 5Ae^{5x}}$$

$$y = e^{-x}$$

$$\frac{dy}{dx} = \frac{d e^{-x}}{dx}$$

$$= e^{-x}\left(\frac{d(-x)}{dx}\right)$$

$$= e^{-x}\left(-\frac{dx}{dx}\right)$$

$$\frac{dy}{dx} = -e^{-x}$$

$$\boxed{y = 3\sin(x^2+2)}$$

$$y = 3\sin(x^2+2)$$

$$\frac{dy}{dx} = 3\cos(x^2+2) \times (2x+0)$$

$$\boxed{\frac{dy}{dx} = 6x\cos(x^2+2)}$$

Note

(1) $y = e^{\alpha x^2}$

Inside function.

Sol^n $y = e^{(\alpha x^2)}$

$$\frac{dy}{dx} = e^{(\alpha x^2)} \times \frac{d(\alpha x^2)}{dx}$$

$$= e^{\alpha x^2} \times \alpha\,(2x)$$

$$= 2x\alpha\, e^{\alpha x^2}$$

Note लिखना

Q) Position of object given as $\boxed{x = A\sin(\underbrace{\omega t+\phi}_{\text{Inside}})}$, ω, ϕ are constant then find $\frac{dx}{dt}$, $\frac{d^2x}{dt^2}$

Sol^n

$$\frac{dx}{dt} = A\cos(\omega t+\phi)\times\frac{d(\omega t+\phi)}{dt}$$

$$= A\cos(\omega t+\phi)\times\left(\omega\left(\frac{dt}{dt}\right)+\cancel{\frac{d\phi}{dt}}^{\,0}\right)$$

$$\frac{dx}{dt} = A\omega\cos(\omega t+\phi)$$

$$\frac{d^2x}{dt^2} = A\omega\left[-\sin(\omega t+\phi)\times(\omega)\right]$$

$$\frac{d^2x}{dt^2} = -\omega^2 A\sin(\omega t+\phi)$$

$$\left(\frac{d^2x}{dt^2}\right) = -\omega^2 A\sin(\omega t+\phi)$$

Put value of (x)

$$\boxed{\frac{d^2x}{dt^2} = -\omega^2 x} \; *$$

$y = \sin(x^2)$

out^r Inn^r

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

\#

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

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

$y = (\sin x)^2$

Inn^r func.

$\frac{dx^2}{dx} = 2x$

$\frac{dt^2}{dt} = 2t$

$y = 2(\sin x)^{2-1} \times \cos x$

$y = 2 \sin x \times \cos x$

$y = \sin(2x)$

$$\boxed{y = \sin(x^3)}$$

$\uparrow$ Inner

$$\frac{dy}{dx} = \cos(x^3) \times 3x^2$$

$$y = \sin^3 x = (\underline{\sin x})^3$$

$\uparrow$ Inner

$$\frac{dy}{dx} = 3(\sin x)^2 \times \cos x$$

$$\boxed{\frac{dy}{dx} = 3\sin^2 x \cos x}$$

$$y = \log_e(\underbrace{x^3 - 2x^2}_{\text{Inside function.}})$$

$$\frac{dy}{dx} = \frac{1}{(x^3 - 2x^2)} \times \frac{d(x^3 - 2x^2)}{dx}$$

$$\frac{dy}{dx} = \frac{1}{(x^3 - 2x^2)} \times (3x^2 - 4x)$$

$$y = \log_e(x)$$

$$\frac{dy}{dx} = \frac{1}{x}$$

MR BOX

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

AB

$$y = \cos^2(x^3+2x)$$

do not write
no use in
physics

$$y = \big(\underbrace{\cos(x^3+2x)}_{\text{Inside}}\big)^2$$

$$\frac{dy}{dx} = 2\left[\cos(x^3+2x)\right]^{2-1} \times \left(-\sin(x^3+2x)\right) \times (3x^2+2)$$

$$\frac{dy}{dx} = -2\cos(x^3+2x)\,\sin(x^3+2x)\,(3x^2+2) \checkmark$$

$y = (\underbrace{x^2+4}_{\text{Inner funct.}})^3$

$$\frac{dy}{dx} = 3\left(x^2+4\right)^{3-1} \times \frac{d(x^2+4)}{dx}$$

$$= 3\left(x^2+4\right)^2 \times (2x+0)$$

$$\boxed{\frac{dy}{dx} = 6x\left(x^2+4\right)^2}$$

$$y = \alpha \sin(\beta t)$$

where α & β are constant

$$\frac{dy}{dt} = \alpha \cos(\beta t) \times \beta$$

$$\# \quad \boxed{\frac{dy}{dt} = \alpha \beta \cos(\beta t)}$$

H/W

(2) $y = e^{\sin x}$

(2) $y = \cos(x^2+4x)$

(3) $y = (x^2+4x)^2$

(4) $y = 4e^{3t}$

(5) $y = 5\sin(4+3t)$

(6) $y = \log(3x+4)$

(7) $y = e^{-4x+3}$

(8) $y = (x^4-1)^{50}$

HomEl work

* *

Partial Differentiation

Gravitation, work energy power, electrostatic

If V is a function of (x, y, z)

Write down

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

$$\boxed{\vec{E} = -\left[\left(\frac{\partial V}{\partial x}\right)_{\substack{y \& z\\ \text{const}^n}}\hat{i} + \left(\frac{\partial V}{\partial y}\right)_{\substack{x, z\\ \text{const}^n}}\hat{j} + \left(\frac{\partial V}{\partial z}\right)_{\substack{x \& y\\ \text{const}^n}}\hat{k}\right]}$$

Q) If electric potential $\boxed{V = 3x^2yz}$ then find electric fied.

write down

Soln

\# $\left(\frac{\partial V}{\partial x}\right)_{y\,\&\,z\ (\text{const})} = \frac{\partial\, 3x^2yz}{\partial x} = 3yz\,\frac{\partial x^2}{\partial x} = 3yz\,(2x)$ — (1)

$= 6xyz\,\hat{i}$

\# $\left(\frac{\partial V}{\partial y}\right)_{x\,\&\,z\ (\text{c})} = 3x^2z\,\frac{\partial y}{\partial y}\,\hat{j} = 3x^2z\,\hat{j}$

\# $\left(\frac{\partial V}{\partial z}\right) = 3x^2y\,\frac{\partial z}{\partial z}\,\hat{k} = 3x^2y$

$\vec{E} = -\left[6xyz\,\hat{i} + 3x^2z\,\hat{j} + 3x^2y\,\hat{k}\right)$

If $\boxed{V = x^2y + y^2z + z^2x}$ find $|\vec{E}| = ??$

$$\vec{E} = -\left[\frac{\partial V}{\partial x}\hat{i} + \frac{\partial V}{\partial y}\hat{j} + \frac{\partial V}{\partial z}\hat{k}\right]$$

given in Questn.

H/W

$y = x^2$

find $\frac{dy}{dx}$

$$\frac{dy}{dx} = \frac{dx^2}{dx}$$

$$\boxed{\frac{dy}{dx} = 2x}$$

#

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

find $\frac{dy}{dt} = ??$

diff^n w.r.t. time

$$\frac{dy}{dt} = \frac{dx^2}{dt} \times \frac{dx}{dx}$$

$$\frac{dy}{dt} = \frac{dx^2}{dx} \times \frac{dx}{dt}$$

$$\boxed{\frac{dy}{dt} = 2x \times \frac{dx}{dt}}$$

$$\frac{dy}{dx} = 2x$$

$$\left(\frac{dy}{dt}\right) = 2x\,\frac{dx}{dt}$$

likhan mat

Q. If radius of circle is increasing at rate $\frac{1}{\pi}$ m/s then find rate of change in Area with respect to time.

$$A = \pi R^2$$

diffⁿ w.r.t R

$$\frac{dA}{dR} = \pi \frac{dR^2}{dR}$$

$$\frac{dA}{dR} = \pi 2R$$

$\frac{dR}{dt} = \frac{1}{\pi}$ m/s

$\frac{dA}{dt} = ??$

$$\frac{dA}{dt} = 2\pi R \frac{dR}{dt}$$

$$= 2\cancel{\pi} R \left(\frac{1}{\cancel{\pi}}\right) = 2R \; m^2/sec$$

unit

H/W
likhna hai

Q. Radius of solid sphere Incres $\frac{1}{\pi}$ m/s then find Rate of change in Volume of sphere w.r.t time when Radius is 2m.

Sol^n

$$\frac{dR}{dt} = \frac{1}{\pi} \text{ m/s}$$

$$\frac{dV}{dt} = ?$$

$$V = \frac{4}{3}\pi R^3$$

diff^n w.r.t 'R'

$$\frac{dV}{dR} = \frac{4}{3}\pi \frac{dR^3}{dR}$$

$$\frac{dV}{dR} = \frac{4}{\cancel{3}}\pi \cancel{3}R^2$$

$$\frac{dV}{dt} = 4\pi R^2 \frac{dR}{dt}$$

$$= 4\cancel{\pi}(2)^2 \times \frac{1}{\cancel{\pi}}$$

$$= 4 \times 4$$

$$\frac{dV}{dt} = 16 \text{ m}^3/\text{sec}$$

Maxima/minima

likhma hai

Happy

minima

$$\boxed{\text{at } x_2 \left(\frac{dy}{dx}\right)_{\text{minima}} = m = 0}$$

Slope → Increas

$\frac{d}{dx}\left(\frac{dy}{dx}\right) = \frac{d^2y}{dx^2} = +ve$ ✓

slope

Sad

Maxima

$$\boxed{\text{at } x_1 \left(\frac{dy}{dx}\right) = 0}$$

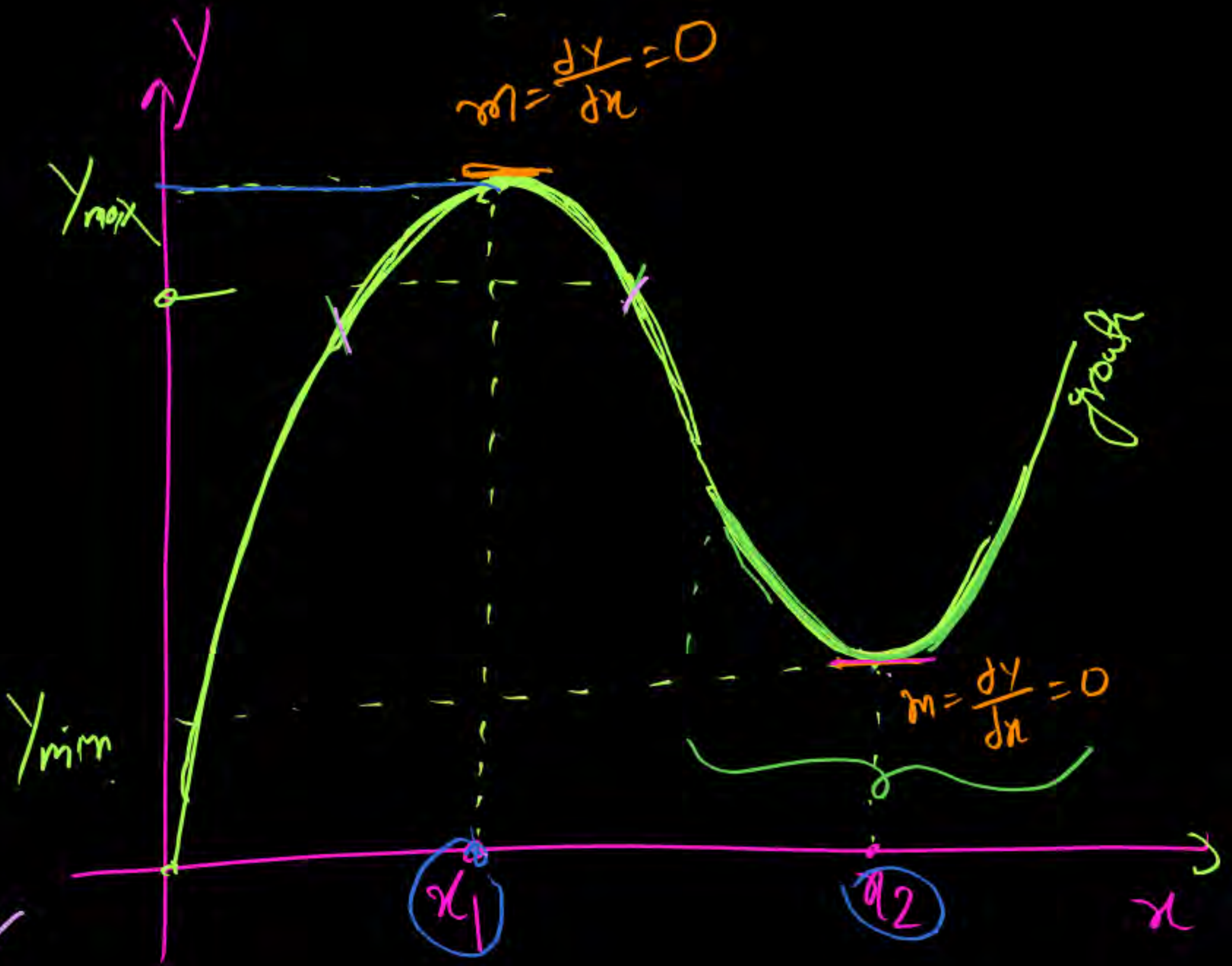
maxima ✓

real → Maxima.

slope decreasing

$\frac{d}{dx}\left(\frac{dy}{dx}\right) = \frac{d^2y}{dx^2} = -ve$ ✓

slope



THANK YOU