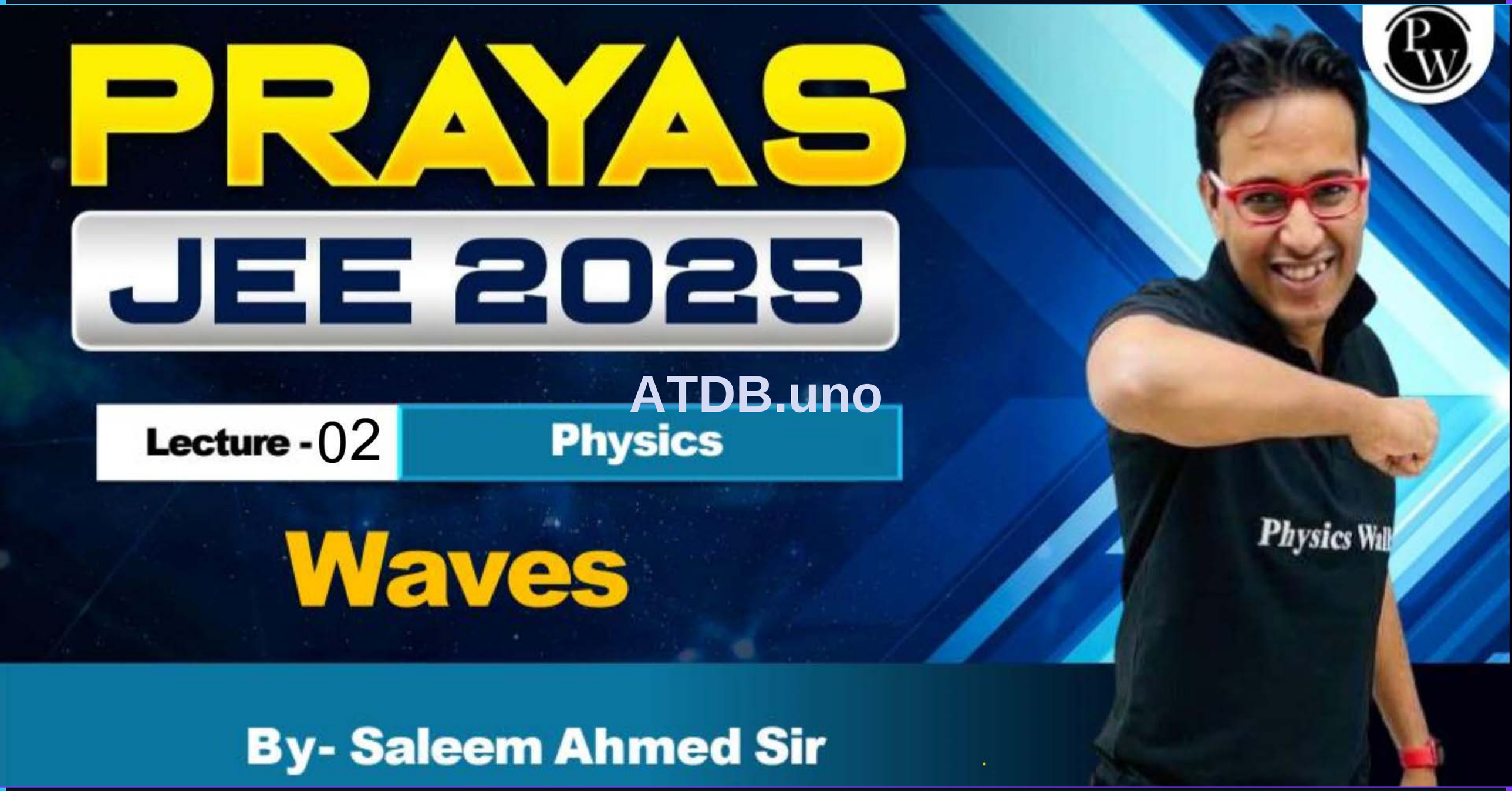
PRAYAS

JEE 2025

Lecture - 02

Physics

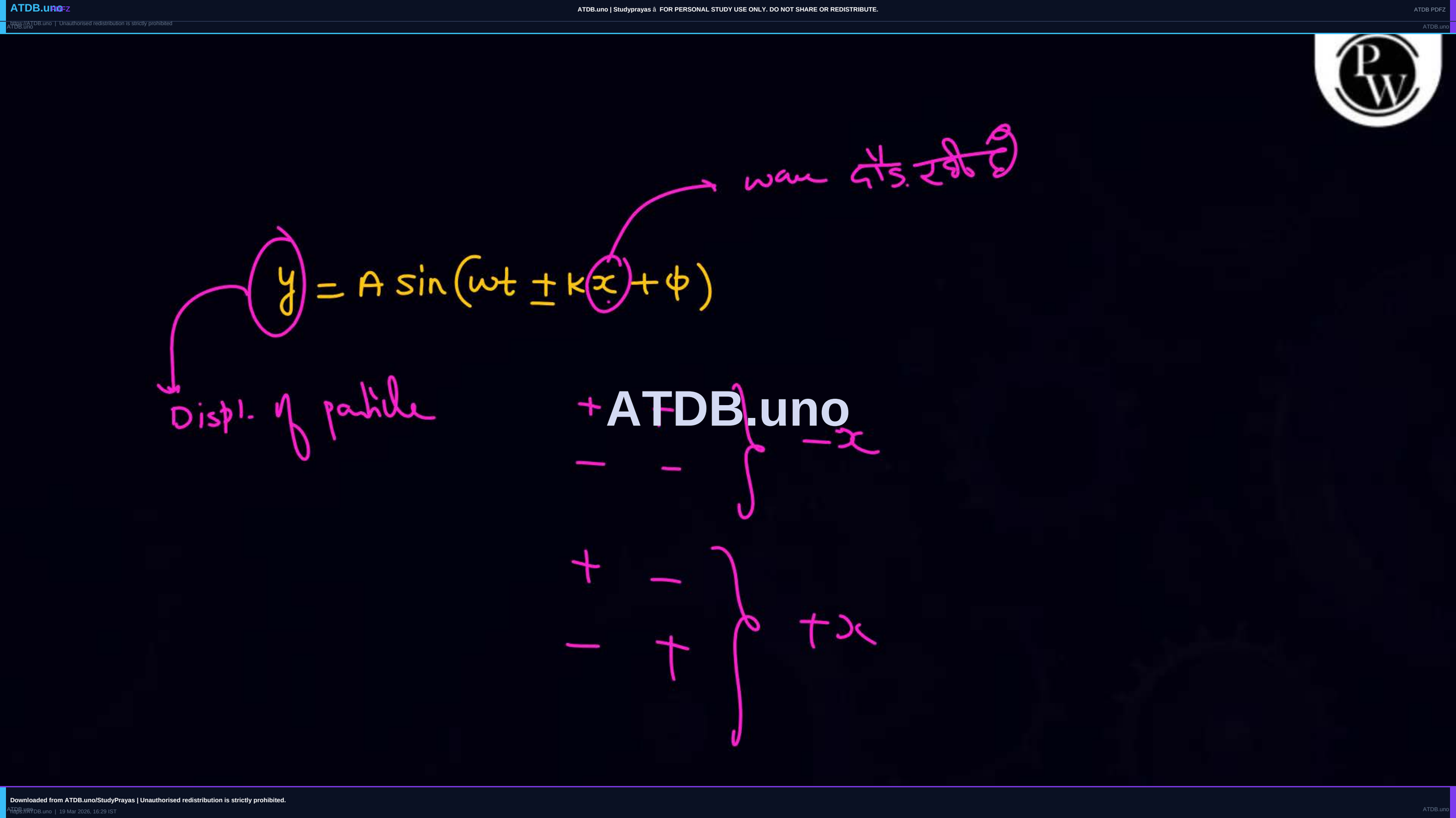
Waves



By- Saleem Ahmed Sir

Topics to be covered

1. Velocity of wave
2. Relation b/w V_p & Slope
3.
4.



Wave function

- Function should be
  - * define
  - * Continous
  - * x- और t में आपस में Lenear relation
  - * Bounded

① $y = \frac{1}{x-1}$ X

② $y = \frac{1}{x-t}$ X

③ $y = \frac{1}{x^2-t^2}$ X

④ $y = A\sin(\omega t - kx+\phi)$ X

⑤ $y = A\sin(\omega t - kx^2+\phi)$ X

⑥ $y = A\sin(\omega t - kx+\phi)$ ✓

⑦ $y = A\,e^{-(x+t)^2}$ ✓

⑧ $y = A\,e^{-(ax^2+bt^2+2\sqrt{ab}xt)}$ ✓

$y = A\,e^{-(\sqrt{a}x+\sqrt{b}t)^2}$

$V_{wave} = -\frac{\text{Coff. of } t}{\text{Coff. of } x}$

$= -\frac{\sqrt{b}}{\sqrt{a}}$

Q $y = \dfrac{1}{(x-t)^2+1}$

$y_{min} = 0$

$y_{max} = 1$

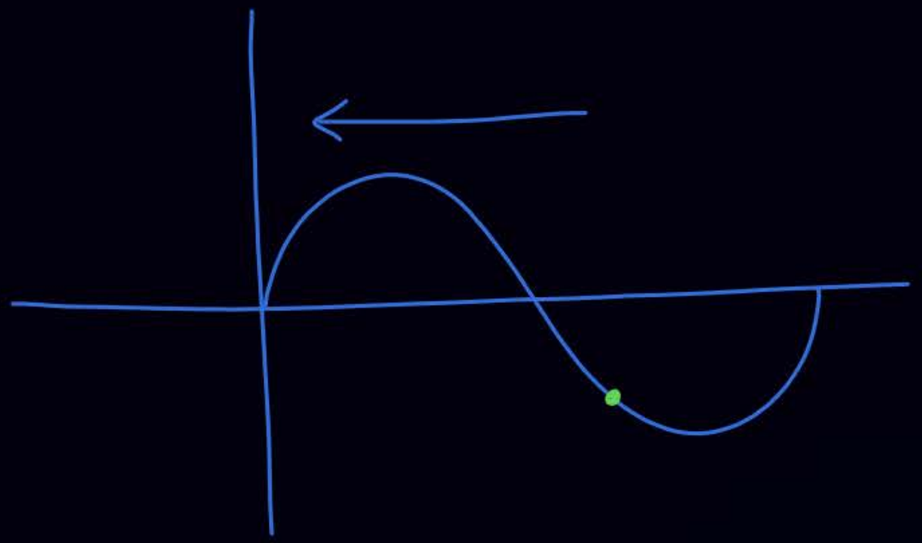
$y \in (0, 1]$

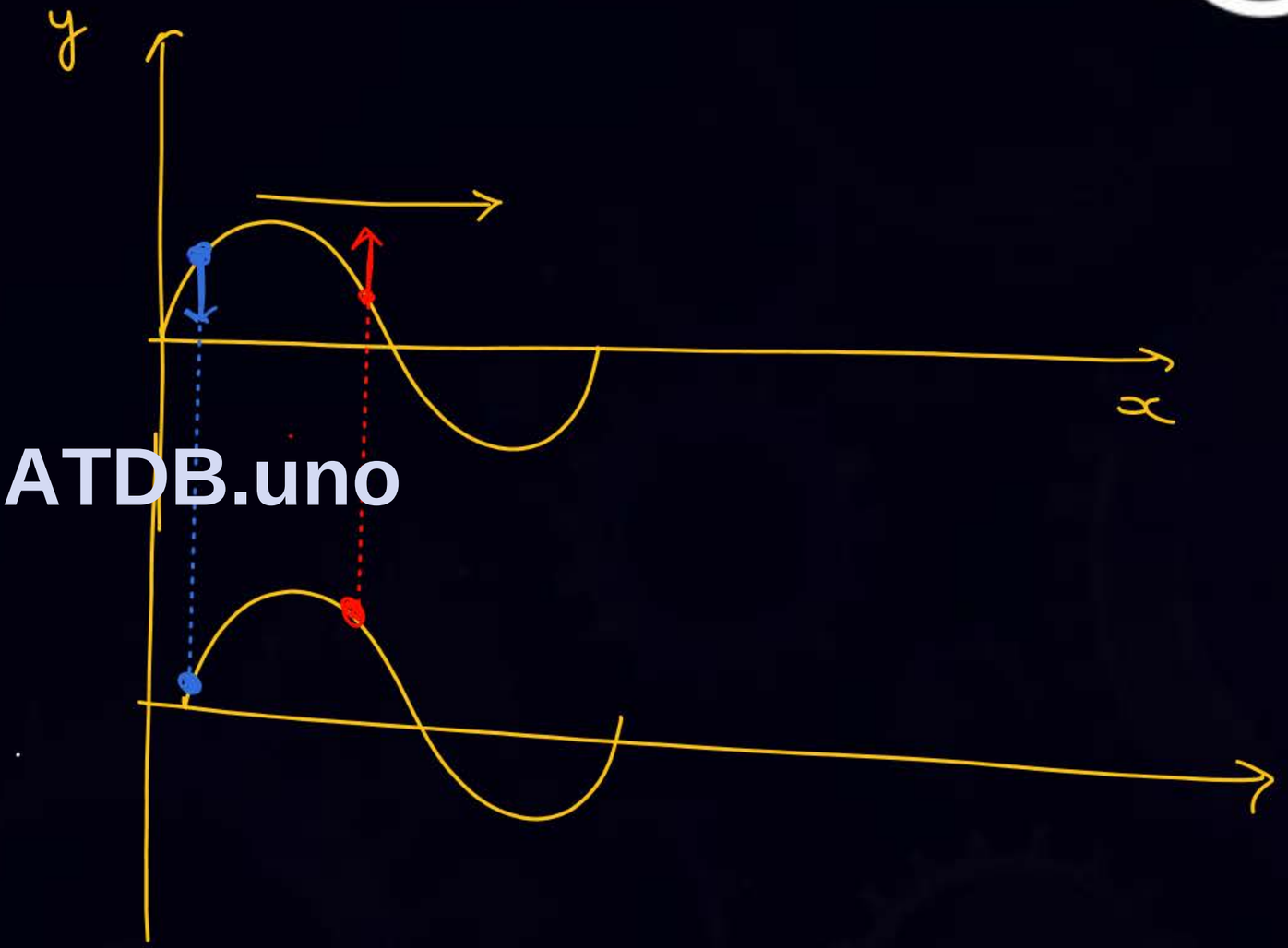
Q $y = \dfrac{1}{x^2+t^2+2xt+2}$

Q $y = A\, e^{-(bx^2+t)}$

$y = \dfrac{1}{(x+t)^2+2}$

$\therefore$





Relation b/w V_p and slope

$$y = A\sin(\omega t - kx + \phi)$$

$$V_p = \frac{\partial y}{\partial t} = A\omega\cos(\omega t - kx + \phi)$$

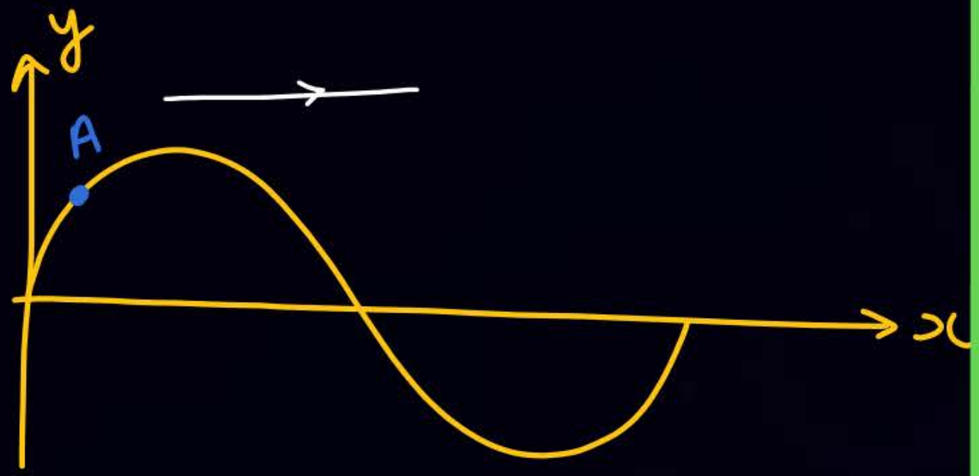
$$\frac{\partial y}{\partial x} = -Ak\cos(\omega t - kx + \phi)$$

$$V_p = -V_w\left(\frac{\partial y}{\partial x}\right)$$

$$\boxed{V_p = -V_w(\text{slope})}$$

$$\frac{V_p}{\left(\frac{\partial y}{\partial x}\right)} = \frac{A\omega\cos(\omega t - kx + \phi)}{-Ak\cos(\omega t - kx + \phi)} = -\frac{\omega}{k}$$

$$V_p = -V_w(\text{slope})$$

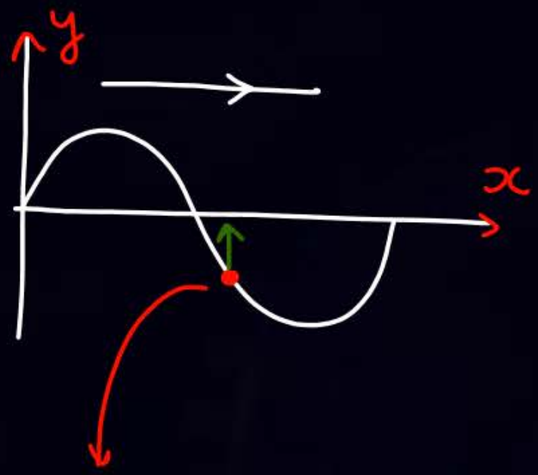


A के लिए $\Rightarrow V_p = -V_w(\text{slope})$

$= - + +$

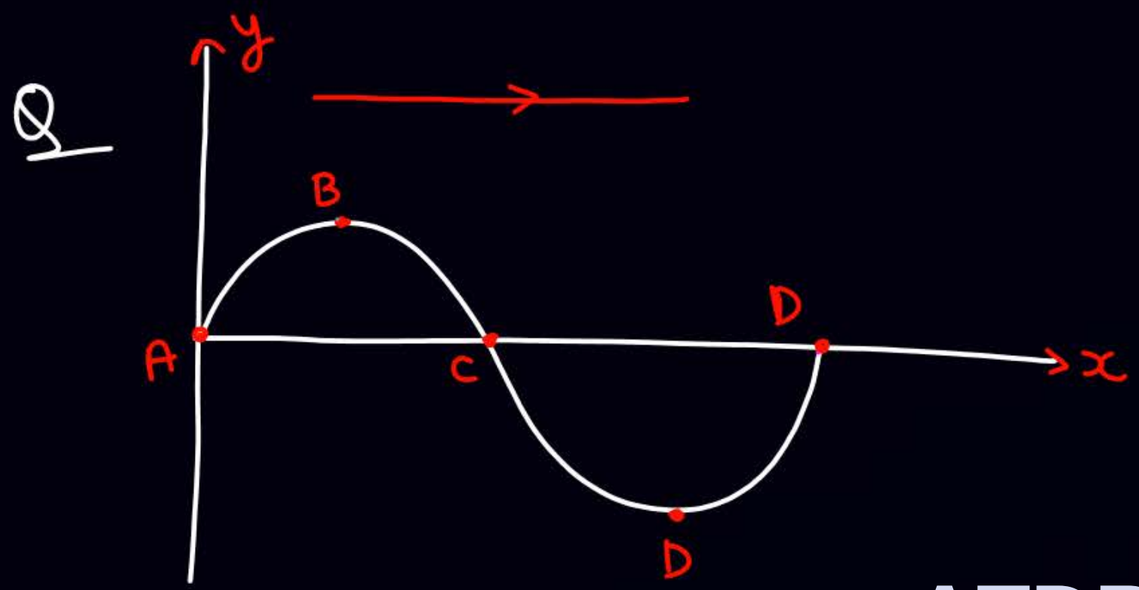
$V_p < 0$

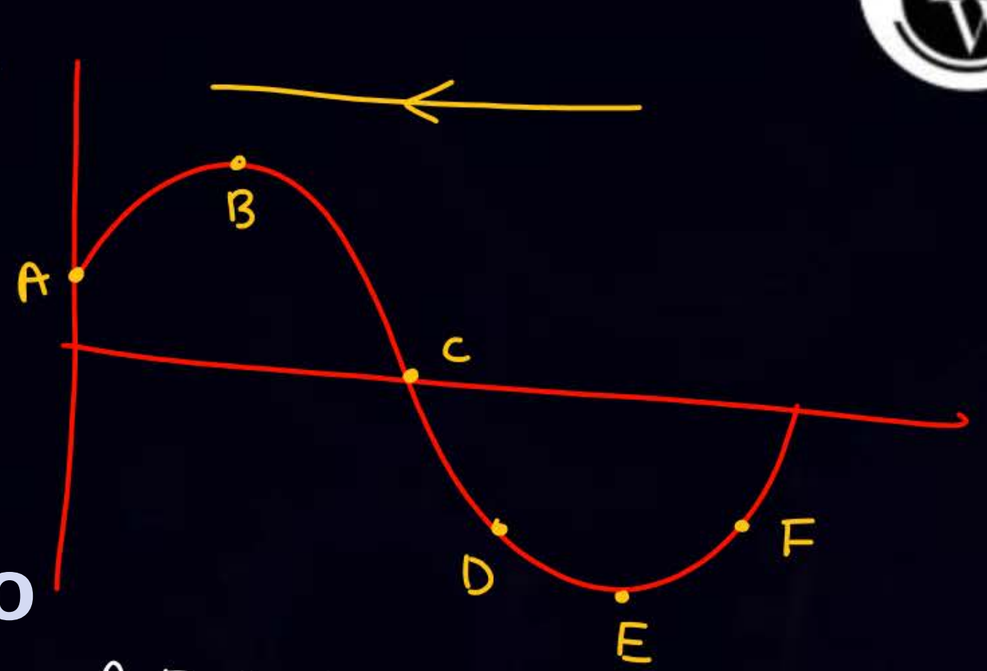
Q



$V_p = - + -$

$V_p > 0$





$B, D \Rightarrow v = 0$

$A, D \Rightarrow V_p = - + +$

$V_p < 0$

$C \equiv V_p = - + -$

$V_p > 0$

$A, F \Rightarrow$ slope $> 0 \Rightarrow V_p = - - + \Rightarrow V_p > 0$

$B, E \Rightarrow$ Slope $= 0 \Rightarrow V_p = 0$

(उत्तर)

$C, D \Rightarrow V_p = - - - \Rightarrow V_p < 0$

Velocity wave in string

Velocity wave in string

* $V_w = \frac{\omega}{k}$

$$V_w = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{T}{\rho A}}$$

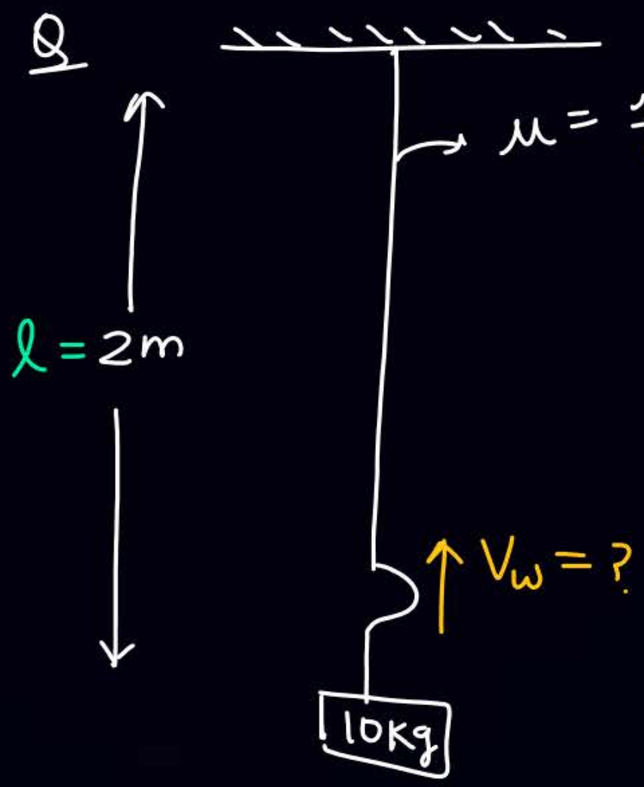
$T \longrightarrow$ Tension

$\mu \longrightarrow$ mass per Unit length

$\rho \longrightarrow$ Density

$A \longrightarrow$ Area of Cross section

$$V_w = \frac{\omega}{k} = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{T}{\rho A}}$$



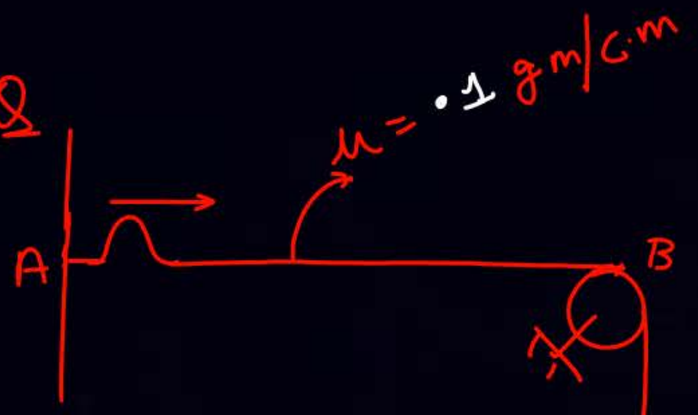
$\mu = 1 gm/m = 10^{-3} kg/m$

$T \approx mg = 100$

$V_w = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{100}{10^{-3}}}$

$V_w = 100\sqrt{10}$

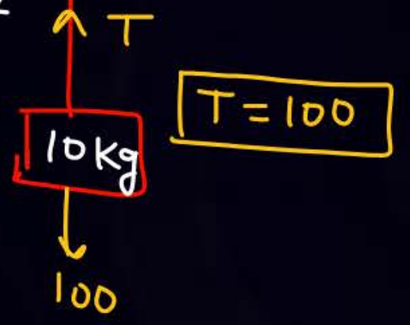
$t = \frac{\ell}{V_w}$

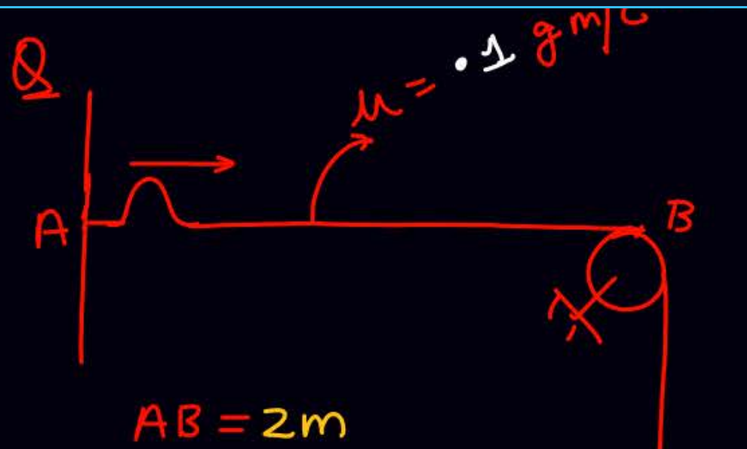


$V_w = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{100 \times 10^{-2}}{.1 \times 10^{-3}}}$

$V_w = 100 m/s$

$t_{AB} = \frac{AB}{V_w}$





(b)

$$V_w = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{100 \times 10^{-2}}{.1 \times 10^{-3}}}$$

$T = 100$

$V_w = 100$ m/s

$$t_{AB} = \frac{AB}{V_w}$$

If eq^ of this wave is given by

$$y = A \sin(2\pi x - \omega t + \phi)$$

find f, ω = ?

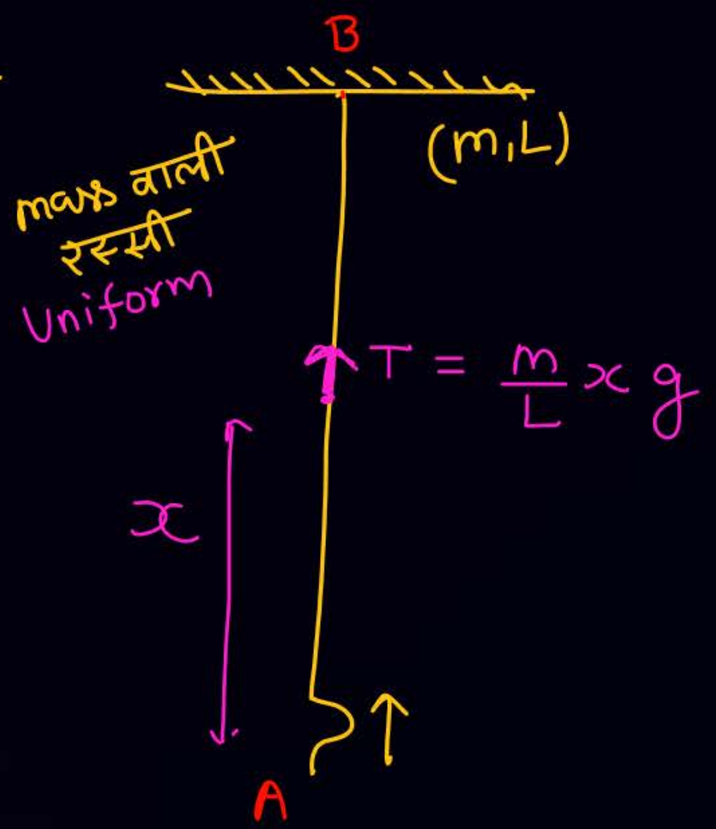
$$V_w = \sqrt{\frac{T}{\mu}} = \frac{\omega}{K}$$

$$100 = \frac{\omega}{2\pi}$$

$$\omega = 2\pi \times 100 = 2\pi f$$

$f = 100$

Q



① $t_{A \to B} = ?$

$$V_w = \sqrt{\frac{T}{\mu}}$$

$$V_w = \sqrt{\frac{\frac{m}{L} x g}{\frac{m}{L}}}$$

$$\boxed{V_w = \sqrt{xg}}$$

$$V_w^2 = xg$$

diff. wrt time

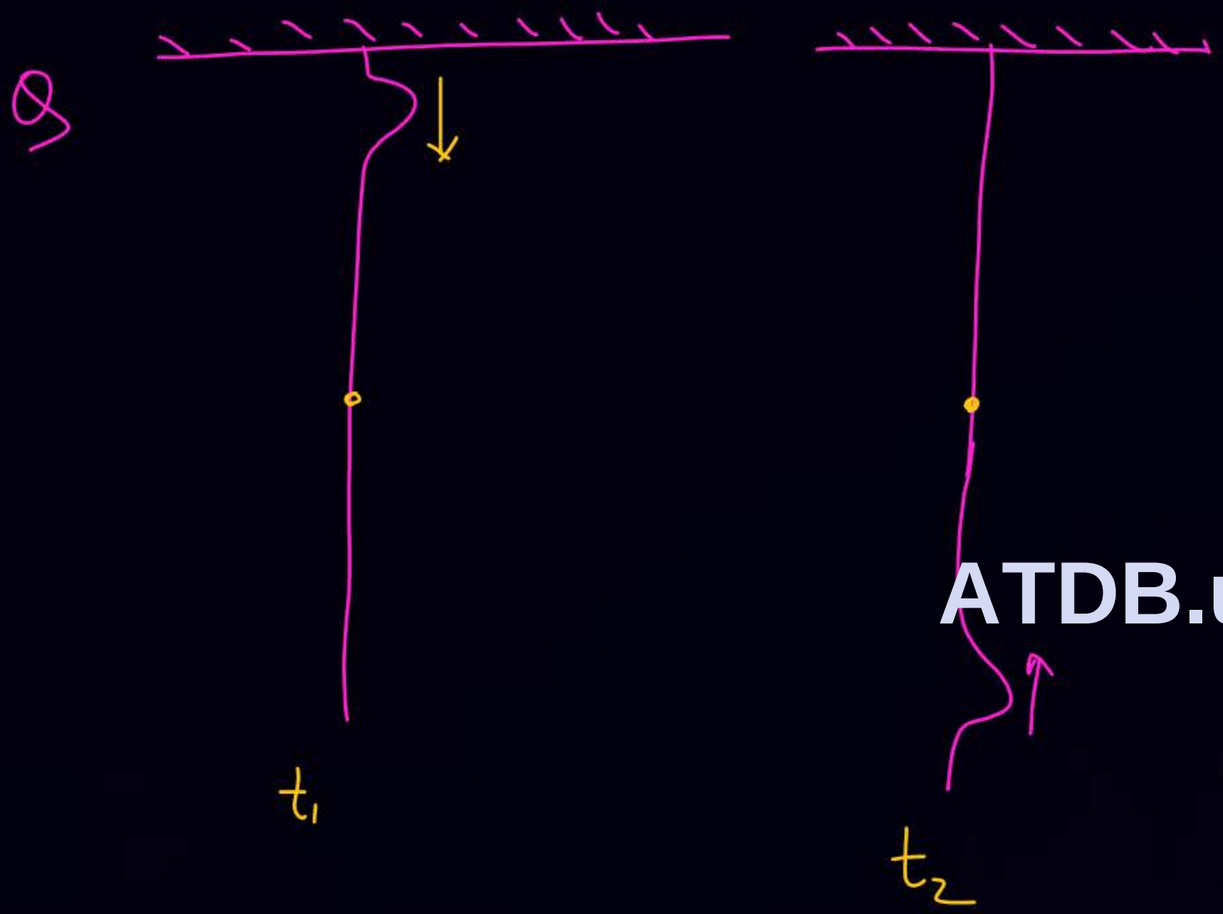
$$2v \cdot a = g$$

$$\boxed{a = g/2 = \text{Const}}$$

$$S = ut + \frac{1}{2} a t^2$$

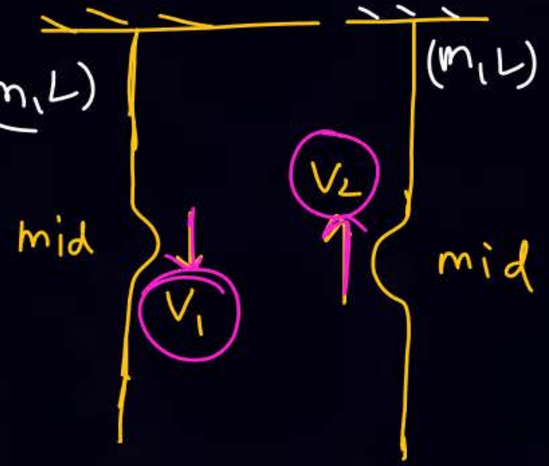
$$L = 0 + \frac{1}{2} \times \frac{g}{2} t^2$$

$$t = \sqrt{\frac{4L}{g}}$$

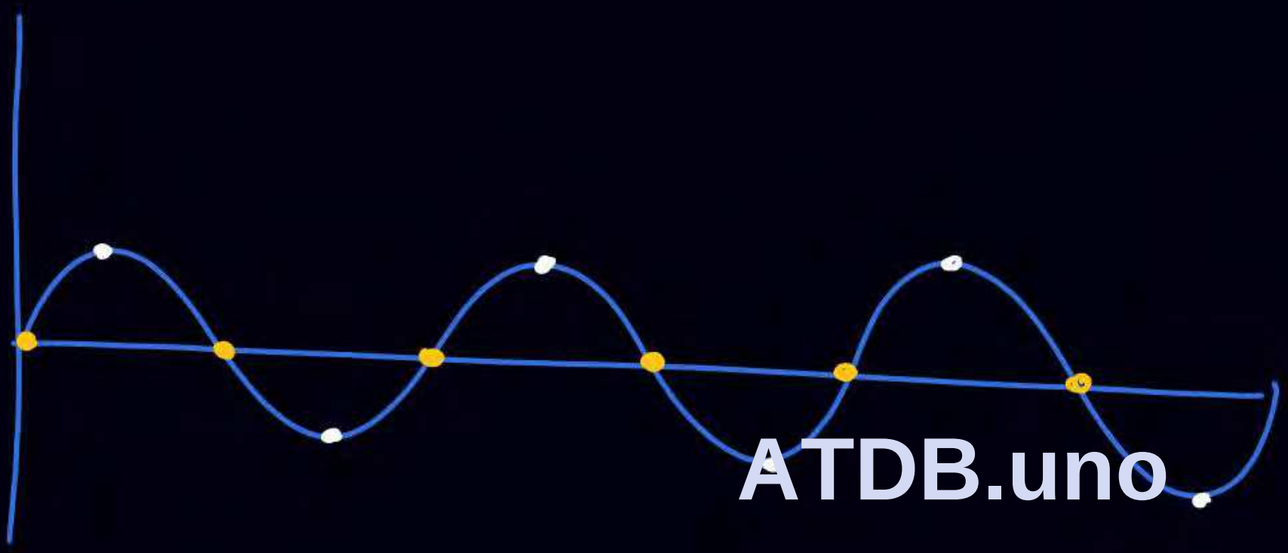


① $t_1 = t_2$

②



$(\text{Velocity})_1 = (\text{Velocity})_2$



Home work

- module ≡ (fluid PYQ) Last day
- JA PYQ 'Fluid (Last day today)
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