VISUAL PHYSICS

SHORT NOTES

CHAPTER

Motion in 1-Dimension

Available at:

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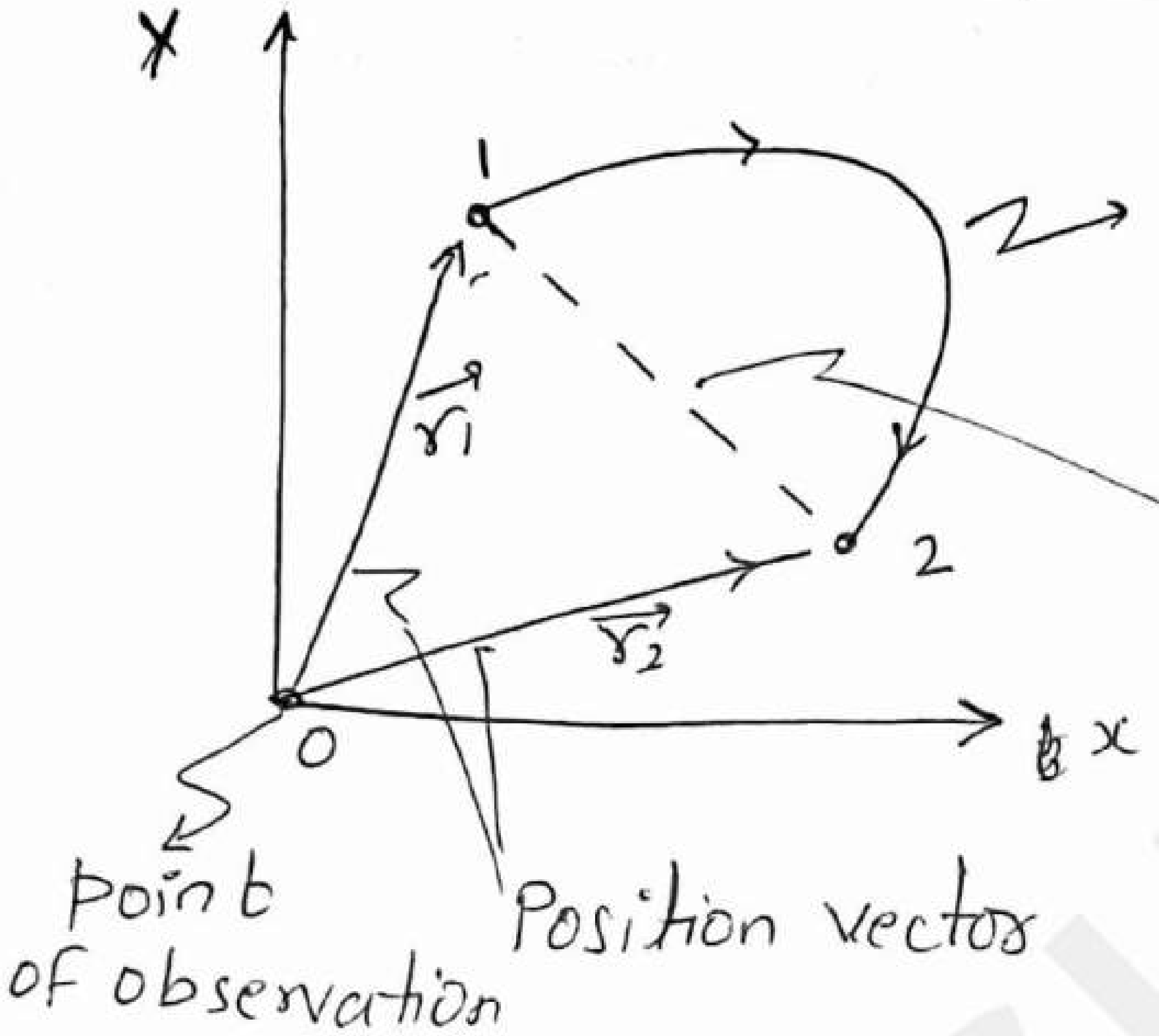
www.visualphysics.in

Motion in 1-D

Distance & Displacement



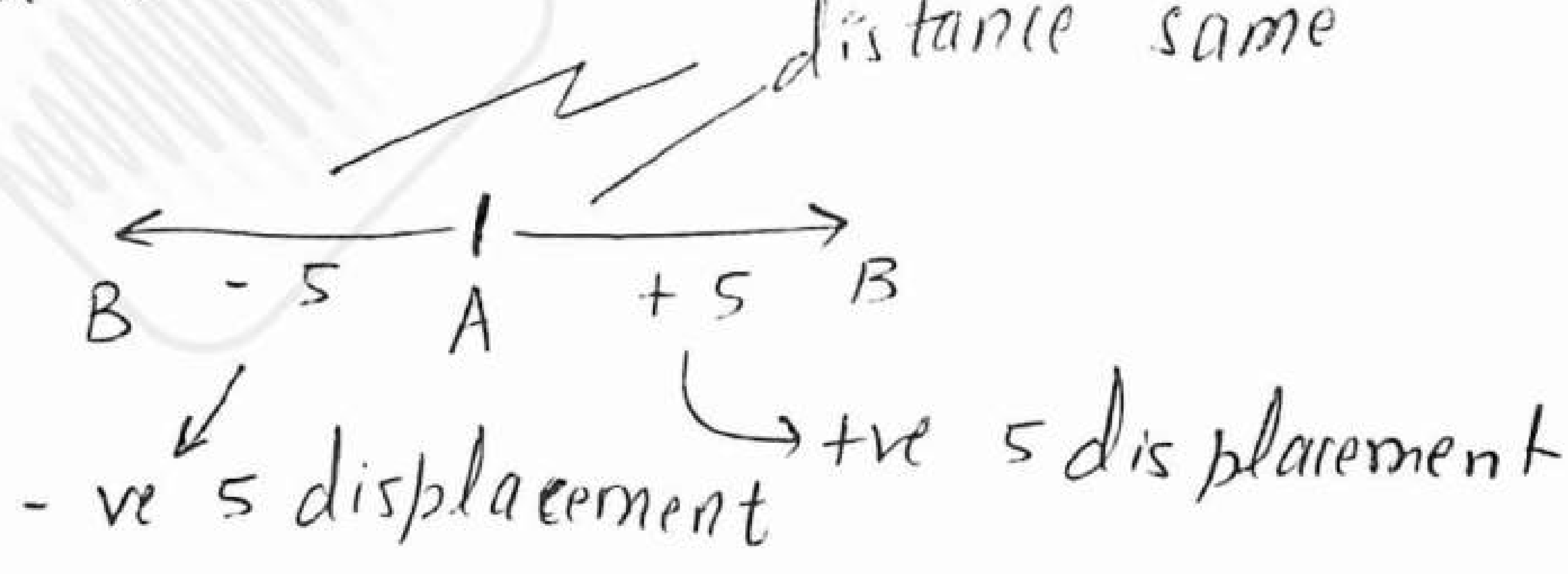
while moving the length of actual path covered is 'DISTANCE'

The shortest distance between initial and final position is "DISPLACEMENT".

Distance → scalar → No direction

Displacement → vector → direction

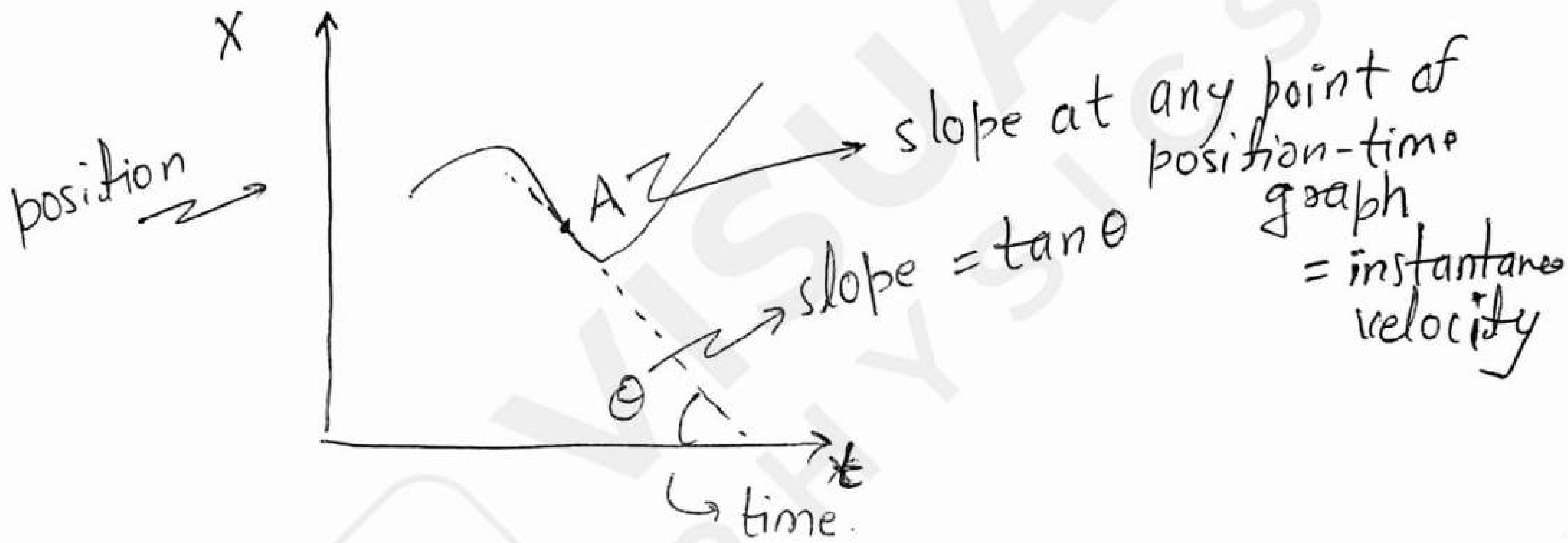
for motion in one direction if we take say +x direction as + direction, so negative x-direction → -ve.



Speed & Velocity (in 1-D)

Average speed = $\dfrac{\text{Total distance covered}}{\text{Time required to cover that distance}}$

Average velocity = $\dfrac{\text{Total displacement}}{\text{Time elapsed to cover that displacement}}$



⇒ Instantaneous speed := magnitude of instantaneous velocity

Instantaneous velocity = $\dfrac{dx}{dt}$ → position

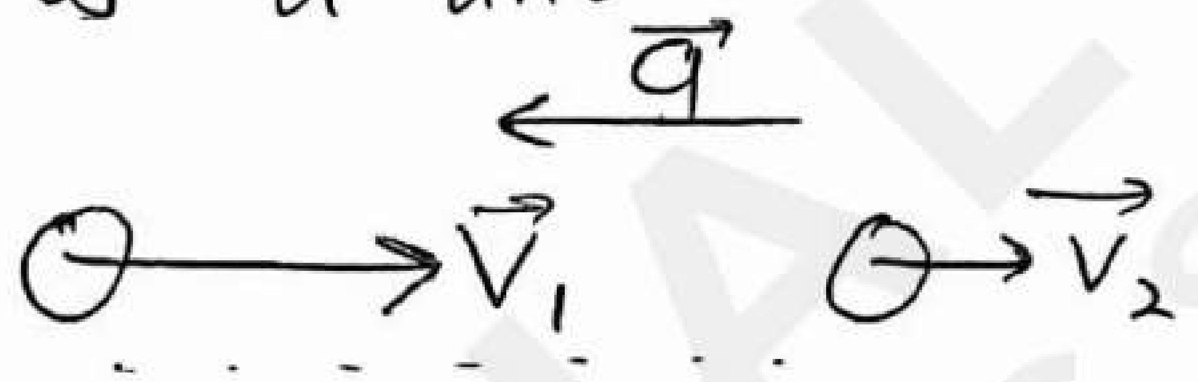
⇒ We always consider one direction as positive and other negative and positive negative sign gives direction of velocity.

Instantaneous Acceleration:

Rate of change of velocity = Acceleration

$$\frac{dv}{dt} = a$$

direction of a and v can be different



$V_1 > V_2$

so, $\vec{a}$ is opposite to $\vec{V}$

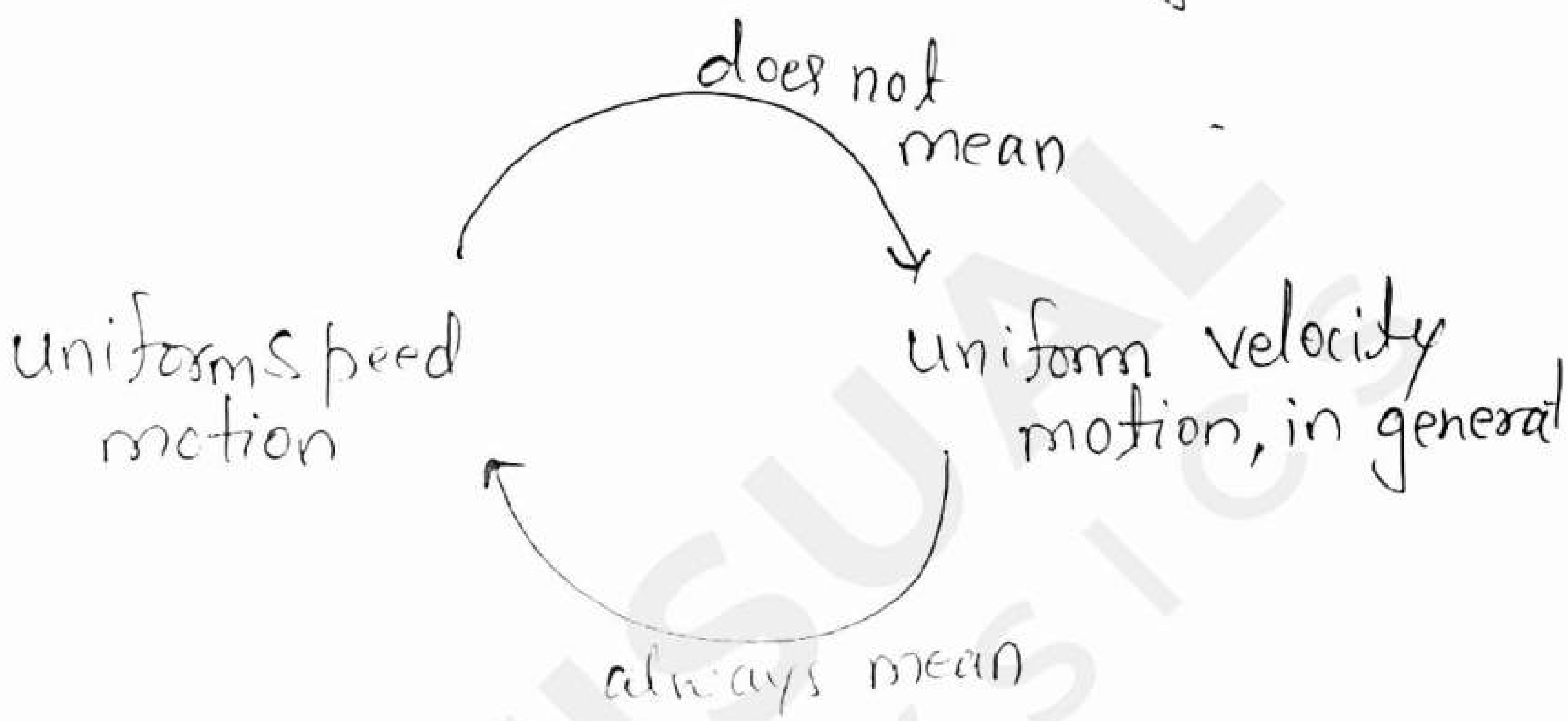
slope of position - time → velocity (instantaneous)

slope of velocity - time graph → Instantaneous acceleration

$$\text{average acceleration} = \frac{\text{change in } \vec{V} \text{ in given time}}{\text{time elapsed}}$$

⇒ **Uniform speed motion** → Speed of object remains constant throughout the motion

⇒ **Uniform velocity motion** → velocity of object remains constant throughout



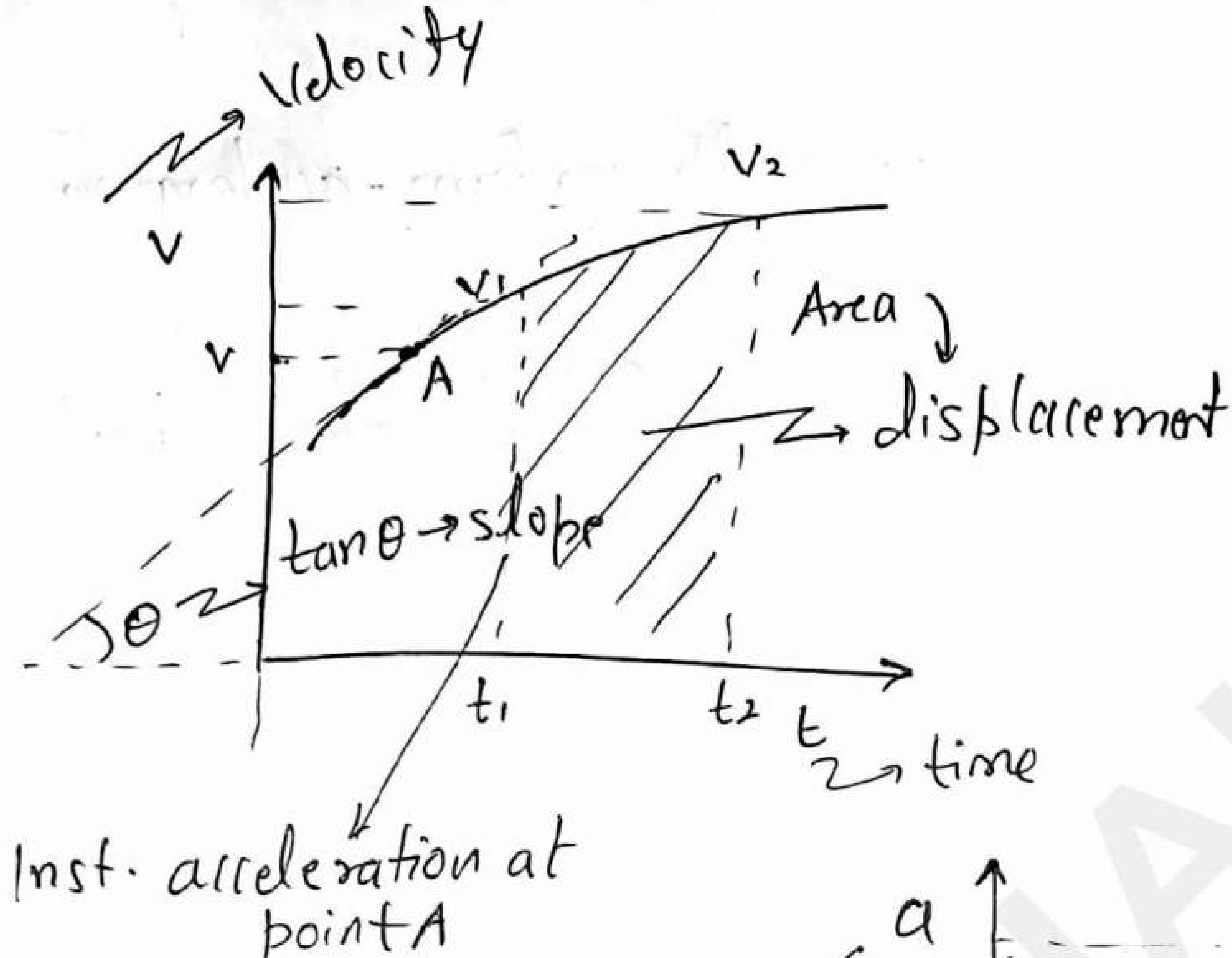
Graph & its outcomes:

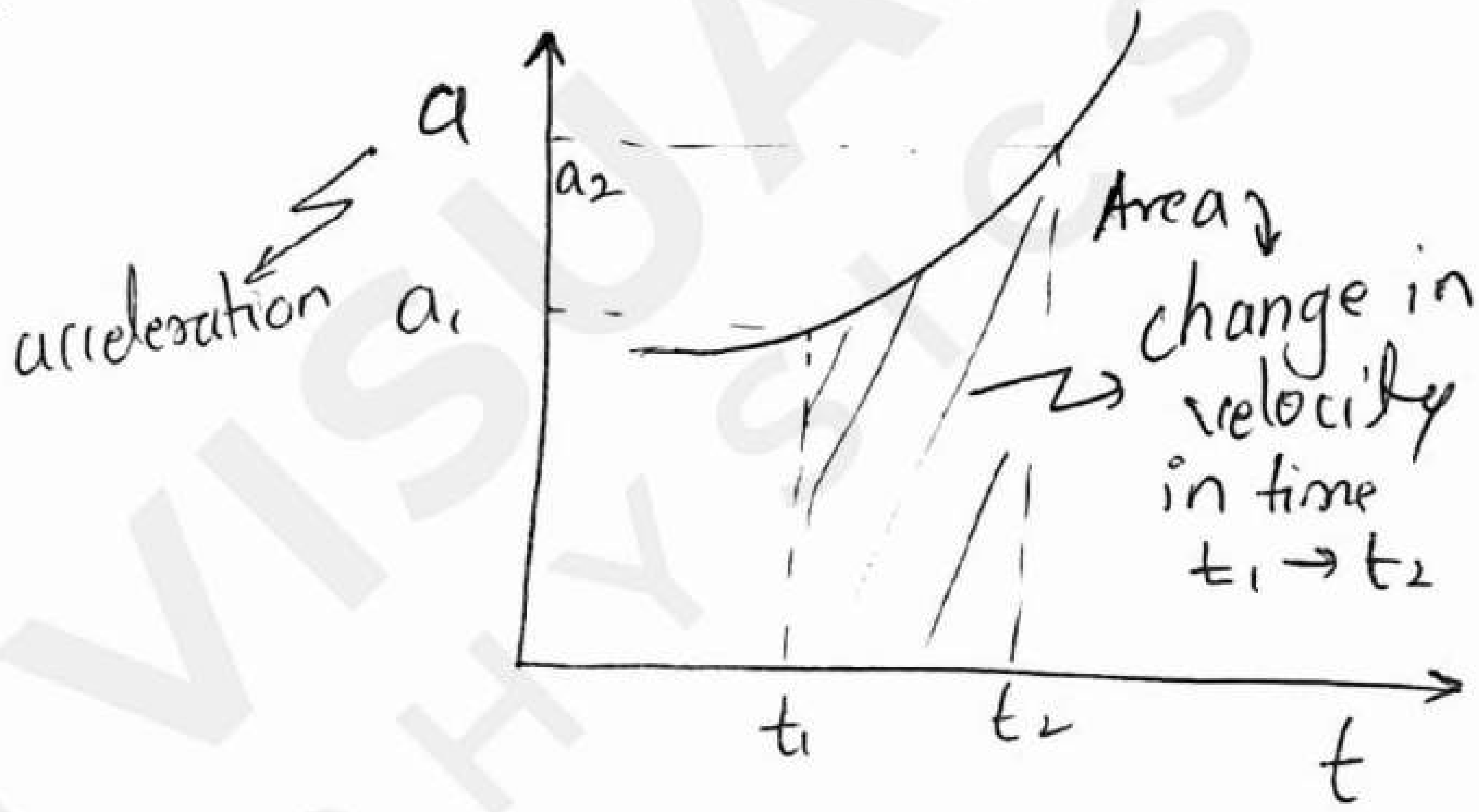
(1) slope of position - time graph → velocity

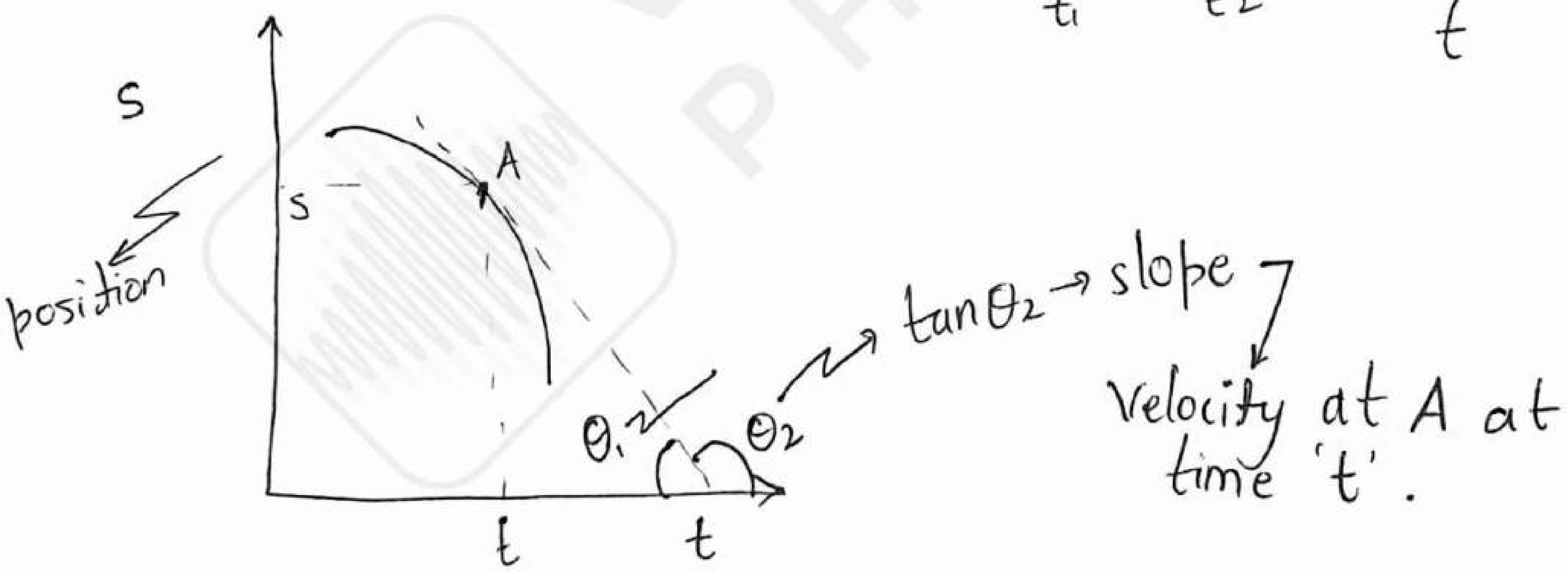
(2) slope of velocity - time graph → allderation

(3) Area under acceleration-time graph → change in velocity

(4) Area under velocity - time graph → displacement


velocity
V
V_2
V_1
v
A
Area → displacement
tanθ → slope
θ
t_1
t_2
t → time
Inst. acceleration at point A


a
acceleration
a_2
a_1
Area → change in velocity in time $t_1 \to t_2$
t_1
t_2
t


S
position
s
A
θ_1
θ_2
$\tan\theta_2$ → slope → Velocity at A at time 't'.
t
t

→ We will consider motion with uniform-acceleration

↳ acceleration will remain constant

→ As,

$$a = \frac{dv}{dt}$$

$$a\,dt = dv$$

$$a\int_0^t dt = \int_u^v dv$$

$$at = v - u$$

$$\Rightarrow \boxed{v = u + at}$$

(v: final velocity; u: initial velocity; a: acceleration; t: time elapsed)

→

$$a = \frac{dv}{dt}$$

$$a = \frac{dv}{dt}\frac{dx}{dx}$$

$$= \frac{dv}{dx}\left(\frac{dx}{dt}\right)$$

($\frac{dx}{dt}$ → velocity)

$$a = v\frac{dv}{dx}$$

$$\int_0^s a\,dx = \int_u^v v\,dv$$

$$as = \frac{v^2 - u^2}{2}$$

$$\Rightarrow \boxed{v^2 = u^2 + 2as} \rightarrow \text{displacement}$$

↑ acceleration

→ as $v = \frac{dx}{dt}$

$$(u + at) = \frac{dx}{dt}$$

$$\int_0^t (u + at)\,dt = \int_0^s dx$$

$$\Rightarrow \boxed{s = ut + \frac{1}{2}at^2}$$

Three equations:

1. $v = u + at$
2. $v^2 = u^2 + 2as$
3. $s = ut + \frac{1}{2}at^2$

Acceleration due to gravity

└→ g → $9.8\,m/s^2$

└→ $10\,m/s^2$

↓

Normaly.

→ direction → always downwards towards earth

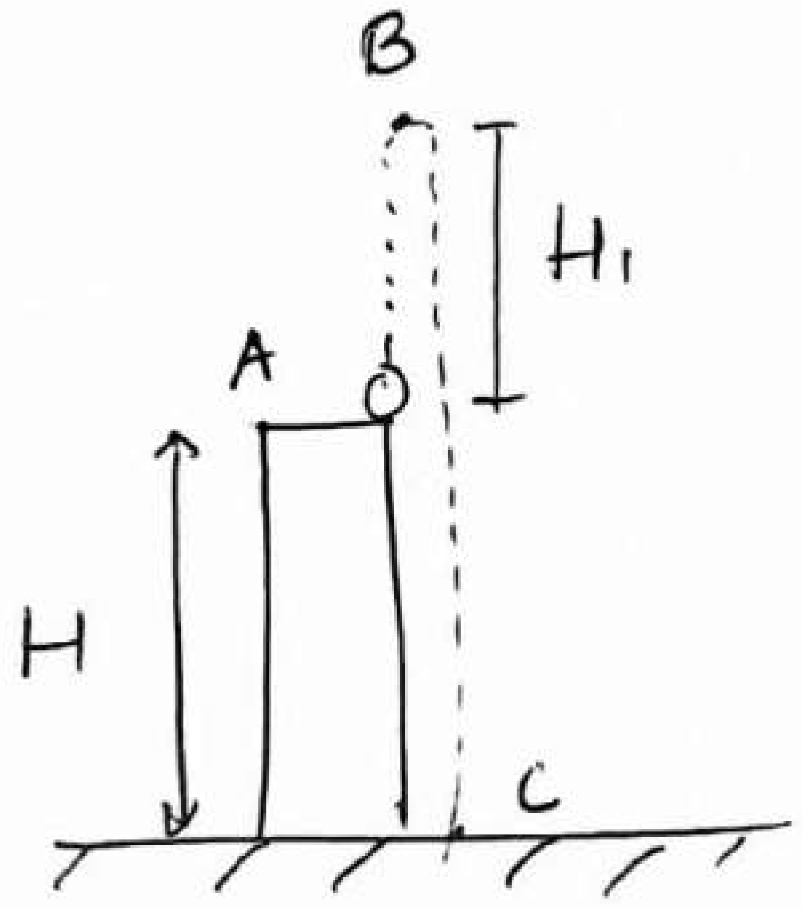
if we take direction ↑ +ve

than $a = -g$

if we take direction ↓ +ve

$a = +g$

Using scalar method:



from A→B
$a = -g$ → as gravity opposes the motion
$s = H$

from B→C
$a = +g$ → gravity support motion
$s = H + H_1$

Using vector

upward direction → +ve
doward direction → -ve

acceleration = $(-g)$ → as gravity is in down direction

$s = (-H)$ → as object ultimately goes from A→C displacement → $-H$