Physics

MOTION

1. what is physics?

Physics word is came from "Furis" which means Nature. Physics derives with study of Nature and Natural phenomenon.

Ex: Formation of wind, Light, Flow of current etc.

Physical Quantities

All those quantities which can be measured.

Ex: Length, mass, time, temperature, pressure, force, work, energy.

Physical Quantities contains two major types:

i.e. 1. Scalar Quantity: It contains only magnitude. Ex: length, mass, Time etc.

Vector: It contains Both direction and magnitude.

Ex: force, acceleration, etc.

Representation: $\vec{A}$ or $\overline{A}$

what is unit?

The reference standard in form of any given Physical quantity is measured.

BOTTOM

Eg: length of table is 5m, it means its length is 5 times as compared to a unit called 1m.

Various types of units.

C G S unit system — centimeter gram sec
M K S unit system — Meter, kilogram, sec
F P S — Foot — Pound - second.

Motion

What is Motion?

The phenomenon change in position of an object with respect to time and observer is known as Motion.
Note: Motion is related term.

Two states of Motion

- State of rest: An object is said to be at rest if it does not change its position with respect to time.

State of Motion: An object is said to be at motion if it changes its position with respect to time.

Motion in a straight line

Distance & Displacement

Distance: Distance is the actual path covered by an object.

Displacement: The shortest line separation between Initial position and Final position.

Difference between Distance & Displacement

Distance	Displacement
Total actual path length covered by the body.	Shortest distance between Initial and Final position.
SI unit → m	SI unit → m
Representation → D.	Representation → $\vec{S}$
Can never be negative.	can be negative.

Speed & velocity.

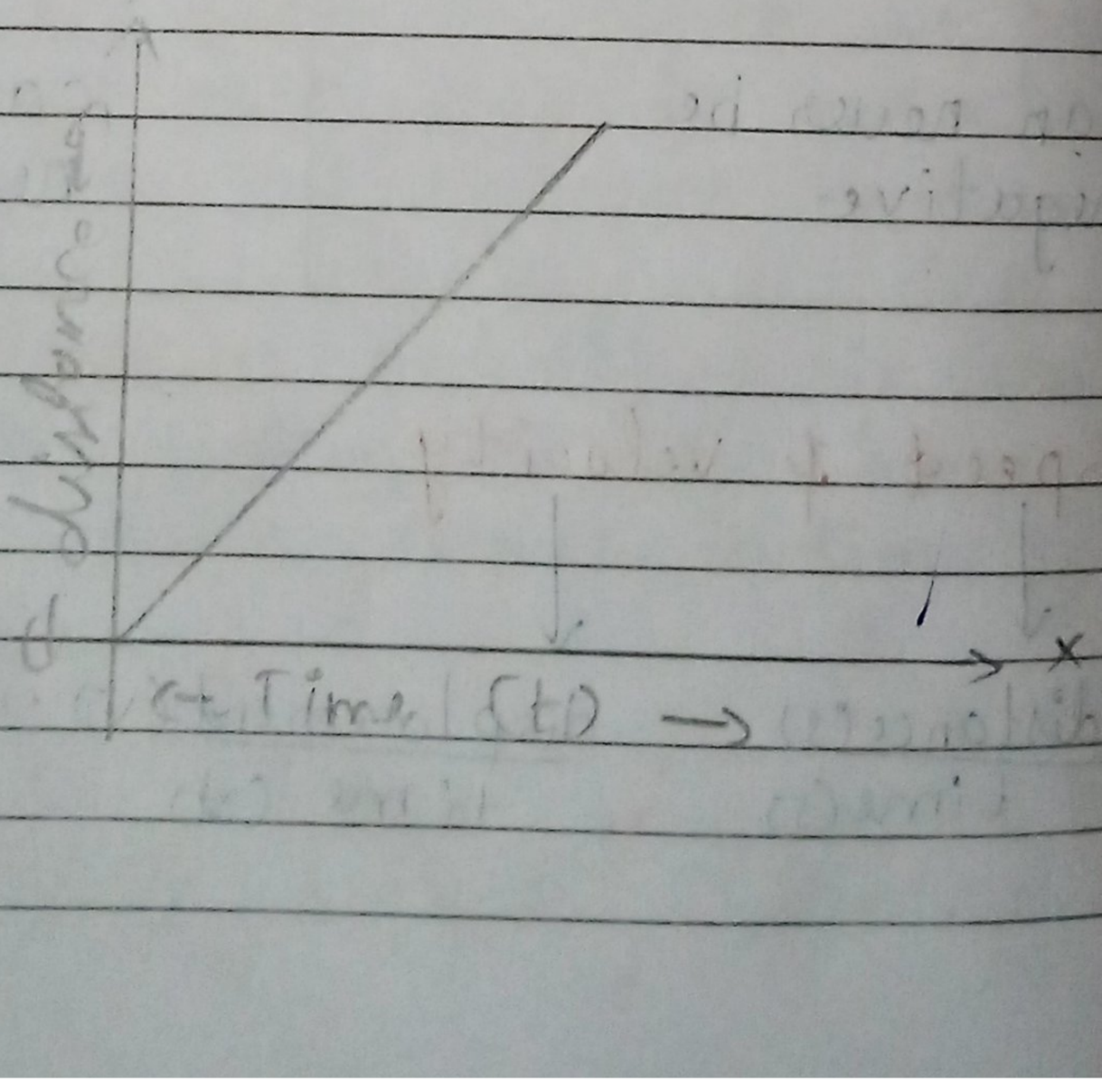
↓ ↓

distance(s) / time(t) — displacement(v) / time(t)

Speed	Velocity
Total distance covered per unit time.	Total displacement occured per unit time.
S.I unit → m/s	S.I unit → m/s
Representation - v	Representation → $\vec{v}$
Scalar Quantity	Vector Quantity

Uniform Motion

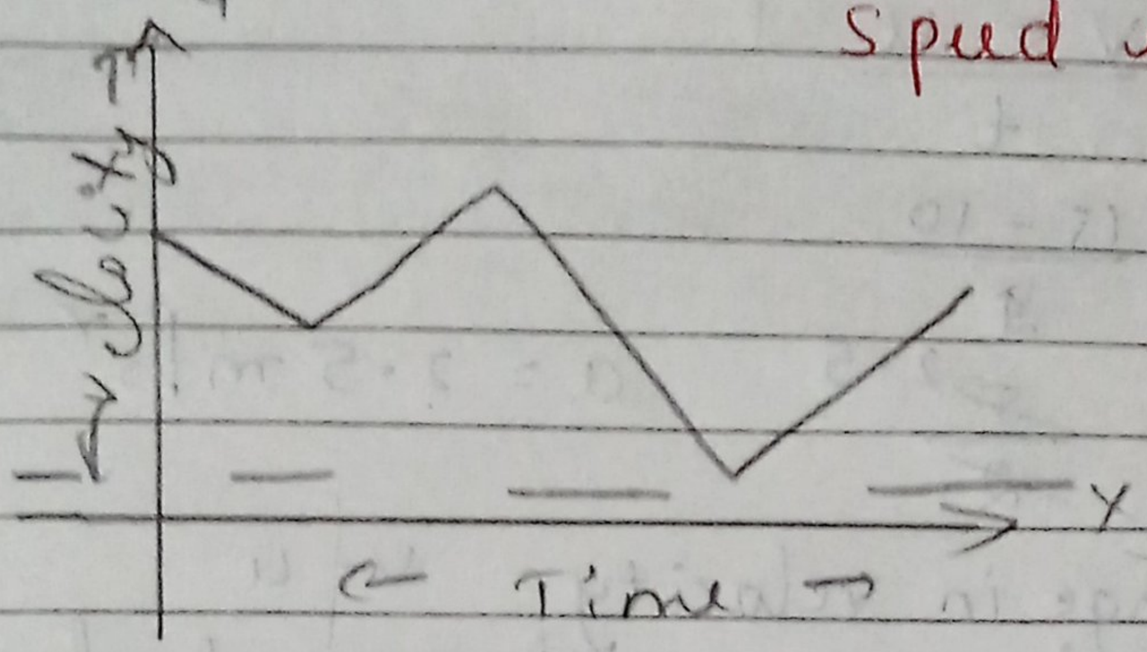
This type of motion is defined as the motion of an object in which the object travels in a straight line and its velocity remains constant along that line and it covers equal distance in equal interval time.



Non Uniform Motion

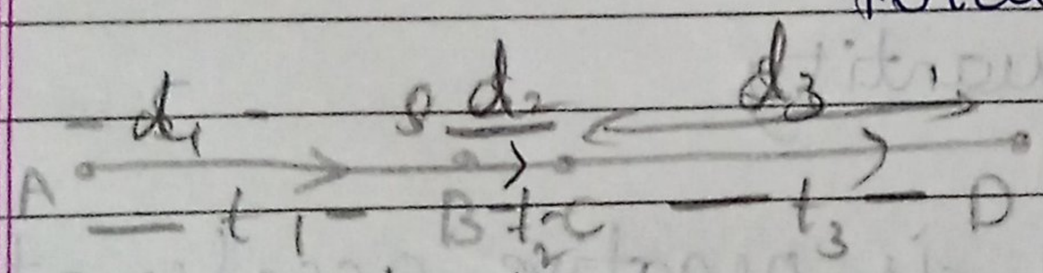
This type of motion is defined as the motion of an object in which the object travels in a straight line and its velocity remains constant along that line as it covered un equal distances in equal intervals of time

Spud is Variable



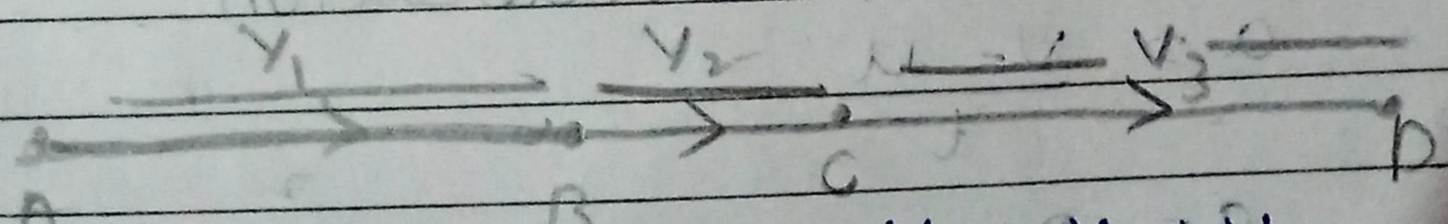
Average speed & Average Velocity:

$$\text{Average speed} = \frac{\text{Total distance covered}}{\text{Total time taken}}$$



$$\text{Average speed} = \frac{D_1 + D_2 + D_3}{t_1 + t_2 + t_3}$$

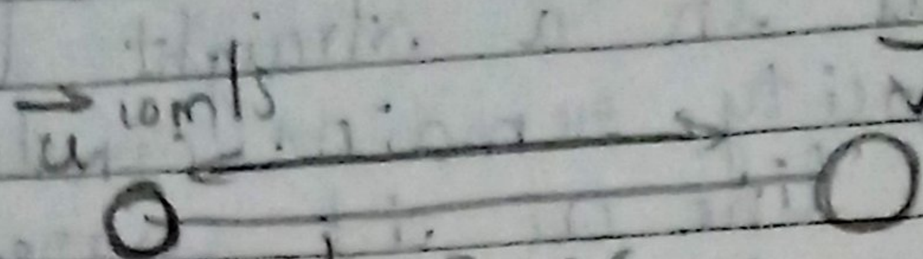
$$\text{Average Velocity} = \frac{\text{Sum of velocities}}{\text{No. of. velocities}}$$



$$\text{Average velocity} = \frac{V_1 + V_2 + V_3}{3}$$

Acceleration

It is the rate of change of velocity



Eg:- $a = \frac{\bar{v} - \bar{u}}{t}$

$= \frac{15 - 10}{2}$

$a = \frac{5}{2}$ 2.5 $\quad a = 2.5\ m/s^2$

→ change in velocity = $v - u$

→ Acceleration, a = $\frac{\text{Change of velocity}}{\text{time}}$.

$a = \frac{v - u}{t}$ $\quad \frac{m/s}{s} = m/s^2$

SI. unit = m/s^2

→ vector Quantity

→ Retardation is negative acceleration

If the Brakes are applied while driving.

$u = 6\ m/s$ $\xrightarrow{2\ sec}$ $v = 2\ m/s$

To find acceleration

$a = \frac{v - u}{t}$

$a = \frac{2 - 6}{2}$ $\quad a = -\frac{4}{2}^{2}$ $\quad a =$

Motion

- Straight line (1 Dimensional) → Non-accelerated
  - Uniform motion ($a = 0$) → $speed = \frac{D}{t}$
  - Non-uniform motion → accelerated motion. → if a → exist → $a = \frac{v - u}{t}$ → Kinematical eqⁿ.
- Plane ↓ 2D motion
- Space ↓ 3D motion

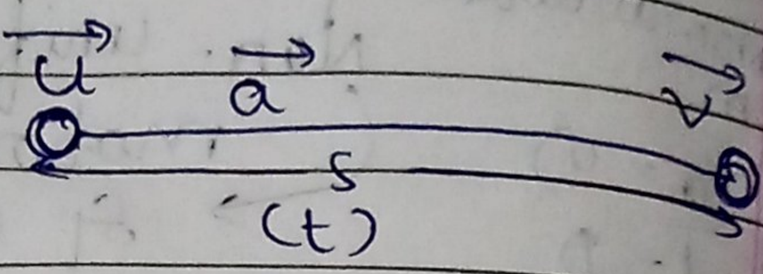
Kinematical eqⁿ.

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

Equations of motion

☆ Deriving Kinematical equations:-

u = intial velocity
v → final velocity
a → acceleration
s → displacement
t → time.



Derive this, ~~v+~~
$v = u + at$
$s = ut + \frac{1}{2}at^2$
$v^2 = u^2 - 2as$

First,
$a = \frac{v-u}{t}$
$at = v - u$
$at + u = v$
or $v = u + at$

Second,
By defination of average velocity.
$v = \frac{\text{displacement}}{\text{time}}$
$\frac{v+u}{2} = \frac{s}{t}$ ∴ velocity will $\frac{v+u}{2}$
$t\left(\frac{v+u}{2}\right) = s \longrightarrow (1)$

$s = \left(\frac{u+v}{2}\right)\left(\frac{v-u}{a}\right)$ if $a = \frac{v-u}{t}$

$2as = (v+u)(v-u)$ then, $t = \frac{v-u}{a}$

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

Next,

$$s = \left[\frac{u+}{2}\right] \times t$$

In first eqn.

$$t\left(\frac{u+v}{2}\right) = s$$

$$t\left(\frac{u+(u+at)}{2}\right) = s$$ ∴ In the place of v we can substitute first formula. i.e. $v = u+at$

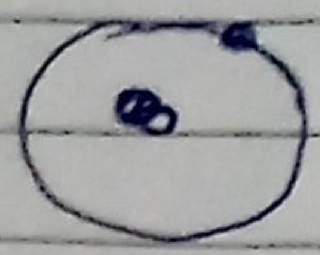
$$t\left(\frac{2u+at}{2}\right) = s$$

$$s = \left(\frac{2u}{2} + \frac{at}{2}\right)t$$

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

Circular Motion

An object moving along circular path.



Uniform Circular Motion: An Object moving along circular path with constant speed.

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

In completing 1 circle,
Distance = Circumference
$(2\pi r)$
Time = Time period of revolution.

$$\therefore \text{Speed} = \frac{2\pi r}{t}$$

∴ In Circular motion velocity can't be Constant.
Because, the direction ~~of~~ is changing all the time.