speed, velocity, Mass, wt. work, Power, energy

⇒ **speed** - The measure of rate in change in position is called speed. Its a scalar quantity as it has only magnitude and no direction.

$$s = d/t$$

where
s = speed, d = distance travelled
t = time

SI unit = m/s.

Types of speed

Uniform - if object covers same distance at regular intervals of time
→ eg 2m in each 2s

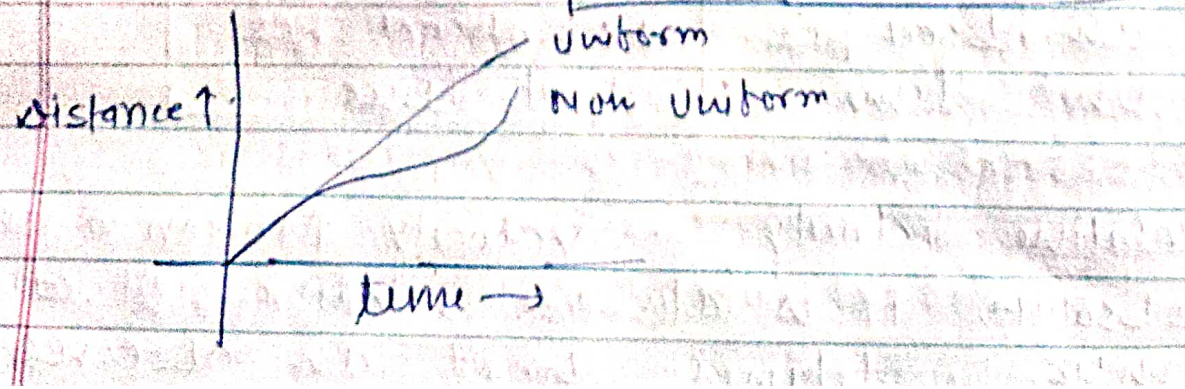
Non-Uniform → The objects covers different distance at different time intervals
→ eg 3 m/s → 2 m/s → 5 m/s.

Average speed - The total distance covered upon total time taken

eg $\frac{x_1}{t_1}$ + $\frac{x_2}{t_2}$ + $\frac{x_3}{t_3}$ + $\frac{x_4}{t_4}$:

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

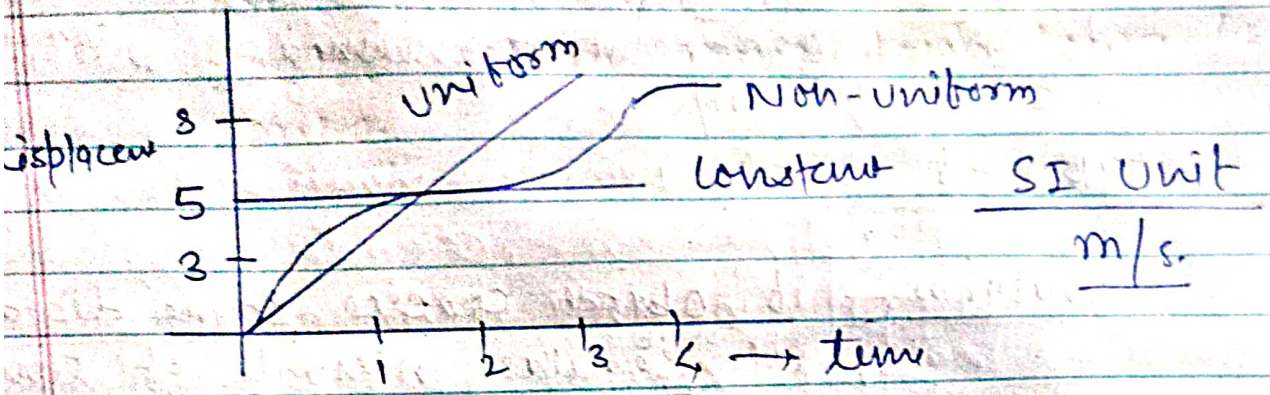
$$= \frac{x_1 + x_2 + x_3 + x_4}{t_1 + t_2 + t_3 + t_4}$$



Velocity – It is the vector measurement of change in position in definite direction. It has both magnitude and direction hence velocity is a vector quantity

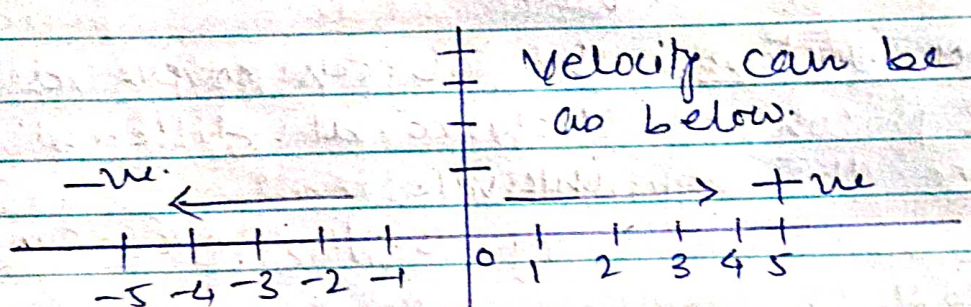
$$\vec{v} = \frac{d(\vec{s})}{dt}$$

v = velocity
s = Displacement
t = time taken.



SI Unit
m/s.

Velocity types



Velocity	Vs	Speed
↳ Vector quantity		↳ Scalar quantity
↳ Can be +ve or -ve or zero		↳ Can't be -ve.
↳ displacement of an object per unit time		↳ Distance of an object per unit time

Relative velocity – Velocity Motion is never absolute it is always relative. It can only be defined w.r.t an observer. So relative velocity is defined as the velocity of one body with respect to another

$$\vec{V_{AB}} = \vec{V_A} - \vec{V_B}$$ Velocity of A wrt B.

Gravity - In physics, gravity (from the Latin word 'Gravitas' [weight]) is a fundamental interaction, which causes mutual attraction between all things that have mass. It is by far the weakest force in the universe.

On the other hand, through its long reach and universal action, it controls the trajectories of bodies of solar systems, stars, galaxies and whole cosmos.

It is the property of our Earth by virtue of which an object gets attracted towards it. Gravity is measured by the acceleration that it gives to free falling body. It is denoted by 'g'

g at surface of Earth = 9.8 m/s²
or 32 ft/s²

g at moon surface = 1.6 m/s²

It varies from equator to pole

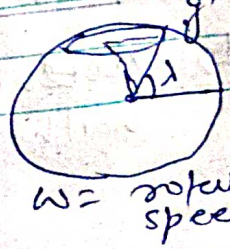
g_{max} = equator pole

g_{min} = equator

Effect of on g

* Effect of Rotation of Earth

$$g' = g(1 - \omega^2 \cos^2\lambda)$$

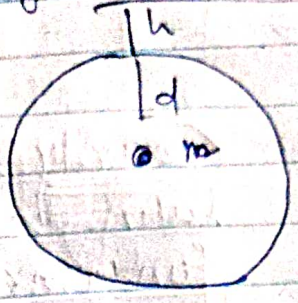


ω = rotation speed

$\lambda = 90°$ $\omega = 0$

$g' = g$

* Change of g w.r.t height / depth



$g_h = g\left(1 - \frac{2h}{R}\right)$

$g_d = g\left(1 - \frac{d}{R}\right)$

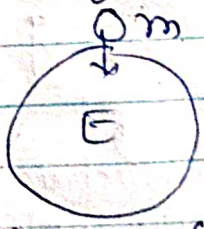
ie $\boxed{g_{max} = \text{surface}}$

with height value of g decreases faster than going down towards centre.

⇒ Mass & weight

Mass is the total measure of 'stuff' or amount of matter of an object.
Mass is always same. a scalar quantity
SI unit = Kg

weight - It is the force of gravity on an object.



$\boxed{Wt = m \times g}$

a vector quantity measured in N (Newton)

Mass	weight
↳ a constant quantity of matter	↳ variable measurement of force of gravity on object
↳ doesn't change with place	↳ changes as per place eg at pole ↑ at equator

⇒ Force Relation between mass

If a free falling object with mass 1 kg with accelaration 9.8 m/s² then wt would be 1 N. It is derived from Newton's second law of motion.

$$F = m \times a \Rightarrow m \times g$$
$$= 1\,kg \times 9.8\,m/s^2 = 9.8\,kg\,m/s^2$$
$$= 1\,N.$$

⇒ Force - In general sence it is a 'push or 'pull'. An external agent which changes or tends to change in shape size or position of an object.

↳ eg & wind force causes sailboat to move.

↳ a & vector quantity → unit → N.
CGS unit - dyne.

↳ According to second law of motion force is the change in movementum.

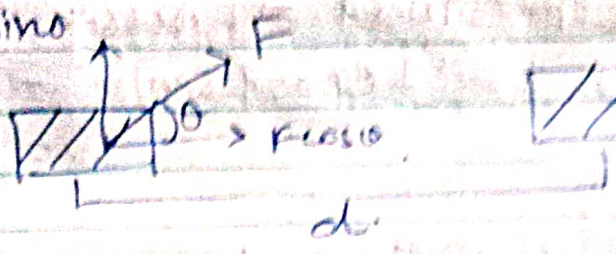
$$F = \frac{d\vec{p}}{dt} = \frac{d(m\vec{v})}{dt} = m\frac{d\vec{v}}{dt}$$
$$= m \times a$$

F = mass x accelesation

↳ Work - The 'word' work may have different meaning for different one eg writing exam → mental work
cycling - physical work

However in physics work is the quantitive measure of multiplication of force & displacement caused.

→ suppose a Force of F N causes displacement to an object to d distance then work done is as



$$W = F\cos\theta \times d$$ a scalar quantity

if $\theta = 0$, W_{max}
$\theta = 90°$ - W_{min}

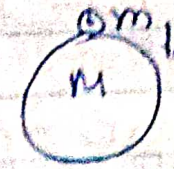
Unit = N s
= Joule
= erg (10^{-7})

Work-Energy
Work-Energy Theorem

The work done by all the forces acting on a body is equal to the change in kinetic energy of the body.

$$W = \Delta K$$

Energy
- Kinetic Energy → by virtue of motion $\frac{1}{2}mv^2$ eg car, bullet etc
- Static Energy - by virtue of position → mgh dam, spring



Energy can be created nor

eg Energy stored in Dam → Static energy

↳ When falls from height it gains motion ↳ energy changes to Kinetic

eg Turbine moves

Solar cell - converts solar to electric

Dynamo - converts Mechanical to electric

Motor → Electric to Mechanical

Power - In our daily life time taken to do a work is important. eg a man can dig a whole in 3 days while JCB can do in 3 hrs. Therefore it is important for us to know rate of doing work which is called power.

Power indicates how a task can be accomplished fastly.

$$P = \frac{\Delta W}{\Delta t}$$ → scalar quantity

unit → J/s - watt

instantaneous power

$$P = \lim_{\Delta t \to 0} \frac{\Delta W}{\Delta t} = \frac{dw}{dt}$$

1 KW = 1000 W

1 MW = 1000 10^6 W

1 HP (Horse Power) → 746 Watt

↳ measure of Big Machines