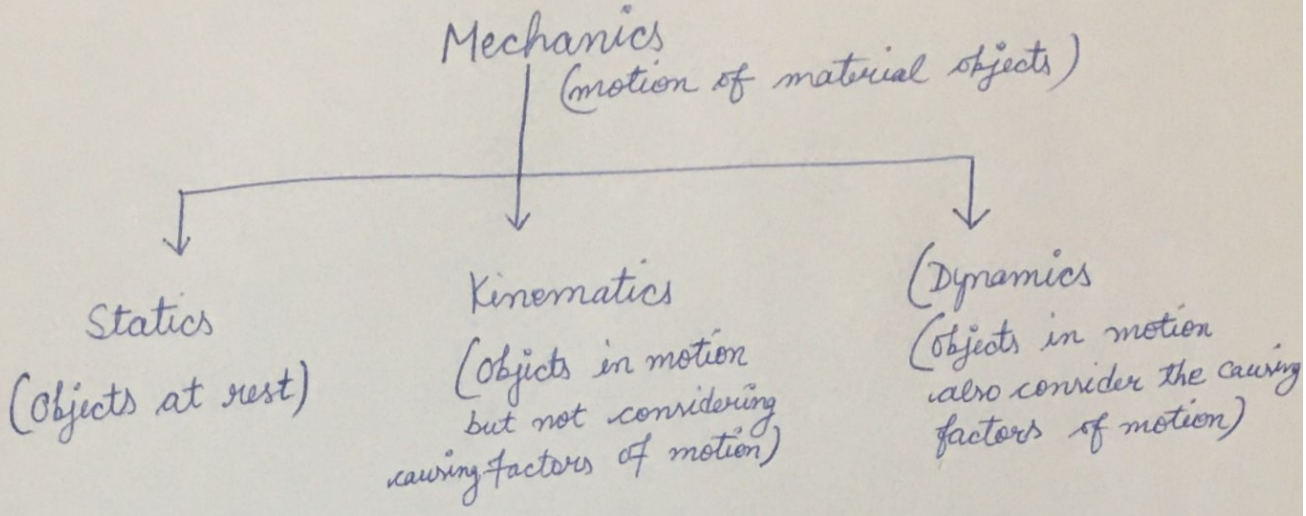
Lecture 1

Statics

Chapter-1 Basic Concepts



causing factors of motion :- force, torque or momentum

Rest: An object is said to be at rest if it does not change its position with time w.r.t. its surroundings.

Q: When body is at rest, does it posseses any form of energy?

Q:- Is the concept of rest or motion is absolute or ~~dynamic~~? relative?

Q:- A body at rest can have
a) Speed b) Energy c) Momentum d) Relative velocity

Motion :- An object is said to be in motion if it changes its position with time w.r.t. its surroundings.

Mathematically, motion can be described in terms of displacement, distance, velocity, acceleration, speed and time.

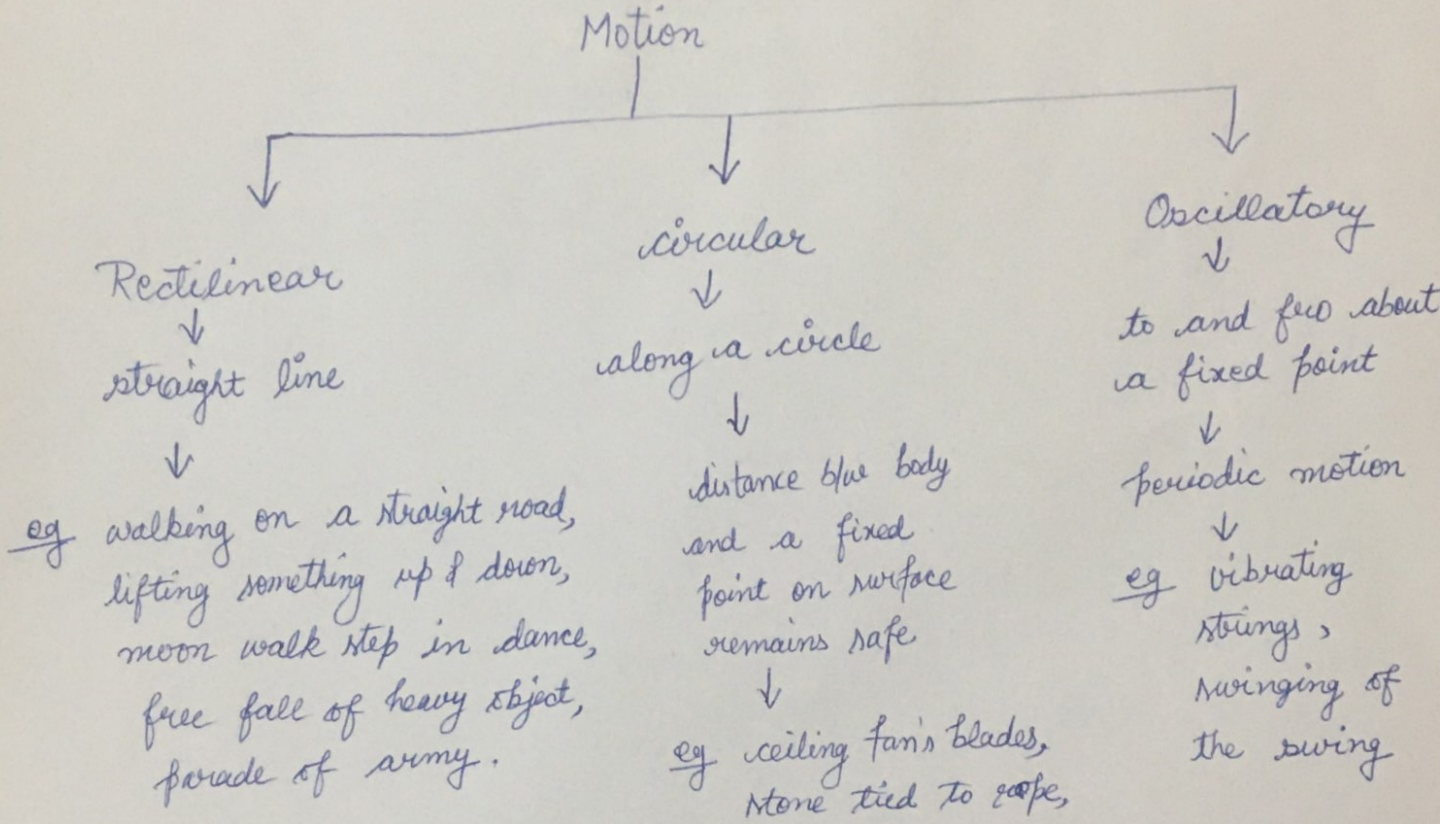
Q: Distinguish between displacement and distance?

Q: How can you define acceleration?

Q: Discuss Momentum.

* An object's motion, and thus its momentum, cannot change unless a force acts on the body.

Types of Motion



Path:- The path of an object is the curve drawn through the successive positions of the particle during motion.

Space:- It is a region in which the events take place.

Matter:- Anything which occupies space is known as matter.

Particle:- A portion of matter which occupies infinitely small size is called a particle. It is represented by a point.

Body :- A portion of matter occupying a finite size is known as a body. A body may be considered to be made up of infinitely many number of particles.

Rigid Body :- Rigid body is a body in which the distance between any two of its particles is constant, thus a rigid body does not change its shape and size when subjected to external forces.

Mass :- It is defined as the quantity of matter contained in the body.

Measuring Process

Unit :- It is the chosen standard of measurement of a quantity which has essentially the same nature that of the quantity.

Fundamental quantities :- Length, mass and time.

Fundamental units :- units of measurement of the fundamental quantities.

Derived units :- These are the units of measurement of quantities which can be obtained from fundamental units.

System of Units :-

i) C.G.S. system – centimeter, gram, second

ii) M.K.S. system – meter, kilogram, second

iii) F.P.S. system – foot, pound, second.

Force:- A force is a push or pull that causes a change in speed, direction or shape.

* Force is the external agency which changes or tends to change the state of rest or of uniform motion along a straight line.

* Force = Magnitude + direction + point of application.

Units of force :-

i) **Absolute Unit:-** In M.K.S., unit of force is "Newton (N)."

$1N = 1kg \times 1\ m/sec^2 = 1kg\ m/sec^2$.

In C.G.S., unit of force is "dyne."

$1\ dyne = 1\ gram \times 1\ cm/sec^2 = 1\ gm\ cm/sec^2$

$= 10^{-3}\ kg \times 10^{-2}\ m/sec^2 = 10^{-5}\ kg\ m/sec^2 = 10^{-5} N$

$\Rightarrow 1N = 10^5$ dyne.

ii) **Gravitational Unit:-** In M.K.S., unit of force is Kilogram weight (kg wt.)

$1\ kg\ wt = 1kg \times 9.8\ m/s^2 = 9.8\ kg\ m/s^2 = 9.8\ N$

In C.G.S., unit of force is gram weight (gm wt.).

$1\ gm\ wt = 1gm \times 980\ cm/s^2 = 980\ g\ cm/s^2 = 980$ dyne

* $1\ kg\ wt = 9.8N = 9.8 \times 10^5$ dyne $= 1000 \times 980$ dyne $= 1000\ gm\ wt$.

$$\boxed{1\ kg\ wt = 1000\ gm\ wt}$$

Weight:- It is a force with which a body is attracted towards the centre of earth.

Weight (N) $\propto$ Mass (m)

$$\vec{N} = m\vec{g}$$

* Weight differs at different places whereas mass remains constant.