Motion in one Dimension

What is Motion?

Change in position of an object.

For example:

- A man is walking. He is changing his position so he is in motion.
- Bus is moving. It is changing its position so it is in motion.
- Earth is revolving around the sun. It means that it is changing its position so it is in motion.

Which of the following objects are in motion?

- Leaves falling from tree.
- Water flowing down a dam.
- Rotation of earth.
- Man standing on a platform.
- Book lying on a table.

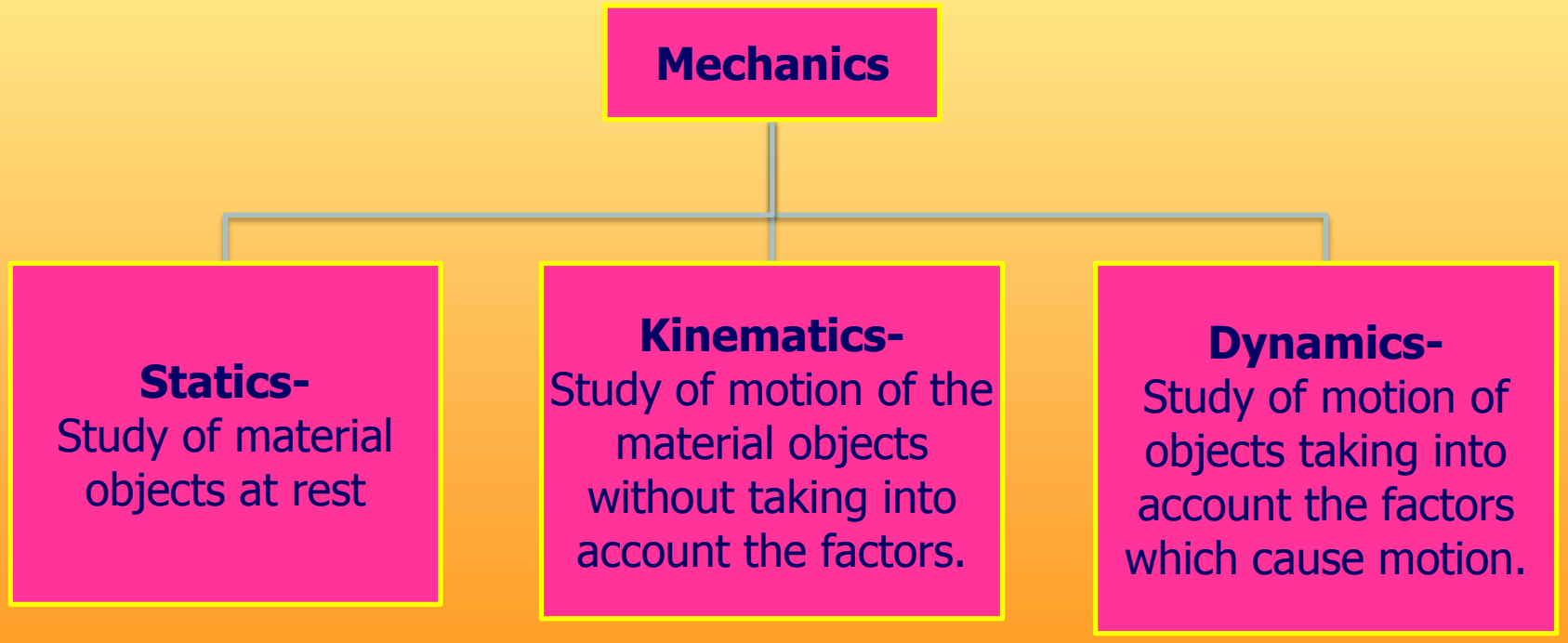
Kinematics

Topics covered in this Lecture are:

- Mechanics
- Motion

Mechanics and its branches

Mechanics : Study of motion of the body.



Object in motion

Rest: Object does not change its position

Motion: Object changes its position with time

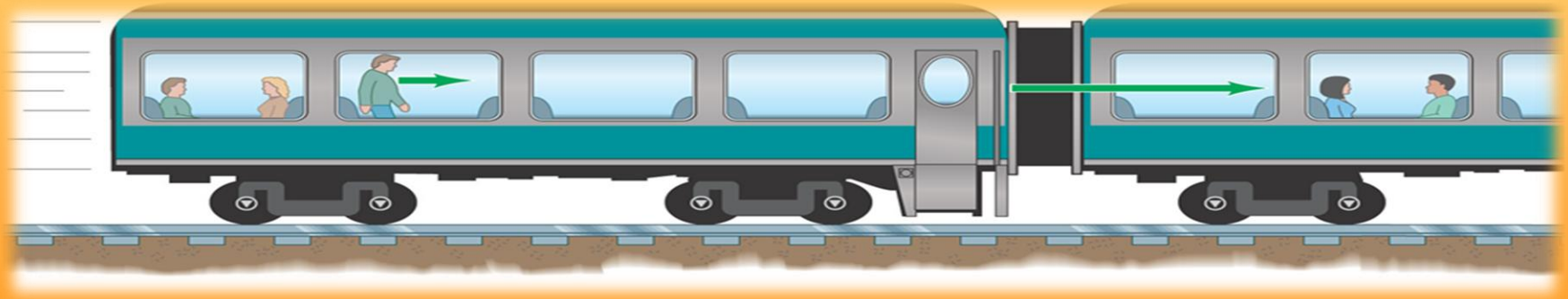
Examples of objects in motion:

- A bird is flying in air
- A train is moving on rails
- A ship sailing on water
- A man walking on road
- Motion of gas molecules.

Relation between Rest and motion

Rest and motion are related

Example: A person sitting in a moving train. He is moving with respect to ground but is at rest with respect to train.



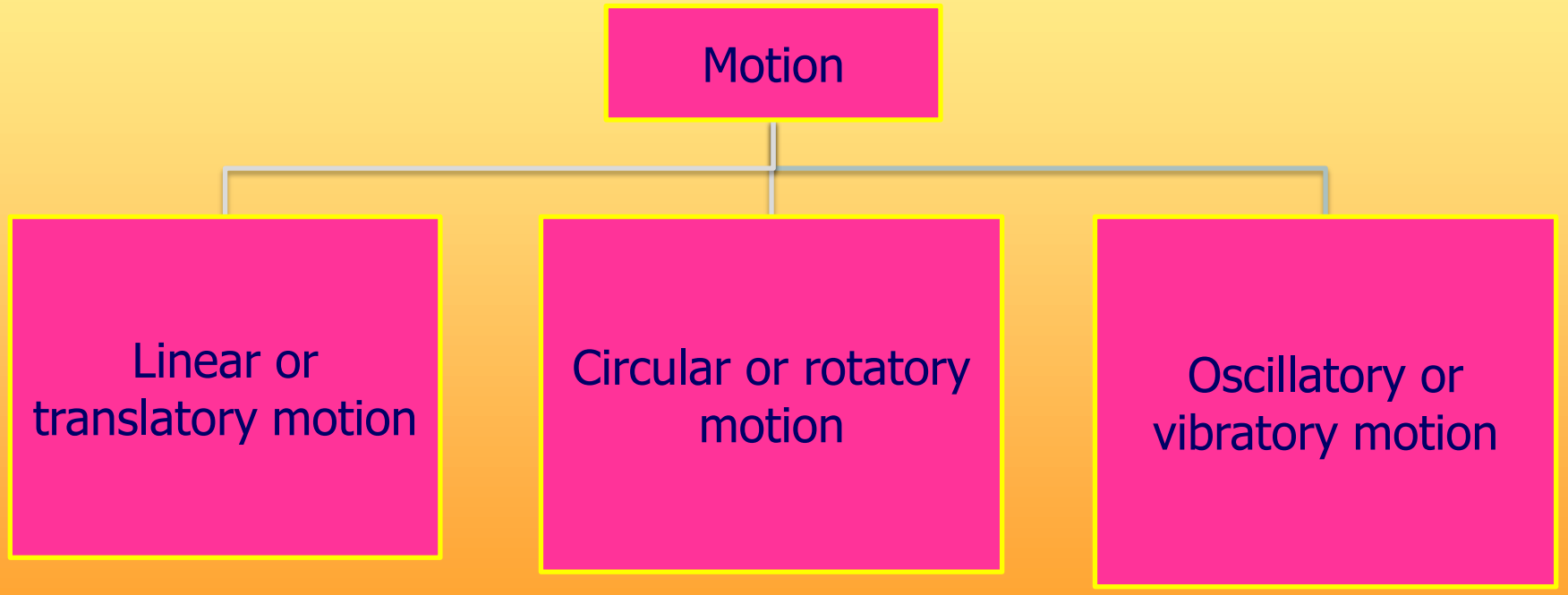
Concept of point mass object

Point object: Object covers distances much greater than its own size.

For example:

- A car travelling a few hundred kilometer distance, can be taken as a point object.
- If a train is travelling over thousand kilometers, then its size can be neglected as compared to its distance. Thus train can be treated as a point object.

Types of motion of a body



Types of motion

Linear motion : When a body moves either in a straight line or along a curved path, then we say that it is executing linear motion.

Types of linear motion:

1. When a body moves in a straight line then the linear motion is called **rectilinear motion.**

For example: An athlete running a 100 meter race along a straight track is said to be a linear motion or rectilinear motion.

Car moving in a straight line.

2. When a body moves along a curved path then the linear motion is called **curvilinear motion.**

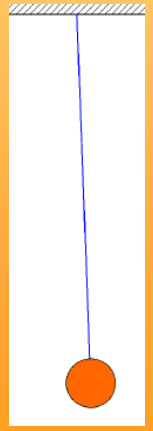
For example: A car moving in a curved path.

Other types of motion are :

Rotatory motion : A body is said to be in rotatory motion when it stays at one place and turns round and round about an axis.

Example :a rotating fan, a spinning ball, the earth.

Oscillatory motion : A body is said to be in oscillatory motion when it swings to and fro about a mean position.



Example : the pendulum of a clock, the swing etc.,

Kinematics

Kinematics is the study of motion without regard for the forces causing the motion or the description of motion.

Three basic kinematic variables:

1. position,
2. velocity and
3. Acceleration

The **position** of an object is simply its location in space. Changes in position can be described by **distance** or **displacement**

The **velocity** of an object is how fast it is changing its position

The **acceleration** of an object is how fast the velocity is changing

Frame of Reference

Any measurement of position, distance, or speed must be made with respect to a reference frame.

For example:

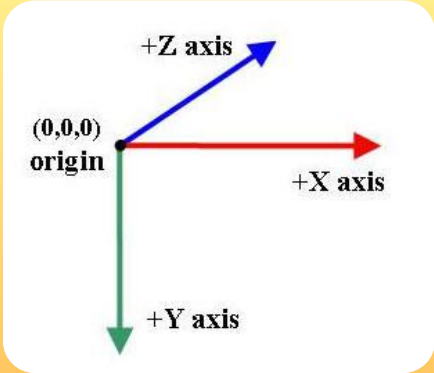
if you are sitting on a train and someone walks down the aisle, their speed with respect to the train is a few miles per hour, at most. Their speed with respect to the ground is much higher.

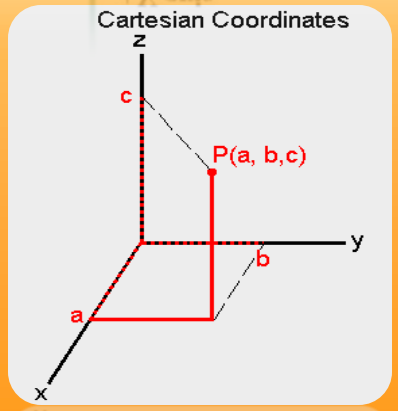
Frame of Reference

Rectangular coordinate system: X-, Y- and Z-axis.

Origin or reference point: The point of intersection of X, Y and Z axis

Position coordinates (a, b, c): Distances of the object along the X-, Y- and Z-axis.





Motion in one dimension

O: origin

Direction of motion of object: along X-axis

P: position of object at time t

OP = x.

One dimensional motion: Motion in which only one coordinate is changing with time.

Rectilinear or linear motion.

Examples:

- Moving train along a straight railway track.
- An object dropped from a certain height above the ground.
- A man walking on a level and narrow road

Motion in two dimensions

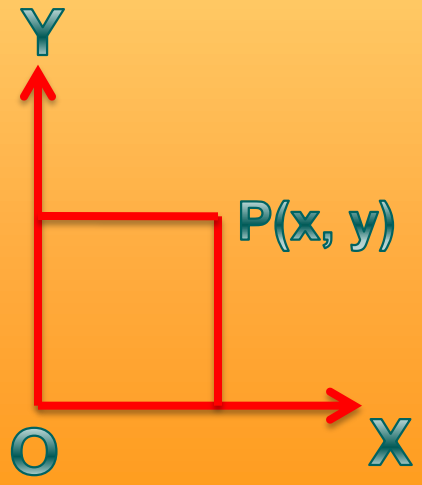
O: origin

Direction of motion of object: X-Y plane

P: position of object at time t

(x,y): coordinates of P.

Two dimensional motion: Motion in which two coordinates are changing with time.



Examples:

- An insect crawling over the floor.
- Earth revolving around the sun.
- A billiard ball moving over the billiard table.

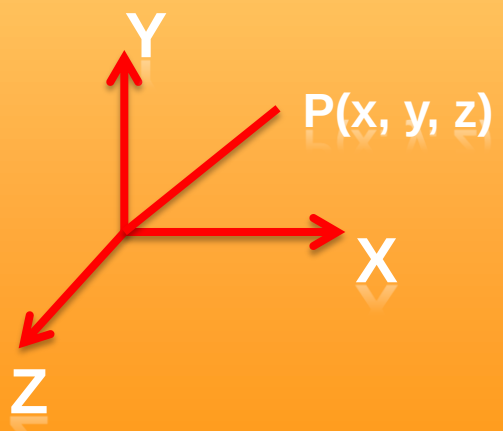
Motion in three dimensions

Motion of object: space having X, Y and Z axes

P: position of object at time t

(x,y,z): coordinates of P.

Three dimensional motion: Motion in which three coordinates are changing with time.



For Example:

- A kite flying on a windy day.
- The random motion of a gas molecule.
- A flying aeroplane or bird

Identify which of these are examples of one dimensional, two dimensional and three dimensional motion.

- Random motion of gas molecules.
- Flying bird.
- Insect crawling over the floor.
- Oscillation of a mass suspended from a vertical spring.

Thanks...