Atomic Energy Education Society, Mumbai

Class XI Chapter- 3
Module- 1
Motion in a straight line

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Motion in a Straight Line

Topics Covered in Module - 1

1) Mechanics
2) Rest and motion
3) Types of motion
4) Frame of reference
5) Motion in one, two and three dimension
6) Scalar and vector

Mechanics

The branch of physics which deals with the study of motion of material objects

Mechanics can be broadly classified into following branches:-

(i) Statics :- It is that branch of mechanics which deals with the study of material objects at rest.

(ii) Kinematics:- It is the branch of mechanics which deals with the study of motion of material objects without taking into account the factors which cause motion.

(iii) Dynamics:- It is the branch of mechanics which deals with the study of motion of objects taking into account the factors which cause motion.

Object in Motion

Rest :- An object is said to be at rest if it does not change its position with time, with respect to it's surroundings.

Motion:- An object is said to be at motion if it changes its position with time, with respect to it's surroundings.

Rest and motion are relative

An object in one situation can be at rest but in another situation the same object can be in motion. For illustration, a person sitting in a moving train is at rest with respect to his fellow passengers but is in motion with respect to the objects outside the train.

Types of Motion of a body

Mainly the motion of a body can be of following three types:

(a) Rectilinear motion or translatory motion :

Rectilinear motion is that motion in which a particle or point is moving along a straight line

Translatory motion is that motion in which a body, which is not a point mass body is moving such that all it's constituent particle move simultaneously along parallel straight lines and shift through equal distance in a given interval of time.

(b) Circular Motion :

A circular motion is that motion in which a particle or apoint mass body is moving on a circle.

A rotatory motion is that motion in which a body is not a point mass body, is moving such that all it's constituents particles move simultaneously along concentric circle, whose centre lie on a line called axis of rotation and shift through equal angle in a given time.

(c) Oscillatory Motion:

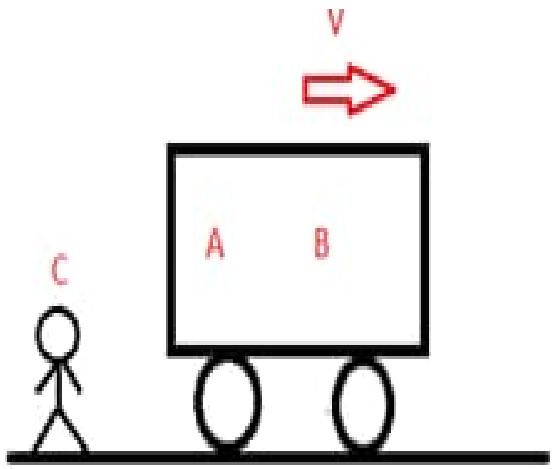
Oscillatory motion is that Marion in which a body moves to and fro or back and forth repeatedly about a fixed point in a definite interval of time

Frame of Reference

In order to specify position of a object, then we need to use a reference point and a system having a set of axes. The point of intersection O of three axes is called origin which serves as a reference point or the position of the observer.

The frame of reference is a system of coordinate axes attached to an observer having a clock with him, with respect to which, the observer can be describe position, displacement, acceleration etc of a moving object.

If we ask A what velocity of B is, he will say it is at rest. But if we ask the same question to C, he will say B is moving with a velocity V in the positive X direction. So we can see specifying the velocity we have to specify in which frame we are or in simple terms, we need to define a frame of reference.



Types of frame of reference:

Once we have chosen our reference they can be of two types:

a) Inertial Frame of Reference

b) Non inertial Frame of Reference

Inertial Frame of Reference:

An inertial frame of reference is a frame where Newton's law holds true. That means if no external force is acting on a body it will stay at rest or remain in uniform motion. Suppose a body is kept on the surface of the earth, for a person on earth it is at rest while for a person on the moon it is in motion.

Actually, the term inertial frame is relative i.e. first we assume a reference frame to be the inertial frame of reference. So a more general definition of an inertial frame would be: Inertial frame is at rest or moves with constant velocity with respect to my assumed inertial reference frame.

Non-inertial Frame of Reference

Now we can define non-inertial frame as a frame which is accelerated with respect to the assumed inertial frame of reference. Newton's law will not hold true in these frames. So in the above example if I assume earth to be an inertial reference frame the moon becomes a non-inertial reference frame as it is in accelerated motion with respect to earth. But if we want to make Newton's law hold here we need to take some mysterious forces also known as pseudo forces.

Motion in One, Two and Three Dimensions

(i) One dimensional motion:- The motion of an object is said to be one dimensional motion if only one out of three coordinates specifying the position of the object change with time. In such a motion an object move along a straight line path.

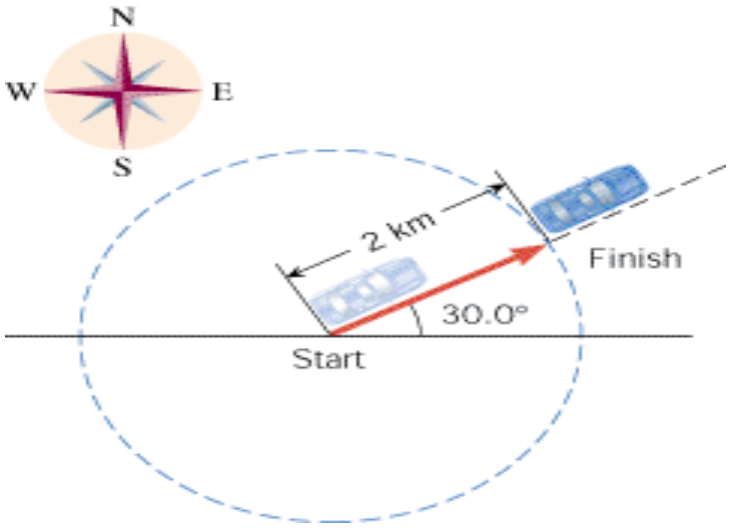
(ii) Two dimensional motion:- The motion of an object is said to be two dimensional motion if two out of three coordinates specifying the position of the object change with time. In such motion the object moves in a plane.

(III) Three dimensional motion:- The motion is said to be three dimensional motion if all the three coordinates specifying the position of an object change with respect to time ,in such a motion an object moves in space.

Scalars and Vectors

- A ***scalar quantity*** is one that can be described with a single number (including any units) giving its magnitude.

- *A **Vector must*** be described *with* both magnitude and direction.



A vector can be represented by an arrow:

- The length of the arrow represents the **magnitude** (always positive) of the vector.
- The direction of the arrow represents the **direction** of the vector.

Difference between vectors and scalars

- The fundamental distinction between scalars and vectors is the characteristic of direction. Vectors have it, and scalars do not.

- Negative value of a scalar means how much it below zero; negative component of a vector means the direction of the vector points to a negative direction.