Kinematics in One and two Dimension

Rest, Motion and Reference Frame

Motion is a combined property of the object under study and the observer. There is no meaning of rest or motion without the viewer.

For example, a book placed on the table remains on the table and we say that it is not moving, it is at rest. However, if we station ourselves on the moon, the whole earth is changing its position, and os the room, the table and the book are all continuously changing their positions.

To locate the position of a particle we need a frame of reference. We can fix up three mutually perpendicular axes, name them X,Y and Z and then specify the position of the particle with respect to that frame. Then if the coordinates of the particle change with respect to time, we can say that the body is moving with respect to this frame.

Many times the choice of frame is clear from the context.

Displacement The magnitude of the displacement is the length of the straight line joining the initial and final position.

Displacement has magnitude as well as direction (initial position and final position).It is a vector quantity.

Displacements add according to triangle rule of vectors. For example, if a book kept on table is displaced and the table is also displaced. The net displacement of the book is obtained by the vector addition of the two displacements.

- Distance
- Average speed
- Instantaneous speed

Average velocity

Average speed and average velocity of a body over a specified time interval may not turnout to be same. The teacher made 10 rounds back and forth in the room and the total distance moved is 800 feet (10 rounds back and forth of 40 ft room). As the time taken is 50 minutes, average speed is 800/50 = 16ft/min.

But because he went out of the same door that he has entered, displacement is zero and hence average velocity is zero.

Motion in a straight line

Choose the line as the X-axis

Position of the particle at time t is given by x.

Velocity is $v = dx/dt$

acceleration is $a = dv/dt = d^2x/dt^2$

If accelaration is constant $dv/dt = a$ (constant)
initial velocity = u (at time t =0)final velocity = v (at time t)

The $v = u+at$

x = distance moved in time $t = ut+\frac{1}{2}at^2$

Also

$$v^2 = u^2+2ax$$

Motion in a plane

Motion in plane is described by x coordinate and y coordinate.
The x-coordinate, the x component of velocity, and the x component of acceleration are related by equations of straight line motion along X axis.