Motion in one dimension

• Scalar Quantities— Physical quantities which only have magnitude, but no direction

Example: speed, distance, current, work

• **Vector Quantities**— Physical quantities that have both magnitude and direction

Example: Velocity, displacement, acceleration, force

- Objects are either at rest or in motion.
- Types of motion:
- When an object moves along a straight line, it possesses **rectilinear motion**.
- Object moving in a curve is called a **curvilinear motion**.
- When a body moves about a fixed axis with out changing its position it is **rotatory motion**.
- When the distance of the object from a fixed point remains constant, it possesses circular motion.
- When an object moves to and fro about a fixed point, it possesses **periodic motion**.
- Other motions are **Oscillatory** and **vibratory motion** and **multiple motions** and **Random motion**.
- An object is at rest when the position of the object does not change with time and with respect to its surroundings.
- An object is in motion when the position of the object changes with time and with respect to its surroundings.
- Rest and motion are relative.
- If the distance covered by an object is much greater than its size during its motion, then the object is considered as point mass object.
- Distance or path length Total length of the path covered by a body (scalar quantity)

- Displacement Shortest distance between initial and final positions measured along a particular direction
 - Uniform motion (object moving with a constant velocity):



• Stationary object (object at rest):



• Average velocity (slope of the *x*-*t* graph)



 \therefore Average velocity = slope of $\overline{P_{P_2}}$

- Average speed = Total path length Total time interval Total path lengthTotal time interval
- [No direction is considered]
- Instantaneous velocity: •



$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{\mathrm{d}x}{\mathrm{d}t}$$

= slope of the tangent at point P

• Average acceleration:

$$\mathbf{a} = \frac{\mathbf{v}_2 - \mathbf{v}_1}{\mathbf{t}_2 - \mathbf{t}_1} = \frac{\Delta \mathbf{v}}{\Delta \mathbf{t}} \mathbf{a} = \mathbf{v}_2 - \mathbf{v}_1 \mathbf{t}_2 - \mathbf{t}_1 = \Delta \mathbf{v} \Delta \mathbf{t}$$

• Instantaneous acceleration:



$$a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt} \quad a = \lim \Delta t \to 0 \Delta v \Delta t = dv dt = slope of the tangent at$$



• Velocity-time graph showing constant acceleration, increasing acceleration and decreasing acceleration:



• Area under the *v*-*t* curve is equal to the displacement of the body.



• Equation of motion

1st equation v = u + at

• 2nd equation

$$s = ut + \frac{1}{2}at^2$$

• 3rd equation $2as = v^2 - u^2$