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

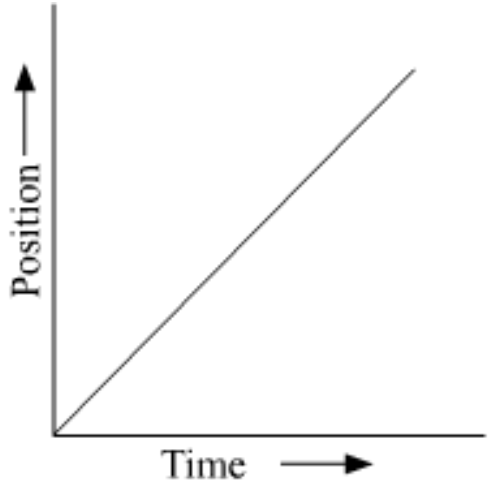
  Example: Velocity, displacement, acceleration, force

- 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.**

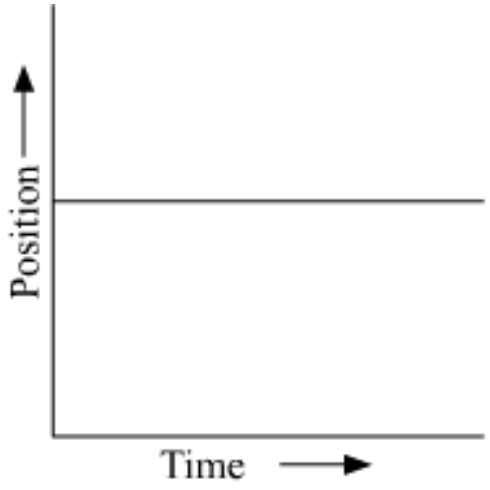
- An object is at rest when the position of the object does not change with time and with respect to its surroundings.
- An object is in motion when the position of the object changes with time and with respect to its surroundings.
- Rest and motion are relative.
- If the distance covered by an object 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

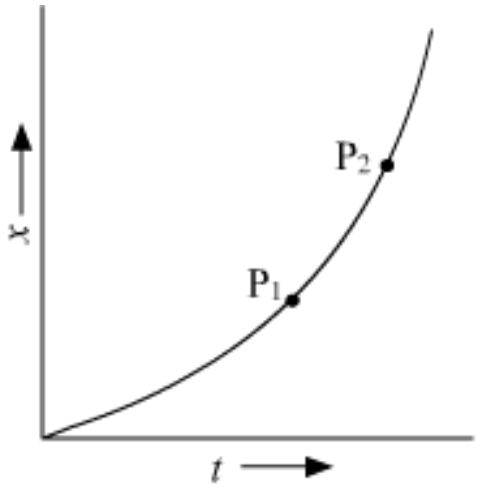
  - **Uniform motion (object moving with a constant velocity):**



  - **Stationary object (object at rest)**:



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



$$\bar{v} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t}$$

∴ Average velocity = slope of $\overline{\mathbf{P_1P_2}}$

- **Average speed** = $\frac{\text{Total path length}}{\text{Total time interval}}$ Total path lengthTotal time interval
- [No direction is considered]
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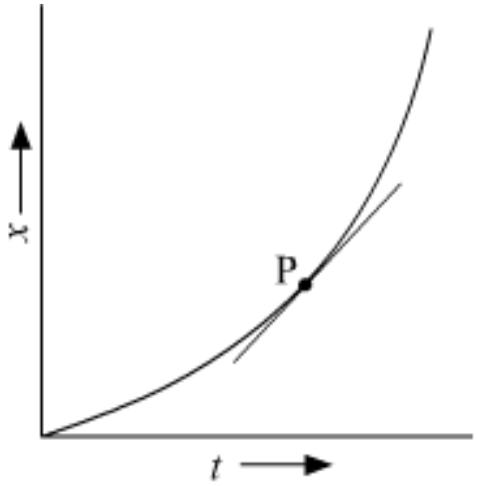
- **Instantaneous velocity:**



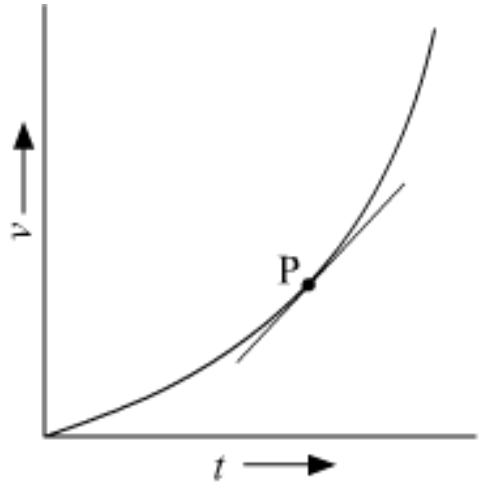
$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

= slope of the tangent at point P

- **Average acceleration:**

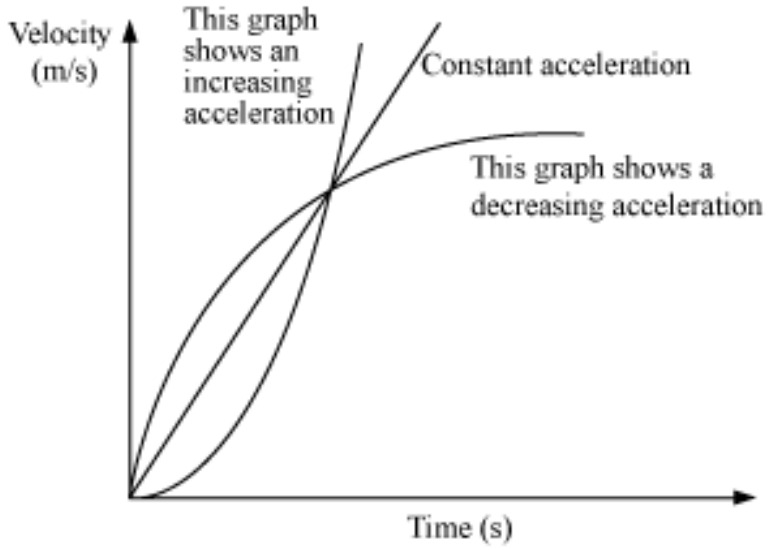
$$\mathbf{a = \frac{v_2 - v_1}{t_2 - t_1} = \frac{\Delta v}{\Delta t}} \quad \mathbf{a=v2-v1t2-t1=\Delta v\Delta t}$$

- **Instantaneous acceleration**:

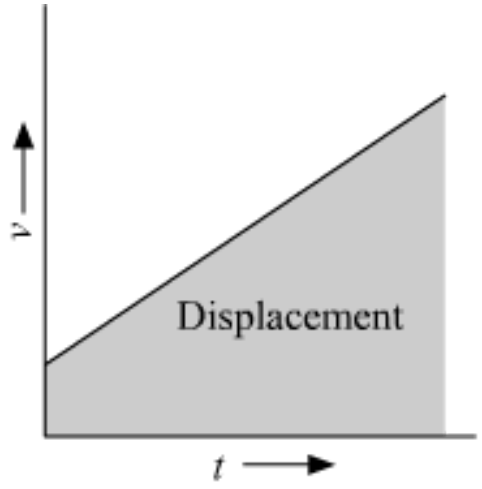


$$a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt} \quad a=\lim \Delta t \to 0 \Delta v \Delta t = dvdt$$ = slope of the tangent at point P

- 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 $2as = v^2 - u^2$