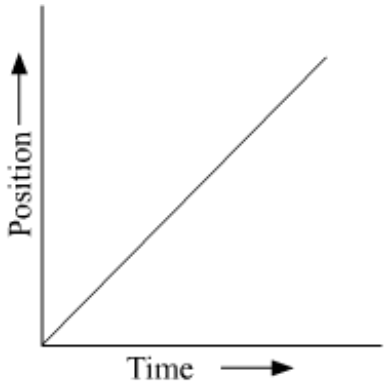
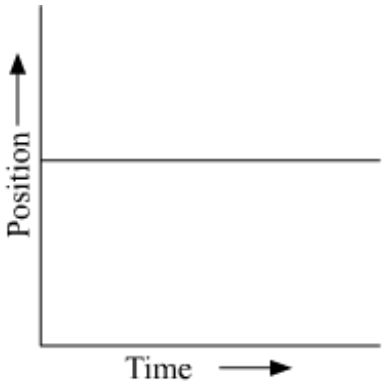
Motion in a straight line

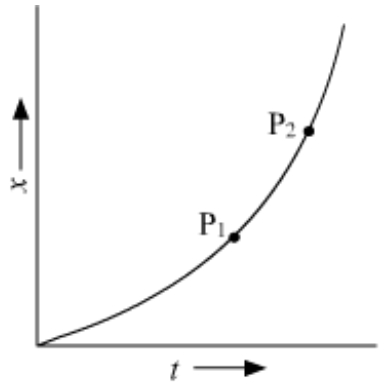
- **Uniform motion (object moving with a constant velocity):**



- **Stationary object** *objectatrest* :



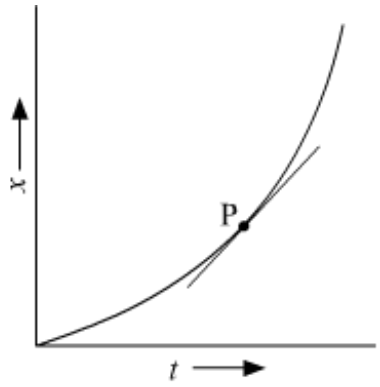
- **Average velocity (slope of the *x-t* graph)**



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

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

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



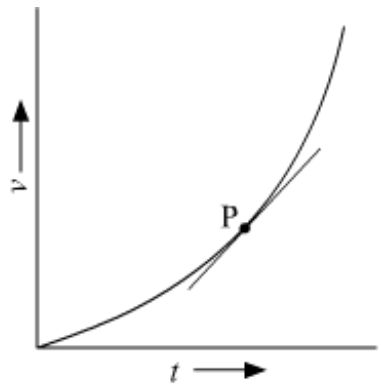
$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

= slope of the tangent at point P

- **Average acceleration:**

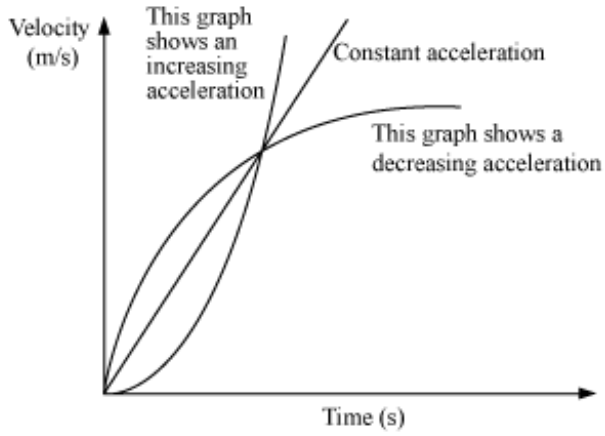
$$a = \frac{v_2 - v_1}{t_2 - t_1} = \frac{\Delta v}{\Delta t}$$

- **Instantaneous acceleration**:

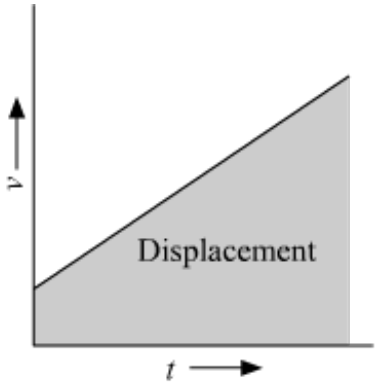


$a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt}$ = slope of the tangent at point P

- 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.**



Equations of motions $Kinematicequations$

$$Whenaccelerationisuniform$$

- Velocity-time relation

$$v = u + at$$

- Disatnce-time relation

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

- Velocity-displacent relation

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

- Distance travelled in n^{th}second of uniformly accelerated motion is given by the relation,

$$D_n = u + \frac{a}{2}(2n-1)$$

Galileo's law of odd number

- The ratios of the distance covered by a body falling from the rest increase by odd numbers

from one second to the next.That means, distances covered by each will increase by factors of 1, 3, 5, 7, …

Relative Velocity

- The relative velocity of a body **A** with respect to another body **B** $\left(v_{AB}\right)$ is the time rate at which **A** changes its position with respect to **B**.
    - **Case 1: Both bodies move in the same direction**: If **A** and **B** are moving in the same direction, then the resultant relative velocity is $v_{AB} = v_A - v_B$
    - **Case 2: The bodies move in opposite directions**: If **A** and **B** are moving in the opposite directions, then the resultant relative velocity is $v_{AB} = v_A + v_B$