

# Motion

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- **Motion:** Change in position of a body with respect to the reference frame(point) is 'motion'.
- **Linear Motion:** A moving body changes its position with time along a straight line.
- **Distance:** Path length covered by a body between two points.
- **Displacement:** The shortest distance between two points.
- Speed is the rate of change of position in 'distance'. Distance can be measured by 'odometer'.

$$\text{Speed} = \frac{\text{Total distance covered}}{\text{Total time}}$$

- Velocity is the rate of change of 'displacement'. Velocity is a quantity that has both magnitude and direction.

$$\text{Velocity} = \frac{\text{Total displacement}}{\text{Total time}}$$

- Magnitude of velocity = Magnitude of average speed, only when there is no change in direction.

$$\text{Average velocity} = \frac{\text{final velocity} + \text{initial velocity}}{2} = \frac{v + u}{2}$$

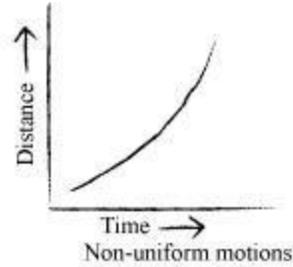
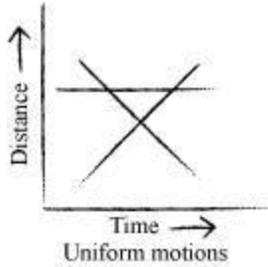
- Uniform motion: A body is said to be in uniform motion if there is no change in **velocity**. That is, no change in speed or direction. Eg. A body moving in a straight line
- Non-uniform motion - Velocity (in terms of speed/ direction or both) changes with time
- Acceleration: A body is said to be 'accelerating' when its velocity changes with time.

- $$\text{Acceleration} = \frac{\text{Final velocity} - \text{Initial velocity}}{\text{Time}} = \frac{v - u}{t}$$

- Uniform acceleration: Uniform change in velocity with time is uniform acceleration.
- Non-uniform acceleration: Non-uniform change in velocity with time.
- The acceleration is positive when the velocity of the moving body increases with time .

- The acceleration is negative when the velocity of the moving body decreases with time .
- The acceleration of a body is considered to be zero when the velocity of the moving body does not change.

- **Distance-time graph**



- **Velocity-time graph**

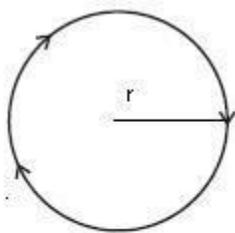
- **Equation of motion**

1st equation  $v = u + at$

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

3rd equation  $2as = v^2 - u^2$

- Circular motion: A body is said to be in circular motion when it rotates about a fix point.



speed =  $v$ , radius =  $r$ ,  
 time to complete 1 rotation =  $T$

$$v = 2\pi r/T$$

Uniform circular motion: If the speed of rotation is constant, then the circular motion is uniform.