



Class 9th

PHYSICS
MOTION

Motion

An object is said to be in the state of motion if it changes its position with respect to time and its surroundings.

Rest

An object is said to be in the state of rest if it does not change its position with respect to time and its surroundings.

Scalar Quantities

Physical quantities having magnitude but no direction are called scalar quantities. e.g., distance, speed.

Vector Quantities

Physical quantities having both magnitude and direction are called vector quantities. e.g., displacement, velocity.

Distance

- The actual path or length travelled by an object during its journey from its initial position to its final position is called the distance.
- Distance is a scalar quantity.
- Distance can never be negative.
- S.I Unit is “metre”

Displacement

- It is the shortest distance between the initial and final position of an object.
- Displacement is a vector quantity.
- Displacement can be positive, negative or zero.
- S.I Unit is “metre”.

Uniform Motion

When a body travels equal distance in equal interval of time, then the motion is said to be uniform motion.

Non uniform motion

When a body travels equal distance in an unequal interval of time or unequal distance in equal interval of time, then the motion is said to be non uniform motion.

Speed

- The measurement of distance travelled by a body per unit time is called speed.
- $\text{Speed} = \text{Distance travelled} / \text{Time taken}$
- Speed is a scalar quantity.
- S.I Unit is m/s.

Velocity

- It is the speed of a body in a given direction.
- $\text{Velocity} = \text{Displacement} / \text{Time}$
- Velocity is a vector quantity.
- S.I unit is m/s.

Average Speed

- The total distance travelled divided by the total time taken is called average speed.
- $\text{Average speed} = \text{Total distance travelled} / \text{Total time taken}$



Average Velocity

- Average Velocity is defined as the total displacement travelled by the body in time t.
- If final Velocity “V” and Initial velocity “U” are known-

$$V_{av} = \frac{U + V}{2}$$

Acceleration

- The rate of change of velocity is called acceleration.
- It is a vector quantity.
- S.I unit is ms^{-2}

Types of acceleration

1. **Positive Acceleration:** Acceleration is said to be positive if velocity of an object increases with time.
2. **Negative acceleration:** Acceleration is said to be negative if velocity of an object decreases with time.
3. **Zero acceleration:** Acceleration is said to be zero if velocity of an object remains constant with time.

Graphical representation of Motion

Distance-Time Graph

- Distance-Time graphs show the change in the position of an object with respect to time.
- Linear variation implies uniform motion and non-linear variations imply non-uniform motion.
- The slope gives us speed.

Velocity-Time Graph

- Velocity-Time graphs show the change in velocity with respect to time.
- Slope gives acceleration.
- The area under the curve gives displacement.
- Line parallel to the x-axis implies constant velocity.

Equations of Motion

The motion of an object moving at uniform acceleration can be described with the help of three equations, namely

(i) $v = u + at$

(ii) $v^2 - u^2 = 2as$

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

where u is the initial velocity, v is the final velocity, t is the time, a is the acceleration and s is the displacement.

Uniform Circular Motion

- If an object moves in a circular path with uniform speed, its motion is called uniform circular motion.
- Velocity changes as direction keeps changing.
- Acceleration is constant.

