Motion

Motion

Motion means movement of things. These things can be non-living like a car, train, earth, moon or living objects like humans, animals etc.

Definition: A body is in motion if its position changes with respect to its surroundings with time.
A body is considered at rest if it is not changing its position with respect to its surroundings with time. Surrounding is really important here. If you are sitting in a running train, you are in motion with respect to people outside the train, like people on the platform. However, you are at rest with respect to another passenger who is sitting with you on the train.

Types of motion:

- **Rectilinear motion:** When an object moves in a straight line, the motion is known as rectilinear motion. All points on the object move in straight lines along parallel paths. E.g. A ball dropped from a height, a car racing on a straight track etc.
- **Translatory motion:** When all points on the body of the object move the same distance in the same interval of time, the object is said to be moving in translatory motion. Rectilinear motion is translatory motion. Another type of translatory motion is curvilinear motion. E.g. A car moving on a road, a ball sliding on a path or a ball rolling on an inclined plane.

  Imp concept: Rolling is translatory as well as rotatory motion. Sliding is only translatory motion.

- **Random motion:** When the direction of motion of the object is not fixed and keeps on changing, the motion is known as random motion.
- **Curvilinear motion:** When a body moves along a circular path, it is said to be moving in curvilinear motion. E.g. a stone thrown high at an angle to the ground, the path of a javelin.
- **Circular motion:** When a body moves in a circular path, it is known as circular motion. At any point in time during the motion, the distance between the body and the centre of the path remains same.
  E.g. revolution of the earth, car moving along a round-about.
- **Rotatory motion:** The motion of an object along its axis such that all points on the object move in a circular path with the centres on the axis. E.g. rotation of the earth, a fidget spinner, a rotating fan or a spinning top.
- **Periodic motion:** The motion which is repeated after a fixed interval of time is known as periodic motion. E.g. Rotation and revolution of the earth. Rotation of clock hands, pendular of a clock etc.
- **Oscillatory motion:** It is also known a vibratory motion. In this motion object moves to and fro about a mean position. E.g. movement of the bob of a pendulum, strings of a guitar, rocking chair etc. Oscillatory motions are often periodic.

Uniform and non-uniform motion

- **Uniform motion:** When an object covers equal distances in equal intervals of time, it is said to be in uniform motion. E.g. A car moving at a steady speed, Earth revolving around the sun, Earth's rotation etc.
- **Non-uniform motion:** When an object covers unequal distances in equal intervals of time, it is said to be non-uniform motion. E.g. horse galloping, fish moving inside water, movement of people in high traffic area etc.

Important concepts:

- **Distance:** When an object moves from one position to another, the actual length of the path covered by the object from starting point to end point is called distance.
  S.I. unit is meter.

- **Displacement:** The shortest distance between the starting point and end point of the motion is called displacement.
  Displacement can be zero in cases when an object reaches its starting point after moving some distance. E.g. When you make a complete movement around a circular track you have moved a distance but your displacement is zero.

  Distance travelled around a circular track=Perimeter of the circular track.
  The perimeter of circular path would be 2? r.

- **Speed:** It is the rate of distance covered per unit time.

  Speed=Distance/Time.

  S.I. unit of speed is m/s

- **Velocity:** Rate of change of displacement per unit time is called velocity. Velocity is a vector quantity.

  Velocity=Displacement/Time.

  Its S.I. unit is same as speed's - m/s.
  Velocity is a vector quantity like displacement and has a direction associated with it.

- **Acceleration:** The rate of change of velocity is called acceleration. Acceleration can be positive or negative. When speed is increasing with time, acceleration is positive. It is called simple acceleration. When speed is decreasing with time, acceleration is negative. It is called retardation in such case.

  The formula of acceleration :
  a=(v - u)/t where v=initial velocity, u=final velocity and t is the time elapsed.

  S.I. unit of acceleration is m/sec^2.

  Acceleration due to gravity: When an object falls freely due to the gravitational force of Earth, its speed increases with a constant rate which is known as acceleration due to gravity. It is denoted by **g** and its value is **9.8 m/sec^2**. **An object thrown upwards** also feels acceleration due to gravity but in opposite direction. Its speed decreases with time at a constant rate. Acceleration acting here is **-9.8 m/sec^2**.

  The speed of ball thrown upwards decreases with time, therefore, it shows retardation and not uniform motion. Similarly, the speed of ball dropped from a height increases with time. It shows acceleration and not uniform motion.