What is Kinematics?

- **Kinematics** is the branch of physics that describes the **motion of objects** without considering the forces that cause the motion.
- It answers: **"How does an object move?"** rather than **"Why does it move?"**

Key Quantities in Kinematics

1. **Displacement (s or x):**
    - The change in position of an object.
    - It's a vector (has magnitude and direction).
    - Example: If you walk 3 m east, displacement = **3 m east**.
2. **Velocity (v):**
    - The rate of change of displacement.
    - **v = Δs / Δt**.
    - It's a vector (direction matters).
    - Example: A car moving 60 km/h east has velocity = **60 km/h east**.
3. **Speed:**
    - How fast an object moves (scalar).
    - **Speed = distance / time.**
4. **Acceleration (a):**
    - The rate of change of velocity.
    - **a = Δv / Δt.**

- Example: A bike increasing speed from 0 to 20 m/s in 4 seconds has **a = 5 m/s².**

5. **Time (t):**
    - The duration over which motion happens.

Equations of Motion (for constant acceleration)

There are 3 famous kinematic equations:

1. **v = u + at**
2. **s = ut + ½at²**
3. **v² = u² + 2as**
    - Where:
        - **u** = initial velocity
        - **v** = final velocity
        - **a** = acceleration
        - **s** = displacement
        - **t** = time

Types of Motion

1. **Linear motion:** Motion along a straight line.
2. **Circular motion:** Motion along a circular path.
3. **Projectile motion:** Motion under gravity with a curved path (like a ball being thrown).

Example Problem

A car starts from rest (u=0) and accelerates at 2 m/s² for 5 seconds.

- **Find final velocity (v):**
  v=u+at=0+2×5=10m/s.v = u + at = 0 + 2 × 5 = 10 m/s.v=u+at=0+2×5=10m/s.

- **Find displacement (s):**
  s=ut+½at2=0+½×2×25=25m.s = ut + ½at² = 0 + ½ × 2 × 25 = 25 m.s=ut+½at2=0+½×2×25=25m.

Why is Kinematics Important?

- It helps in understanding and predicting how objects move.

- It's widely used in engineering, robotics, vehicle motion, and even space science.