Physics - Kinematics

Topics : Computer engineering
Written on March 18, 2024

Kinematics is the branch of classical mechanics that deals with the motion of objects without considering the forces causing the motion.

1. **Basic Concepts:**

   - **Position:** The location of an object relative to a reference point. It is typically described using coordinates in a coordinate system.
   - **Displacement:** The change in position of an object. It is a vector quantity and has both magnitude and direction.
   - **Velocity:** The rate of change of displacement with respect to time. It is also a vector quantity.
   - **Speed:** The magnitude of velocity without regard to direction. It is a scalar quantity.
   - **Acceleration:** The rate of change of velocity with respect to time. Like velocity, it is also a vector quantity.
   - **Scalar vs. Vector Quantities:** Scalar quantities have only magnitude (e.g., speed), whereas vector quantities have both magnitude and direction (e.g., velocity, displacement).

2. **Equations of Motion:**

   - **Constant Velocity (Uniform Motion):** If an object moves with a constant velocity, its displacement can be calculated using the equation $\Delta x = v \cdot t$, where v is the velocity and t is the time.
   - **Constant Acceleration (Uniformly Accelerated Motion):** If an object accelerates with a constant acceleration a, its displacement can be calculated using the equation $\Delta x = v_0 \cdot t + 1/2 \cdot a \cdot t^2$, where v_0 is the initial velocity.
   - **Equations of Motion with Uniformly Accelerated Motion:** The following equations describe the relationships between displacement (Δx), initial velocity (v_0), final velocity (v), acceleration (a), and time (t):
     - $v = v_0 + at$ (Velocity-Time equation)
     - $v^2 = v_0^2 + 2a\Delta x$ (Velocity-Displacement equation)

3. **Graphical Representation:**

   - Kinematic quantities can be represented graphically, where displacement, velocity, and acceleration are plotted against time.
   - The slope of the displacement-time graph represents velocity, while the slope of the velocity-time graph represents acceleration.

4. **Projectile Motion:**

   - Projectile motion refers to the motion of an object projected into the air and subject to the force of gravity.
   - It consists of both horizontal and vertical motion components.
   - The horizontal motion is uniform, while the vertical motion is uniformly accelerated due to gravity.

5. **Relative Motion:**

   - Relative motion describes the motion of one object with respect to another object.
   - It involves considering the motion of one object as observed from the frame of reference of another object.