

Physics - Kinematics

Topics : <u>Computer engineering</u> Written on <u>March 18, 2024</u>

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.
- $\circ~$ 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:

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

4. Projectile Motion:

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

5. Relative Motion:

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

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