MOTION

Speed, Displacement, Velocity & Acceleration

Displacement

- **Definition:** Displacement is the **shortest straight-line distance** from the initial position to the final position of an object, including direction.
- **Type:** Vector quantity (has magnitude and direction)
- **Unit:** Meter (m)
- **Key Idea:** It depends only on the **start and end points**, not the path taken.

Example:
If you walk 5 m east, then 3 m west → displacement = 2 m east.

Speed

- **Definition:** Speed is the **rate of change of distance.** In order words it the distance traveled within a particular period of time.
- **Formula:**
  Speed = Distance ÷ Time
- **Type:** Scalar quantity (Magnitude but no direction)
- **Unit:** meters per second (m/s)

Key Points:

- Always positive
- Does not consider direction

Example:

A car travels 100 m in 10 s → speed = 10 m/s

Velocity

- **Definition:** Velocity is the **rate of change of displacement**. In other words, it is the distance travelled in a specified direction at a given period of time.
- **Formula:**
  Velocity = Displacement ÷ Time
- **Type:** Vector quantity (has magnitude and direction)
- **Unit:** m/s

Key Difference from Speed:

- Velocity includes **direction**, speed does not.

Example:

10 m/s **north** is velocity, while 10 m/s is speed.

Acceleration

- **Definition:** Acceleration is the **rate of change of velocity**.
- **Formula:**
  Acceleration = Change in Velocity ÷ Time
- **Type:** Vector quantity
- **Unit:** meters per second squared (m/s^2)

Key Points:

- Can be **positive** (speeding up) or **negative** (slowing down, called deceleration)
- Occurs when:

- Speed changes
- Direction changes
- Or both

Example:

If velocity changes from 5 m/s to 15 m/s in 5 s → Acceleration = $(15 - 5) \div 5 = 2$ m/s²

Quick Assessment Questions

1. Define the following terms clearly:
    a. Displacement
    b. Speed
    c. Velocity
    d. Acceleration
2. Differentiate between **speed and velocity** using at least **two clear points**.
3. A student walks 60 meters east in 12 seconds.
    a. Calculate the **speed**
    b. Determine the **velocity**
4. A car increases its velocity from 10 m/s to 25 m/s in 5 seconds.
   Calculate the **acceleration** of the car.
5. Explain why an object moving in a circular path at constant speed is still said to be **accelerating**.