

Physics - Unit 3: Motion in a Straight Line

1. Distance and Displacement

Distance: Total length of the path travelled by an object.

Displacement: Shortest straight-line distance from the starting point to the ending point, with direction.

2. Speed and Velocity

Speed: How fast an object is moving, regardless of direction.

Formula: $\text{Speed} = \text{Distance} / \text{Time}$ (Scalar quantity)

Velocity: Speed with a direction.

Formula: $\text{Velocity} = \text{Displacement} / \text{Time}$ (Vector quantity)

3. Acceleration

Change in velocity per unit time.

Formula: $\text{Acceleration} = \text{Change in Velocity} / \text{Time}$

4. Equations of Motion (for constant acceleration)

$v = u + at$ -> Final velocity after time t

$s = ut + \frac{1}{2}at^2$ -> Displacement after time t

$v^2 = u^2 + 2as$ -> Relation between velocity and displacement

Where:

u = initial velocity,

v = final velocity,

a = acceleration,

t = time,

s = displacement

5. Example Problem

A car starts from rest ($u = 0$) and accelerates at 3 m/s^2 for 4s.

Final velocity: $v = u + at = 0 + (3 \times 4) = 12 \text{ m/s}$

6. Summary

In this unit, we studied motion along a straight line and learned about:

- Distance vs. displacement
- Speed vs. velocity
- Acceleration and how it relates to velocity change
- Important motion equations to calculate velocity, displacement, and time
- Practical example demonstrating acceleration

7. Practice Questions (Try these!)

1. Define distance and displacement with examples.
2. A runner completes a 400 m lap around a track in 50 seconds. Calculate the average speed.
3. A bike accelerates from 5 m/s to 15 m/s in 4 seconds. Find the acceleration.
4. Using the equations of motion, find the displacement of an object that starts from rest and accelerates at 2 m/s^2 for 5 seconds.