

Displacement, Velocity, and Acceleration – Full Revision Sheet

Displacement (s or Δx)

- Shortest straight-line distance between two points.
- **Vector**: needs both size and direction (e.g., 5m East).
- Can be **positive**, **negative**, or **zero** depending on direction.
- **Important**: Displacement \neq Distance traveled (e.g., a full lap displacement = 0).

Velocity (v)

- How fast displacement changes.
- **Vector**: depends on direction.
- Constant velocity \rightarrow no change in speed or direction.
- Changing velocity \rightarrow acceleration or deceleration.
- **Instantaneous Velocity**: velocity at a specific moment.
- **Average Velocity**:

Average $v = \frac{\text{Total Displacement}}{\text{Total Time}}$ $\text{Average } v = \frac{\text{Total Displacement}}{\text{Total Time}}$

Speed (v)

- How fast distance changes, no direction considered.
- **Scalar**: only magnitude.
- Speed can't be negative.
- **Average Speed**:

Average Speed = $\frac{\text{Total Distance}}{\text{Total Time}}$ $\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$

Acceleration (a)

- How fast velocity changes.
- **Vector**: direction matters.
- **Positive acceleration** = speeding up.
- **Negative acceleration (deceleration)** = slowing down.
- **Uniform Acceleration**: constant change in velocity.

Key Equations of Motion (SUVAT equations)

- $v = u + at$
- $s = ut + \frac{1}{2}at^2$
- $v^2 = u^2 + 2as$
- $s = \frac{(u + v)t}{2}$
- Only valid when acceleration is constant.

Graph Analysis

- **Displacement–Time Graph:**
 - Slope (gradient) = Velocity.
 - Curved graph = Changing velocity.
- **Velocity–Time Graph:**
 - Slope = Acceleration.
 - Area under graph = Displacement.
 - Straight horizontal line = Constant velocity.
- **Acceleration–Time Graph:**
 - Area under graph = Change in velocity.

Quick Tips

- If displacement = 0, velocity = 0 (even if speed isn't 0).
- Uniform motion → constant speed or constant velocity.
- Free fall acceleration (g) $\approx 9.8 \text{ m/s}^2$ downward.