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 ≠ Distance traveled (e.g., a full lap displacement = 0).

Velocity (v)

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

Average v=Total DisplacementTotal Time\text{Average } v = \frac{\text{Total Displacement}}{\text{Total Time}}Average v=Total TimeTotal Displacement

Speed (v)

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

Average Speed=Total DistanceTotal Time\text{Average Speed} = \frac{\text{Total Distance}}{\text{Total Time}}Average Speed=Total TimeTotal Distance

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+atv = u + atv=u+at
- s=ut+12at2s = ut + \frac{1}{2}at^2s=ut+21at2
- v2=u2+2asv^2 = u^2 + 2asv2=u2+2as
- s=(u+v)2ts = \frac{(u + v)}{2} ts=2(u+v)t
- 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) ≈ 9.8 m/s² downward.