**Summary Lecture 1**

**Kinematics: Objects in Motion**

Distance traveled
Average Speed = \[ \frac{\text{Distance traveled}}{\text{Elapsed Time}} \]

\[ \bar{v}_s = \frac{d}{\Delta t} \]

Units: Speed is measured in \([\text{m/s}]\)

Unit conversion: \[ 1 \text{ mi} = 1610 \text{ m} \]
\[ 1 \text{ hr} = 3600 \text{ s} \]

\[
55 \text{ mph} = 55 \frac{\text{mi}}{\text{hr}} \cdot \frac{1610 \text{ m}}{3600 \text{ s}} = 24.6 \text{ m/s}
\]

**Instantaneous speed = speed at a given moment in time**

\[ v_s = \frac{d}{\Delta t} \quad \text{(for very small } \Delta t) \]
Speed and Velocity

To describe how (fast) a body is moving we need:

1. The speed of the object
2. The Reference Frame we have chosen to describe the motion
3. The direction of the object

Define: \( \text{Velocity} = \text{Speed} + \text{Direction} \)

Speed is the magnitude of the velocity vector. Speed is just a number with units.
Displacement = distance from origin

Average Velocity = \frac{\text{Displacement}}{\text{Elapsed Time}}

\bar{v} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t}

Note: \bar{v} could be zero even if the average speed is not

Instantaneous velocity = velocity at a given moment in time

v = \frac{\Delta x}{\Delta t} \quad \text{(for very small } \Delta t)\text{)}

Note: velocity = change in position over change in time