

# Motion

**Motion is the change of an object's position in time.**

# How far?

- 1. Displacement ( $D$ ) is the change in position of an object. Displacement is the final position minus the initial position. Displacement is a vector having both magnitude and direction.
- 2. Distance ( $d$ ) is the length traveled along its path. Distance is a scalar having magnitude but not direction.

# Velocity versus Speed

- Velocity =  $V$  = Displacement/time
- Velocity is a vector. The direction of the velocity is always the same as the direction of the displacement.
- Speed =  $v$  = distance/time
- Speed is a scalar. It has magnitude but no direction.

# Instantaneous Velocity

- Instantaneous Velocity at any moment is the average velocity over a very small time interval.
- Average Velocity = Displacement/time
- $= (x(\text{final}) - x(\text{initial}))/\text{time}$

# Example

- The position of an object is +35 meters at 2.0 seconds and is +87 meters at 15 seconds. Calculate the average velocity of the object.
- $V = D/t = x(\text{final}) - x(\text{initial})/\text{time}$
- $= (87 - 35)/15 - 2 = 52/13 = 4 \text{ m/s}$
- The average velocity,  $V$ , is 4 m/s in the positive direction (usually to the right).

# Group Activity

- 1. The average speed of a plane was 600 km/hr. How long did it take the plane to travel 120 km?
- 2. What is the total distance traveled by an object that moves with an average speed of 6.0 m/s for 8.0 seconds?
- 3. An object travels for 8.00 seconds with an average speed of 160 m/s. The distance traveled by the object is how far?

# Group Activity

- 4. What must be your average speed in order to travel 230 km in 3.25 hr?
- 5. A bird can fly 25 km/hr. How long does it take to fly 15 km?
- 6. You are driving home from school steadily at 65 mph for 130 miles. It then begins to rain and you slow to 55 mph. You arrive home after driving 3 hours and 20 minutes. How far is your hometown from school? What was your average speed?

# Group Activity

- 7. Two trains approach each other on parallel tracks. Each has a speed of 95 km/hr with respect to the ground. If they are initially 8.5 km apart, how long will it be before they reach each other?