

## Describing Motion, Distance, Distance and Speed

- I. Everyday objects are in constant motion.
- II. Motion is defined as a change in position.
  - i. We don't always directly observe an object's movement, however we do know that motion has occurred based on our observations.
    1. Example: The neighbor's car was in front of your house before school, after school you notice it has moved into the driveway.
- III. An object's position, as well as its motion is relative to the frame of reference.
- IV. Distance vs Displacement for a moving object
  - i. Distance is the total length of travel.
    1. Distance is a scalar quantity, it only has a size value
  - ii. Displacement is the distance and the direction of travel
    1. Displacement is a vector quantity, it has size and direction

### Calculations of Distance and Displacement

Example 1: A runner jogs 50 meters, then turns around and jogs 40 meters in the direction he came from. What is this runner's total distance traveled? What is his total displacement?

$$\text{Total Distance} = 50 \text{ m} + 40 \text{ m} = 90 \text{ m}$$

$$\text{Total Displacement} = 50 \text{ m} - 40 \text{ m} = 10 \text{ m from start}$$

Example 2: Mrs. Nickel travels 22 miles from her house to work every morning. Every afternoon she travels 22 miles back home. What is her total distance traveled per day? What is her total displacement for each day?

$$\text{Total Distance} = 22 + 22 = 44 \text{ miles} \quad \text{Displacement} = 22 - 22 = 0 \text{ miles}$$

## Describing Motion, Distance, Distance and Speed

Example 3: Matthew Stafford throws a pass from the 20 yd. line, Calvin Johnson, catches the ball at the 30 yd. line and is immediately tackled. The ref calls a penalty and the lions get a 15 yd. penalty against them, moving the ball back. What is the footballs total distance traveled, what is the footballs total displacement?

$$\text{Total Distance} = (30-20) + 15 = 25 \text{ yds.}$$

$$\text{Total Displacement} = (30-20) -15 = -5 \text{ yds.} \quad 5 \text{ yards behind where the ball started}$$

- V. Speed is the distance an object travels per unit of time.
- i. Instantaneous speed- speed of an object at a single moment in time.
  - ii. Average speed- how an object moved over the entire distance traveled.
- VI. Speed is always measured using distance and time
- i. Speed = Distance/Time
  - ii. Units are always two values
    1. m/s, ft/s, km/hr, mi/hr

### Calculations of Speed

Example 1: An ant travels 50 cm in 5 s. What was the ant's speed?

$$\text{Speed} = \text{Distance} / \text{Time} \quad 50/5 = 10 \text{ cm/s}$$

Example 2: If it takes your 5 hours to drive 500 km. What was your speed?

$$\text{Speed} = \text{Distance}/\text{Time} \quad 500/5 = 100 \text{ km/h}$$

Example 3: A bus leaves at 9 a.m. with a group of students, they travel for 3 hours and cover a distance of 350 km. They stop for lunch, then return to traveling for an additional 250 km and finish their trip at 3 p.m. What was the average speed of the bus?

$$\text{Average Speed} = \text{Distance}/\text{Total Time} \quad (350 + 250)/ (6\text{h}) = 100\text{km/h}$$

## Describing Motion, Distance, Distance and Speed Calculations Using Speed

Example 1: You and your family are traveling at an average speed of 60 miles per hour, you are in the car for a total of 6 hours, how far have you traveled?

Reformat the equation:  $S = \text{Distance}/\text{Time}$  to solve for distance

$$\text{Distance} = \text{Speed} \times \text{Time} \qquad 60 \times 6 = 360$$

You have traveled 360 miles

Example 2: Mrs. Nickel travels at an average speed of 50 miles per hour on her way to work. If she travels a total distance of 25 miles, how long will it take her to get to work?

Reformat the question to solve for time  $\text{Time} = \text{Distance}/\text{speed}$

$$25 \text{ miles}/50 \text{ mph} = 0.5 \text{ hours or 30 minutes}$$

Example 3: After work her average speed drops to 12.5 miles per hour, she travels the same distance of 25 miles to get back home, how much longer will it take her get home than it did to get to school?

$$25 \text{ miles}/12.5 \text{ mph} = 2 \text{ hours}$$

It will take her 1.5 hours longer to get home from work than it did to get to school.