DEFINING MOTION

Objectives

- Understand the difference between position, distance, and displacement.
- Understand the difference between speed and velocity.
- Solve problems involving average speed and velocity.
- Calculate distance, displacement, speed, velocity, and acceleration.

Scalars

Scalars are physical quantities with a magnitude (size) only

- Temperature
- Mass
- Time

Vectors

- Vectors are quantities that have magnitude and direction
  - Velocity
  - Force
  - Momentum

Position

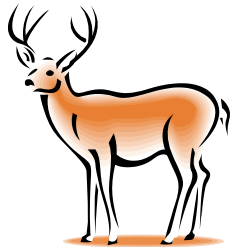
- An object's position, in one dimension, can be assigned to a variable on a number scale.

- You can assign the zero point, as well as the positive and negative directions.
- The symbol for position 1D is *x.*

Distance

- When position changes, an object has traveled some distance. The more position changes, the more distance is traveled.
- Distance is scalar (does not depend on direction), and is measured in meters.

Sample Problem - Distance



- A deer walks 1300 meters east to a creek for a drink. The deer then walks 500 meters west to the berry patch for dinner, before running 300 meters west when startled by a loud raccoon. What **distance** did the deer travel?

Displacement

- Displacement is a vector which describes the straight line from where your starting point to your ending point.
- Displacement Δx (x_f-x_i) is also measured in meters.

Sample Problem - Displacement

- A deer walks 1300 meters east to a creek for a drink. The deer then walks 500 meters west to the berry patch for dinner, before running 300 meters west when startled by a loud raccoon. What is the deer's **displacement**?

Average Speed

- Average Speed is the rate at which distance is traveled, and is scalar.

$$v = \frac{x}{t}$$

- Average speed is scalar, and is measured in meters/second.
- Speed is Scalar

Average Velocity

- Average Velocity is the rate at which displacement changes, and is a vector.

$$v = \frac{x_f - x_i}{t} = \frac{\Delta x}{t}$$

- Average velocity is also measured in meters/second.
- **V**elocity is a **V**ector.

Sample Problem- Avg. Velocity

- A deer walks 1300 meters east to a creek for a drink. The deer then walks 500 meters west to the berry patch for dinner, before running 300 meters west when startled by a loud raccoon. What is the deer's average velocity if the entire trip took 600 seconds?

Chuck the Hungry Squirrel

- Chuck the hungry squirrel travels 4m east and 3m north in search of an acorn. The entire trip takes him 20 seconds.

Find:

- Chuck's distance traveled
- Chuck's displacement
- Chuck's average speed
- Chuck's average velocity

Acceleration

- Acceleration is the rate at which velocity changes.

$$a = \frac{\Delta v}{t}$$

- Acceleration is a vector.
- Units are m/s/s, or $m/s^{2.}$

Acceleration Problem

- Monty the Monkey accelerates from rest to a velocity of 9 m/s in a time span of 3 seconds. Calculate Monty's acceleration.