Notes 1.1: Introduction to Linear Motion

- Learning Goals:
  1. Distinguish between variables of distance, displacement, speed, velocity, and acceleration (P2.2A).
  2. Perform calculations involving average speed and velocity equations (P2.1A & P2.1g).

A. Vocabulary

- Frame of Reference – Place to start/measure from
- Unit – A standardized amount (for measurement)
- Magnitude – How large or small? Amount or size.

A. Vocabulary

- Scalar – Quantities with magnitude only (no direction)
  - Examples: 6m or 10s
- Vector – Quantities with magnitude and direction.
  - Examples: 5m, North or 27 m/s, left

A. Vocabulary

- Distance – A scalar quantity (mag. only) that describes the length of path taken by an object
  - Example: 6 m
- Displacement – A vector quantity (mag. & dir.) that describes the length between the starting and ending positions, regardless of path
  - Example: 5 m, left or -5 m

A. Vocabulary

- Speed – A scalar quantity that describes the rate at which an object's distance changes over time
  - Example: 5m/s
- Velocity – A vector quantity that describes the rate at which an object's displacement changes over time
  - Example: 5m/s, left or -5m/s

B. Equations

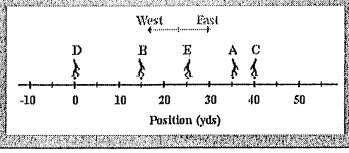
- Equation: Speed = $\frac{\text{Distance}}{\text{Time}}$
- Example Units: mi/hr, m/s, km/hr
- Example problem: In the 2008 Olympics, Jamaican sprinter Usain Bolt shocked the world as he ran the 100-meter dash in 9.69 seconds. Determine Usain's average speed for the race.

B. Equations

- Equation: Velocity = $\frac{\text{Displacement}}{\text{Time}}$
- Example Units: mi/hr, m/s, km/hr
- Example problem: In the 2009 Olympics, Jamaican sprinter Usain Bolt shocked the world as he ran the 100-meter dash BACKWARDS in 9.69 seconds. Determine Usain's average velocity for the race.

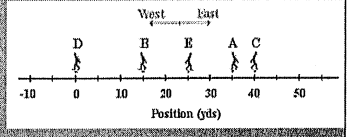
C. Multiple Movement Problems

- A football coach starts at the 35-yard line (A) and walks to the 15-yard line (B). He turns around and walks to the 40-yard line (C). He turns around again and walks back to the 0-yard line (D). He turns around once more and walks back to the 25-yard line (E), thus completing his 10 minutes of pacing.



C. Multiple Movement Problems

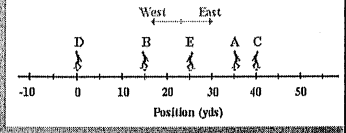
- What is the coach's distance?



- What is the coach's displacement?

C. Multiple Movement Problems

- What is the coach's average speed?



- What is the coach's average velocity?

Notes 1.2: Acceleration

- Learning Goals:
  1. Distinguish between variables of distance, displacement, speed, velocity, and acceleration (P2.2A).
  3. Perform calculations involving average acceleration equation (P2.2B).

A. Vocabulary

- *Acceleration* – **A vector quantity that describes an object's change in velocity.**
  - *Example: 5 mi/hr/s, left or -10 m/s²*
- **Three ways to accelerate:**
  - **Speed up**
  - **Slow down**
  - **Change directions**

B. Vocab & Common Language

Label the following as true or false:

a. An object traveling fast has an acceleration.

b. An object that is speeding up has acceleration.

c. An object can be accelerating and have a low velocity.

d. An object that is slowing down does not have an acceleration.

e. An object can have a high velocity and no acceleration.

f. An object traveling in a circle at 20 *mi/hr* does not have an acceleration.

C. Equation

- *Equation:* **Acceleration = $\frac{\text{Change in Velocity}}{\text{Time}}$**
- *Example Units:* **mi/hr/s, m/s², km/hr/s**
- *Example Problem:* **The Lamborghini Murcielago can accelerate from 0 to 27.8 m/s (62.2 mi/hr) in a time of 3.40 seconds. Determine the acceleration of this car in both m/s² and mi/hr/s.**

D. Direction of Acceleration

- Rule:
  - Speeding up = vel & acc have same direction
  - Slowing down = vel & acc have opposite direction
- Examples: What is the direction of acceleration?
  a. Ball is thrown upward but slowing down
  b. Ball is falling down, but gaining speed
  c. Car moving backwards, speeding up
  d. Car moving left, losing speed

D. Direction of Acceleration

- Examples: Is the object speeding up or slowing down?
  a. Ball is thrown left with rightward acceleration
  b. Ball is falling down with downward acceleration
  c. Car moving backwards with negative acceleration
  d. Car with positive velocity & negative acceleration