# *Displacement and Velocity*

- Chapter 2-1

- As any object moves from one position to another, the length of the straight line drawn from its initial position to the object's final position is called **displacement**.
- Displacement doesn't always tell you **distance** an object moved.
- $\Delta x = x_f - x_i$

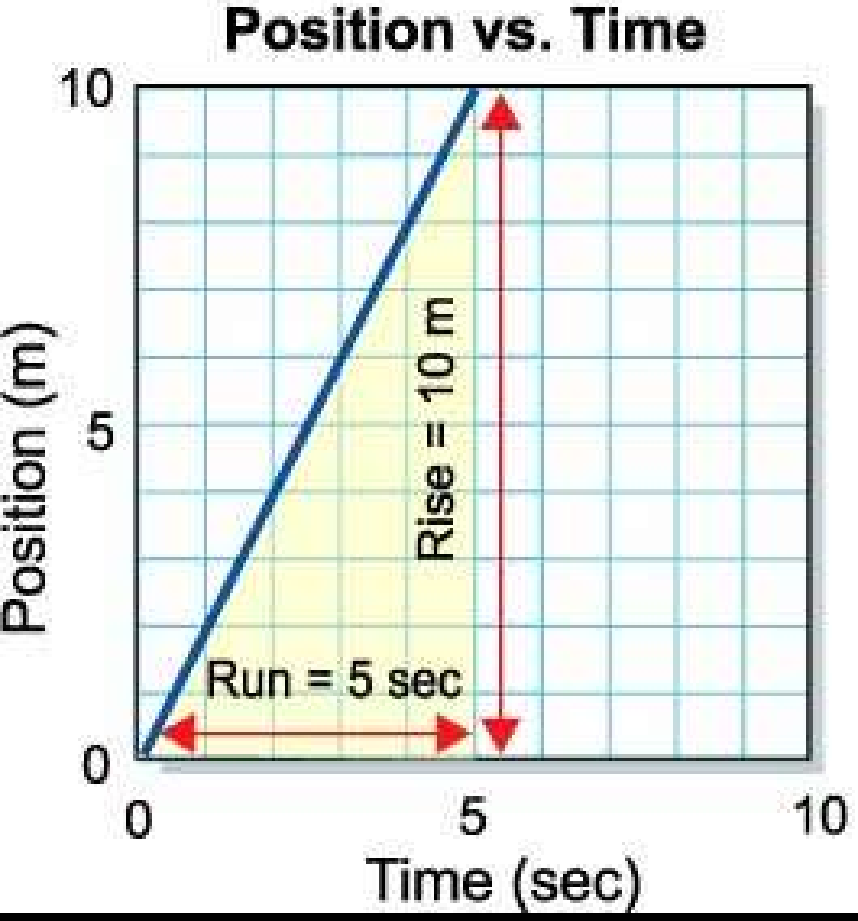
- If displacement is **positive**, the object moves to the right.
- If the displacement is **negative**, the object moves to the left.

- Average velocity = displacement / time
- Units are meters/second (**m/s**)
- Average velocity does not tell you speed or velocity at each moment.
- Can be positive or negative depending on direction moved.
- Time can never be negative!

- Velocity is not the same as speed.
- Velocity gives both direction and magnitude or size while speed only gives size - no direction
- Average speed = distance/time

- If you graph distance on the y-axis and time on the x-axis, the slope of the line is equal to the average velocity.
- Slope=rise=position= velocity
  run time

# Position vs. Time Graph




$$\text{Slope} = \frac{\text{rise}}{\text{run}} = \frac{10\text{ m}}{5\text{ sec}} = 2\text{ m/sec}$$

The slope of position vs. time is the **speed.**

- To determine velocity at any instant it is called instantaneous speed.
- To determine instantaneous speed on a graph, study a small time interval to calculate the speed. Smaller intervals approach instantaneous speed.

# Solving Problems

**Identify what the problem is looking for**

Calculating gravitational forces

Use the following information to calculate the force of gravity between Earth and the moon.
Mass of Earth: $5.97 \times 10^{24}$ m  Mass of moon: $7.34 \times 10^{22}$ kg  Distance between centers of Earth and moon: $3.84 \times 10^{8}$ m

**Identify the information you are given**

***1. Looking for:*** You are asked for the force of gravity between Earth and the moon.

***2. Given:*** You are given their two masses in kilograms and the distance between their centers in meters.

**Identify useful relationships**

***3. Relationships:*** $F_g = G\dfrac{m_1 m_2}{r^2}$

**Solve the problem**

***4. Solution:***

$$F_g = (6.67\times10^{-11}\ \frac{\text{N}\cdot\text{m}^2}{\text{kg}^2})\frac{(5.97\times10^{24}\ \text{kg})(7.34\times10^{22}\ \text{kg})}{(3.84\times10^{8}\ \text{m})^2}$$

$$F_g = (6.67\times10^{-11}\ \frac{\text{N}\cdot\text{m}^2}{\text{kg}^2})\frac{(4.38\times10^{47}\ \text{kg}^2)}{(1.47\times10^{17}\ \text{m}^2)} = 1.99\times10^{20}\ \text{N}$$

**Your turn...**

a. Calculate the force of gravity on a 50-kilogram person on Earth ($6.38 \times 10^{6}$ m from its center). **Answer:** 489 N

b. Calculate the force of gravity on a 50-kilogram person on the moon ($1.74 \times 10^{6}$ m from its center). **Answer:** 81 N

**Practice your problem-solving skills**

- #1. Heather and Matthew walk eastward with a speed of .98 m/s. If it takes them 34 min to walk to the store, how far have they walked?
- Knowns? What do you know? Write it down.
- Unknown? What do you want to know?
- Equation? Write the equation you'll use.
- Work the problem.

# *Homework*

- Chapter 2.1 Worksheet

- *Be sure and convert minutes to seconds and km to meters!
- *Be sure and convert mm to meters and cm to meters and minutes to seconds!