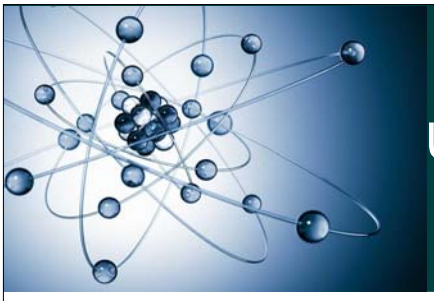
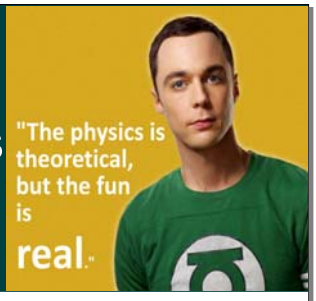


Unit 1: Kinematics



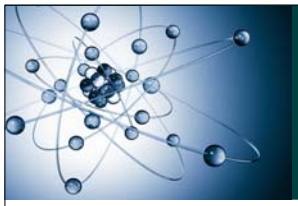
1.2 Graphing Uniform Motion

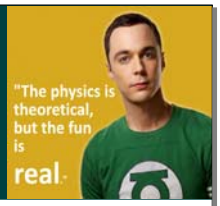
Uniform Motion - constant velocity

ie. car on cruise control

Non-Uniform Motion - acceleration

ie. merging on the highway.





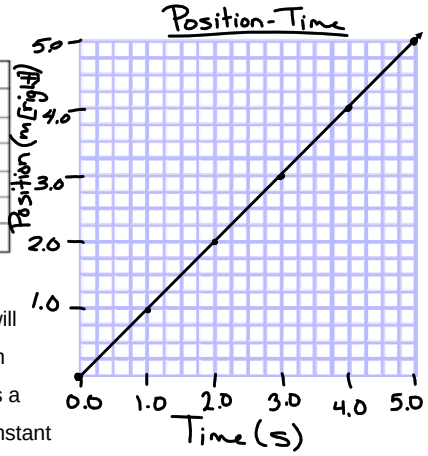
We graph data in Physics so we can analyze patterns and relationships among the data. The following table shows the position of a golf ball at certain times:

▼ **Table 1.1** Position-time data

	Time (s)	Position (m [right])
t_0	0.0	0.0
t_1	1.0	1.0
t_2	2.0	2.0
t_3	3.0	3.0
t_4	4.0	4.0
t_5	5.0	5.0

*Note: Most data is not perfect. Here we are ignoring friction between the ball and the grass.

Position-Time



When you graph the data, you will notice a straight line. Recall from Math 10C that a straight line has a constant slope. What does a constant slope represent in Physics?

$m = \frac{\text{rise}}{\text{run}} = \frac{m}{s} = \vec{v} = \frac{1.0}{1.0} = 1.0\ m/s\ [right]$

You can find two different velocities from the graph:

1. Instantaneous Velocity: the velocity at any one time interval on the graph. $\vec{V} = \frac{\vec{d}}{t}$
2. Average Velocity: an average of instantaneous velocity; also found by taking the slope of a distance vs. time graph.

$$\vec{V}_{ave} = \frac{\Delta \vec{d}}{\Delta t}$$

To find Instantaneous Velocity:

$$\vec{v} = \frac{\vec{d}}{t}$$

To find average velocity:

$$\vec{v}_{ave} = \frac{\Delta \vec{d}}{\Delta t}$$

Ex.) Determine:

a) the instantaneous velocity of the golf ball at 3.0 s.

$\vec{d} = 3.0\text{m}$
$t = 3.0\text{s}$
$\vec{v} = ?$

$$\vec{v} = \frac{\vec{d}}{t} = \frac{3.0\text{m [right]}}{3.0\text{s}} = 1.0\text{ m/s [right]}$$

b) the avergae velocity of the ball over the entire time interval.

$$\vec{v}_{ave} = \frac{\Delta\vec{d}}{\Delta t} = \frac{5.0\text{m [right]} - 0.0\text{m}}{5.0\text{s} - 0.0\text{s}} = 1.0\text{m/s [right]}$$

Something to memorize:

slope of a distance/displacement vs. time graph is velocity

+ ive slope = moving forwards

- ive slope = moving backwards

Does each scenario represent uniform motion?

"constant velocity, no acceleration"

- A dog moving 1.5 m every second. ✓
- A plane flying at a constant velocity. ✓
- A car driving 110 km/h. ✓
- A person standing still. ✓

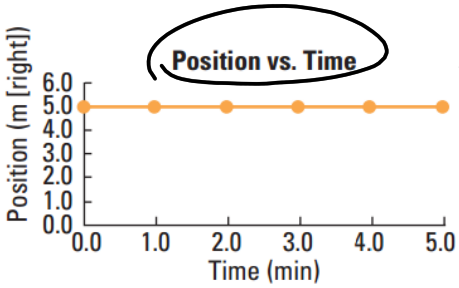
"object at rest"

Uniform Motion defines any constant velocity, even a constant velocity of zero (ie. an object at rest.)

- to move 0.0 m every second still has a constant change in distance over time

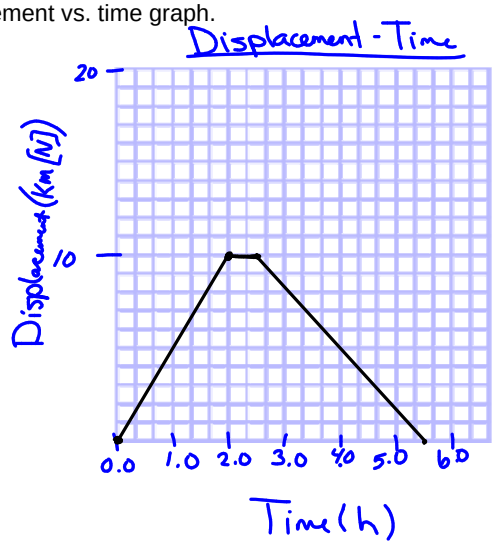
- objects at rest have a velocity of zero (remember a slope of zero is a horizontal line)

Eg.)

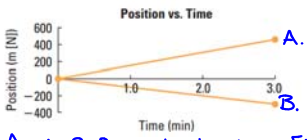


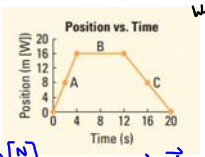
horizontal line → object at rest

Ex.) Starting from t = 0.0h, a hiker walks 10 km N in 2.0 h, stops for 0.50 h, then walks 10 km S in 3 hours back to his starting position. Display this movement in a displacement vs. time graph.



Examine the graphs. Describe in words the motion of the objects producing each graph. Find velocities.





W E N S

A. in 3.0 min, the object goes 500m [N]

B. " " 200m [S]

A. $\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{500\text{m [N]} - 0\text{m}}{1.8\text{x}10^2\text{s} - 0\text{s}} = 2.8\text{m/s [N]}$

B. $\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{200\text{m [S]} - 0\text{m}}{1.8\text{x}10^2\text{s} - 0\text{s}} = 1.1\text{m/s [S]}$

OR $= \frac{-200\text{m} - 0\text{m}}{1.8\text{x}10^2\text{s} - 0\text{s}} = -1.1\text{m/s} = 1.1\text{m/s [S]}$

+ : N
− : E

A. $\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{16\text{m [N]} - 0\text{m}}{4\text{s} - 0\text{s}} = 4\text{m/s [N]}$

B. $\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{16\text{m [N]} - 16\text{m [N]}}{12\text{s} - 4\text{s}} = 0\text{m/s}$

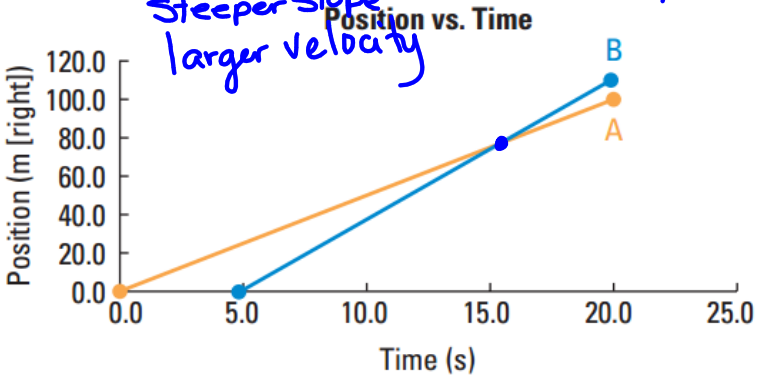
C. $\vec{v} = \frac{\Delta \vec{d}}{\Delta t} = \frac{0\text{m} - 16\text{m [N]}}{20\text{s} - 12\text{s}} = -2\text{m/s} = 2\text{m/s [E]}$

- point of intersection

Which object is moving faster? When do the objects meet? How do you know?

B steeper slope larger velocity

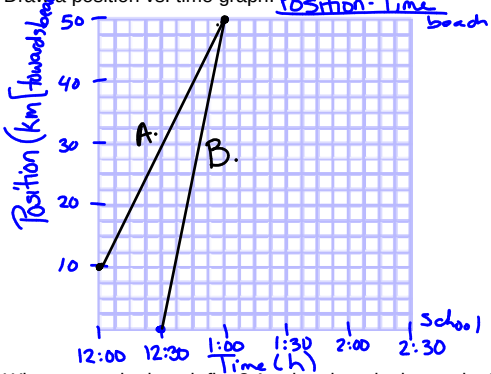
15.0s, 75m [right]



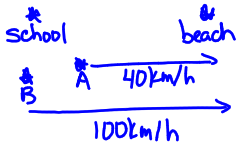
Ex.) Two cars drive towards a beach, 50 km from a school. Car A starts 10 km closer to the beach at noon and travels at 40 km/h. Car B starts from the school at 12:30 and drives at 100 km/h.

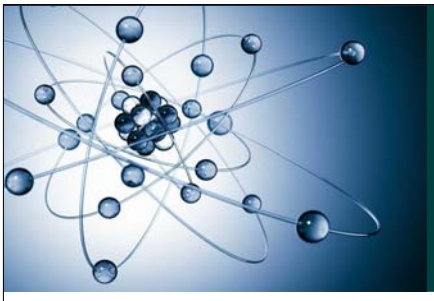
a) Draw a position vs. time graph.

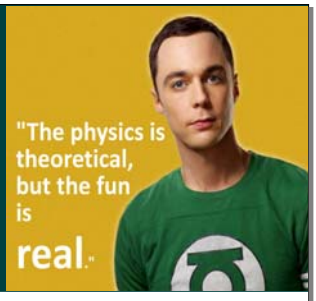
Position-Time



b) Who gets to the beach first? At what time do they arrive?







1. Read pages 14-19.
2. Questions: Pg. 20 # 1, 2, 5-13.