Name: _____ Date: _____

CONTENT 4.1

4.1 Velocity

READ 

Speed and velocity do not have the same meaning to scientists. Speed is a *scalar quantity*, which means it can be completely described by its magnitude (or size). The magnitude is given by a number and a unit. For example, an object's speed may be measured as 15 meters per second.

Velocity is a *vector quantity*. In order to measure a vector quantity, you must know the both its magnitude and direction. The velocity of an object is determined by measuring both the *speed* and *direction* in which an object is traveling.

- If the speed of an object changes, then its velocity also changes.
- If the direction in which an object is traveling changes, then its velocity changes.
- A change in either speed, direction, or both causes a change in velocity.

You can rearrange $\mathbf{v} = d/t$ to solve velocity problems the same way you solved speed problems earlier in this course. The boldfaced **v** is used to represent velocity as a vector quantity. The variables d and t are used for distance and time. **The velocity of an object in motion is equal to the distance it travels per unit of time in a given direction**.

EXAMPLES

Example 1: What is the velocity of a car that travels 100.0 meters, northeast in 4.65 seconds?

Looking for Velocity of the car.	**Solution** $\text{velocity} = \frac{d}{t} = \frac{100.0\ \text{m}}{4.65\ \text{s}} = \frac{21.5\ \text{m}}{\text{s}}$ The velocity of the car is 21.5 meters per second, northeast.
Given Distance = 100.0 meters Time = 4.65 seconds	
Relationship $\text{velocity} = \frac{d}{t}$	

Example 2: A boat travels with a velocity equal to 14.0 meters per second, east in 5.15 seconds. What distance in meters does the boat travel?

Looking for Distance the boat travels.	**Solution** $\text{distance} = v \times t = \frac{14.0\ \text{m}}{\text{s}} \times 5.15\ \text{s} = 72.1\ \text{m}$ The boat travels 72.1 meters.
Given Velocity = 14.0 meters per second, east Time = 5.15 seconds	
Relationship $\text{distance} = v \times t$	

PRACTICE

1. An airplane flies 525 kilometers north in 1.25 hours. What is the airplane's velocity?

Looking for	**Solution**
Given	
Relationship	

2. A soccer player kicks a ball 6.5 meters. How much time is needed for the ball to travel this distance if its velocity is 22 meters per second, south?

3. A cruise ship travels east across a river at 19.0 meters per minute. If the river is 4,250 meters wide, how long does it take for the ship to reach the other side?

4. Joaquin mows the lawn at his grandmother's home during the summer months. Joaquin measured the distance across his grandmother's lawn as 11.5 meters.
   a. If Joaquin mows one length across the lawn from east to west in 7.10 seconds, then what is the velocity of the lawnmower?
   b. Once he reaches the edge of the lawn, Joaquin turns the lawnmower around. He mows in the opposite direction but maintains the same speed. What is the velocity of the lawnmower?

5. A family drives 881 miles from Houston, Texas to Santa Fe, New Mexico for vacation. How long will it take the family to reach their destination if they travel at a velocity of 55.0 miles per hour, northwest?

6. A shopping cart is pushed 15.6 meters west across a parking lot in 5.2 seconds. What is the velocity of the shopping cart?

7. Katie and her best friend Liam play tennis every Saturday morning. When Katie serves the ball to Liam, it travels 9.5 meters south in 2.1 seconds.
   a. What is the velocity of the tennis ball?
   b. If the tennis ball travels at constant speed, what is its velocity when Liam returns Katie's serve?

8. A driver realizes that she is traveling in the wrong direction on a one-way street. She has already driven 350 meters at a velocity of 16 meters per second, east before deciding to make a U-turn. How long did it take for the driver to realize her error?

9. Juan's mother drives 7.25 miles southwest to her favorite shopping mall. What is the average velocity of her automobile if she arrives at the mall in 20. minutes?

10. A bus is traveling at 79.7 kilometers per hour east. How far does the bus travel 1.45 hours?

11. A girl scout troop hiked 5.8 kilometers southeast in 1.5 hours.What was the troop's velocity?

12. A volcanologist noted that a lahar rushed down a mountain at 32.2 kilometers per hour, south. How far did the mud flow in 17.5 minutes?