Physics Chapter 3
Motion in 2-Dimensions and Vectors

Section 3.1

Introduction to Vectors

Motion in Two Dimensions

--When objects move in two dimensions, the <u>direction</u> of the motion must be considered along with the <u>size or magnitude</u> of the displacement, velocity, or acceleration.

--The quantity that represents the magnitude and direction of a quantity is called a <u>vector</u>.

Vectors and Scalars

--A quantity that does <u>not</u> include direction is called a <u>scalar</u>.

--A scalar quantity includes a number (magnitude) along with the necessary unit.

--Examples of scalar quantities include:

speed volume mass

--A vector quantity includes the magnitude and necessary unit along with the <u>direction</u> of the quantity.

--Examples of vectors include:

displacement	acceleration
velocity	force

Representation of Vectors

--Quantities that are vectors are represented by placing an arrow over the symbol for the quantity. For example:

Velocity is represented by: $\vec{v}$

Acceleration is represented by: $\vec{a}$

--(The text uses **boldface** to represent a vector and *italics* to represent a scalar.)

--Vectors can be represent on <u>vector diagrams</u> as <u>arrows</u>:

--The length of the arrow represents the magnitude of the vector to scale

--and the direction in which the arrow points shows the direction of the vector.

Addition of Vectors

--Vectors can be added graphically on a vector diagram; a scale is chosen to represent the vectors being added.

--For example, to add two velocity vectors of V = 20.0 m/s, N and V = 30.0 m/s, E. a scale of 1 cm = 2 m /smight be used.

--Each vector is then drawn to scale with the proper direction, with the <u>tail of one vector placed at the head of the other vector</u>.

--The answer, called the <u>resultant</u>, is then reached by connecting the <u>open tail to the open head</u> of the two (or more) vectors being added.

--The magnitude and direction of the resultant vector is then determined. (Note that the order in which the vectors are added does not change the resultant.)

Properties of Vectors

--Vectors can be moved parallel to themselves, maintaining their magnitude and direction

--Vectors can be added in any order.

Subtraction of Vectors

--To subtract vectors, add its opposite. For example, if we subtract a displacement of 20 km, W from one of 30 km, E, we express the west displacement as a negative value to arrive at an answer of 10 km, E.

$$\Delta x_1 - \Delta x_2 = \Delta x_1 + (-\Delta x_2)$$

$$= +30\,km + (-20\,km) = +10\,km$$

Example:

Multiplication and Division of Vectors by Scalars

--If a vector is multiplied or divided by a scalar, the direction of the vector remains the same with the magnitude of the vector changing.

--For example, a vector of V = 20 km/h, E multiplied by 4 becomes V = 80 km/h, E.