Understanding Vectors

Ch. 3.1-3.5
Preview of Session

• Why Vectors?
• Graphical/Geometric Approach
• Practice
• Vector Components
Why Vectors?

- Give magnitude (positive number) and direction
- Some physical quantities require both
- Mathematical tools to handle more involved physics situations
Graphical/Geometric Approach

- Length represents magnitude (need scale)
- Direction indicated with arrow
- Example:

\[ V_p = 90 \text{ km/hr} \]
(Airplane velocity in still air)

\[ V_a = 30 \text{ km/hr} \]
(wind velocity)

- Methods of adding vectors
  - Parallelogram
  - Head-to-tail
Practice with Vectors

- Find $a + b$ (answer in ___ m/s, direction)
- Show $a + b = b + a$
- Find $d = a + b + c$ (answer in ___ m/s, direction)
- Find $a - b$ (answer in ___ m/s, direction)
- Find $b - a$ (answer in ___ m/s, direction)
- $b - a = -(a - b)$?
Vector Components

• Given a vector – **magnitude and direction** – determine x- and y-components of the vector

\[ \text{How much of 12 m/s is in } x \text{ direction?} \]
\[ \text{How much of 12 m/s is in } y \text{ direction?} \]

• Given x- and y-components, determine magnitude and direction of vector

\[ F_x = 4.0 \text{ m/s and } F_y = 8.0 \text{ m/s} \]
\[ |\vec{V}| = ? , \text{ Direction of } \vec{V} \text{ is ?} \]
Using Components to Add and Subtract Vectors

Given vectors $A$ and $B$, find $C = A + B$ using components.

$$C_x = A_x + B_x \quad \text{and} \quad C_y = A_y + B_y$$

- $|C| = \sqrt{C_x^2 + C_y^2} = \sqrt{(A_x + B_x)^2 + (A_y + B_y)^2}$

- Direction given by angle, $\theta$, from $x$-axis

$$\tan \theta = \frac{C_y}{C_x} = \frac{A_y + B_y}{A_x + B_x}$$

$$\theta = \tan^{-1}\left(\frac{C_y}{C_x}\right) = \tan^{-1}\left(\frac{A_y + B_y}{A_x + B_x}\right)$$