DEVIL PHYSICS

THE BADDEST CLASS ON CAMPUS

AP PHYSICS

LSN 3-7: PROJECTILE MOTION IS PARABOLIC
LSN 3-8: RELATIVE VELOCITY

Questions From Reading Activity?

Big Idea(s):

- The interactions of an object with other objects can be described by forces.

Enduring Understanding(s):

- All forces share certain common characteristics when considered by observers in inertial reference frames.

Essential Knowledge(s):

- An observer in a particular reference frame can describe the motion of an object using such quantities as position, displacement, distance, velocity, speed, and acceleration.
  - Displacement, velocity, and acceleration are all vector quantities.
  - Displacement is change in position. Velocity is the rate of change of position with time. Acceleration is the rate of change of velocity with time. Changes in each property are expressed by subtracting initial values from final values.
  - A choice of reference frame determines the direction and the magnitude of each of these quantities.

Essential Knowledge(s):

- Forces are described by vectors.
  - Forces are detected by their influence on the motion of an object.
  - Forces have magnitude and direction.

Learning Objective(s):

- The student is able to express the motion of an object using narrative, mathematical, and graphical representations.

Learning Objective(s):

- The student is able to analyze experimental data describing the motion of an object and is able to express the results of the analysis using narrative, mathematical, and graphical representations.

Learning Objective(s):

- The student is able to represent forces in diagrams or mathematically using appropriately labeled vectors with magnitude, direction, and units during the analysis of a situation.

Projectile Motion is Parabolic*

- * If we ignore air resistance and assume acceleration due to gravity is constant.
- For the mathniacs:

$$x = v_{x_0} t$$

$$t = \frac{x}{v_{x_0}}$$

$$y = v_{y_0} t - \frac{1}{2} g t^2$$

$$y = v_{y_0} \left(\frac{x}{v_{x_0}} \right) - \frac{1}{2} g \left(\frac{x}{v_{x_0}} \right)^2$$

Projectile Motion is Parabolic

- * If we ignore air resistance and assume acceleration due to gravity is constant.
- Where *a* and *b* are constant for a given velocity and angle.

$$y = v_{y_0}\left(\frac{x}{v_{x_0}}\right) - \frac{1}{2}g\left(\frac{x}{v_{x_0}}\right)^2$$

$$y = \left(\frac{v_{y_0}}{v_{x_0}}\right)x - \left(\frac{g}{2v_{x_0}^2}\right)x^2$$

$$a = \left(\frac{v_{y_0}}{v_{x_0}}\right), b = \left(\frac{g}{2v_{x_0}^2}\right)$$

$$y = ax - bx^2$$

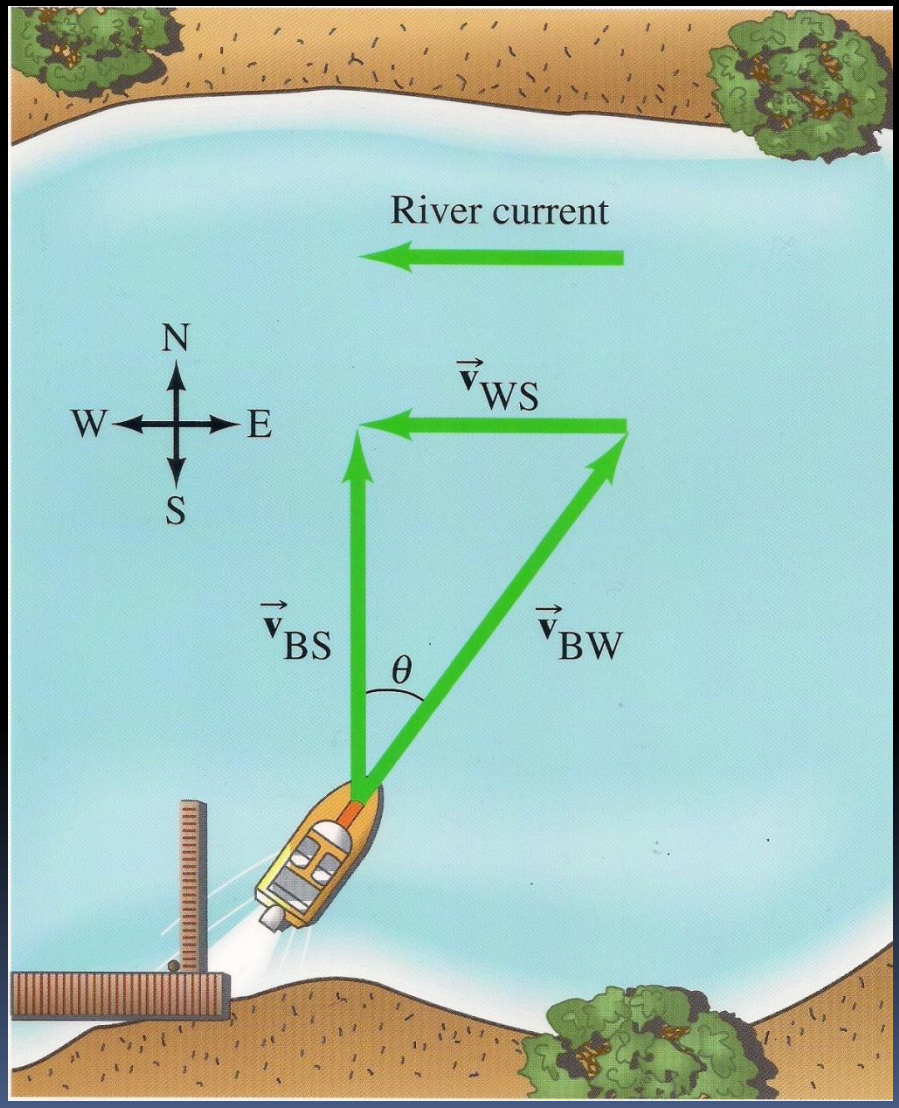
Relative Velocity

Relative Velocity

- Exploring how observations made in different reference frames can be related to each other through vector addition
- ***It is extremely important to:***
  - ***Draw a picture***
  - ***Label the vectors with meaningful subscripts***

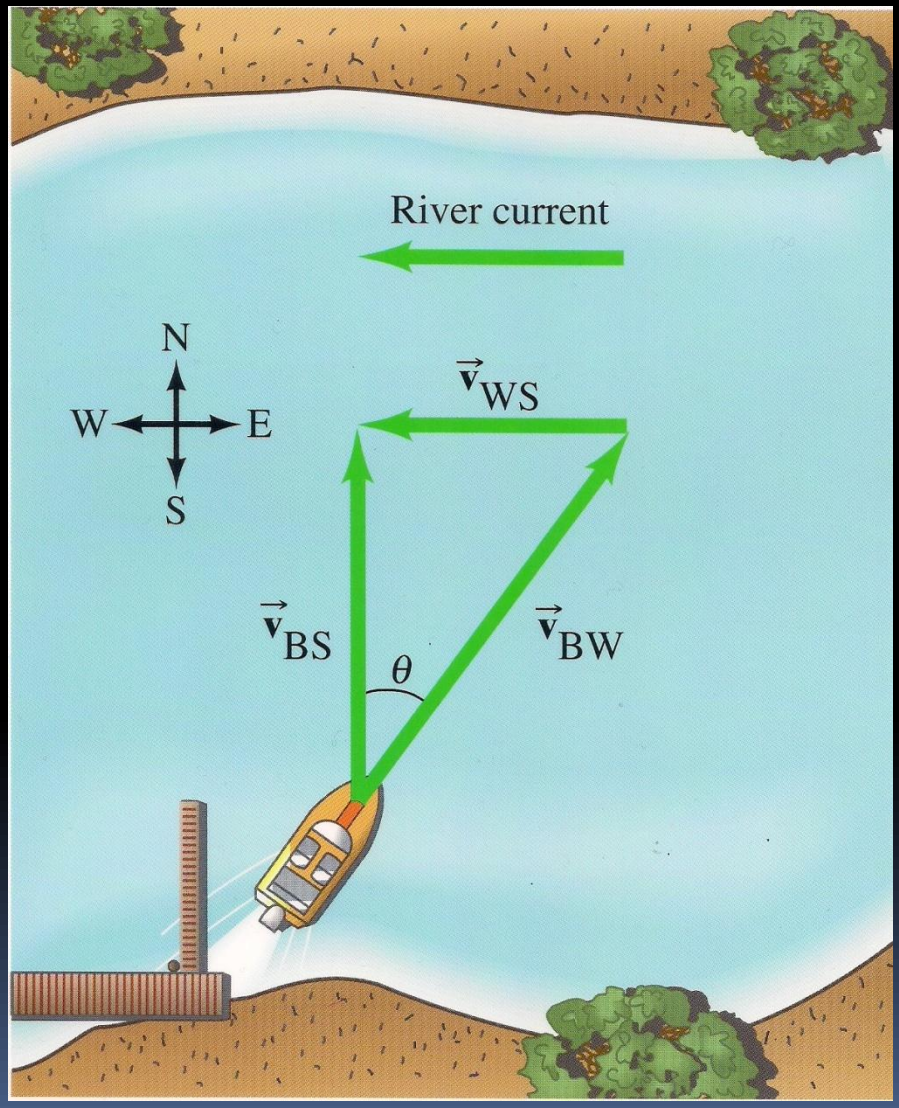
Relative Velocity

- The first subscript refers to the object
- The second refers to the reference frame
- $\mathbf{v_{BW}}$ would refer to **the boat *<u>with respect to</u>* the water**
- $\mathbf{v_{WS}}$ would refer to **the water *<u>with respect to</u>* the shore**



Relative Velocity

- Here, you are adding v_{BW} to v_{WS} to get v_{BS}
- Notice how the resultant, v_{BS}, will always have the same first subscript of the first vector and the same second subscript of the second vector.
- Kinda like tail-to-head vector addition



Sample Problem #1

- Homework #36

Sample Problem #2

- Homework #43

Sample Problem #3

- Homework #48

Sample Problem #4

- Homework #51

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QUESTIONS?

Homework

#36-48