Physics
Lab: Paper River (20 points)

Name:
Date:

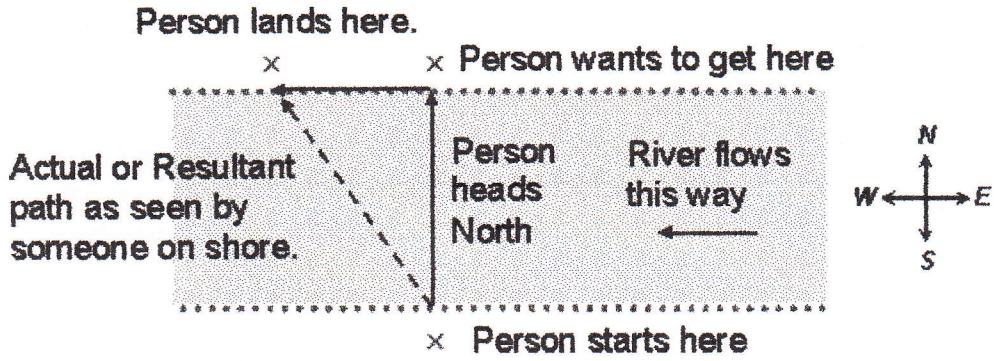
Objective: calculate the velocity of a boat on a river applying vector concepts
create a model of 2D motion

Question: How does a boat travel on a river?

Background:

Relative Velocity and Riverboat Problems
http://www.physicsclassroom.com/Class/vectors/u3l1f.cfm

Summary of Navigation/Heading Problems
http://www.kwantlen.ca/science/physics/faculty/mcoombes/webtests/notes/HeadingProblems/Heading_Problems.html



Hypothesis: (2pts)
Predict how much time is required for your boat to go directly across the river _____

Predict how much time is required for your boat to go across the river with a current: _____

Materials: constant motion car meter stick, stopwatch, protractor, long piece of paper, tape

Procedure: Imagine a river. There are two banks we will call North and South. The car will model the motion of a boat. The captain will control the boat by steering it across the river. The paper will be a model of a river. The hydrological engineer will determine the current of the river by pulling it. Observers may be stationed on either bank of the river. Remember – boats only travel if completely in the water.

A. Describe how the boat's speed can be determined before entering the river. (1 pt)

Collect data required and then calculate the boat's speed (1pt)

B. Measure the width of the river. Predict how much time is required for your boat to go directly across the river when there is no current. Show data and calculations to support your answer(2pts)

Prediction: Measurements: Calculations:

C. Predict if it will take more, less, or the same amount of time to cross the river if there is a current. (1pt)

circle: more time less time same amount of time

D. Have the hydrological engineer create a current (move the river) at a constant rate to the west like the diagram on page one. Navigate the boat (point to travel straight) across the river for three trials. Mark with tape on the bank (floor) where the boat launches and lands to assist measuring.

E. Make the required measurements to complete the data table below:

Trials	Distance straight across river	Time to cross river	Distance downstream from launch point	Calculated velocity (North)	Calculated velocity (West)	Calculated Resultant velocity (Northwest)
1						
2						
3						
Average						

Analysis:

1. Consider the motion of the boat as viewed from a hot air balloon overhead looking down.

Diagram the displacement of the boat both components and resultant(3pts)

Diagram the velocity of the boat with with components and resultant (3pts)

2. Does the boat move in the direction that it is pointing? Cite evidence to support answer. (1pt)

3. Did the motion of the water affect the time for the boat to cross the river? Cite evidence. (1pt)

4. Suppose our captain turns the boat parallel to the bank while in the middle of the river. Using the previous calculated results for the average speed of the boat and the river - Calculate the speed of the boat as viewed from the bank if the boat is headed one of two directions. Include vector diagrams to represent the velocities for each scenario. (4 pts)

   a. headed directly down stream (with the current)

   b. headed directly upstream (against the current)

5. Using the data collected – What direction (degrees) would the boat have to travel in order to land directly across stream if considering the average velocity of the moving river? Diagram and solve (2pts)