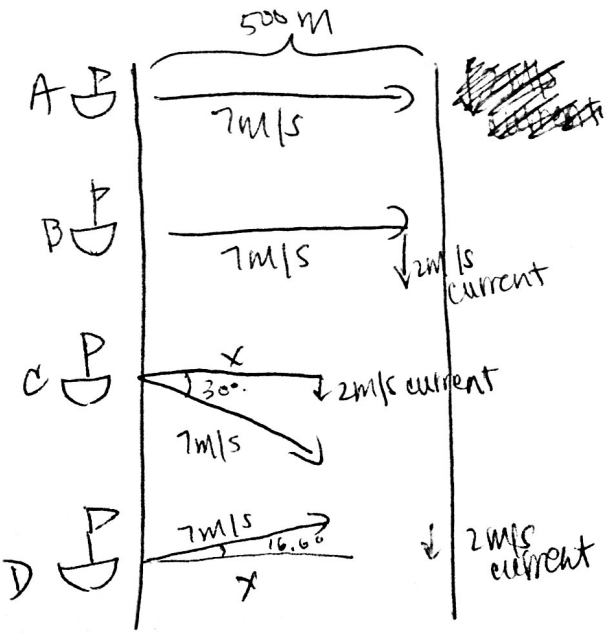
Name _____ Period _____ Date _____

Boat Race Vectors

Four boats are in a race across a river that is 500 m across at all places in the river, where whoever crosses the 500 m horizontal distance first wins. The driver of each boat is allowed to choose where to place their boat. Driver of Boat A chooses a place in the river that has no current, believing this will ensure that no current hinders the boat. Driver of Boat B believes a downward current doesn't affect the horizontal speed of the boat, so places Boat B in a place with a downward current of 2 m/s. Driver of Boat C thinks the downward current can help, so places C in a similar place in the river with the downward current of 2 m/s, but turns the boat 30 degrees in the direction of the current. Driver of Boat D places Boat D in the downward current of 2 m/s but turns the boat 16.6 degrees against the current so the boat will have a straight shot across the river. Each boat goes 7 m/s relative to the water.

a) **Draw this scenario. Include the vectors of each boat's movement and the current.**
b) **In what order do the boats get to the other side? You can either calculate the amount of time each boat takes to get across or justify your answer with an explanation about the horizontal and vertical components of each boat's resulting velocity vector.** (A = B > C > D)

Horizontal velocity is the only thing that affects how long it takes an object to go a horizontal distance



Horizontal velocity

A: 7m/s

B: 7m/s

C: $\cos 30 = \frac{x}{7m/s}$, $x = 6.06 m/s$

D: $\cos 16.6 = \frac{x}{7m/s}$, $x = 6.7 m/s$

Time

A: $v = \frac{\Delta x}{\Delta t}$, $7m/s = \frac{500m}{\Delta t}$, $\Delta t_A = 71.4 sec$

B: $\Delta t_B = 71.4 sec$

C: $6.06 m/s$, $\Delta t_C = 82.5 sec$

D: $\Delta t_D = 74.6 sec$

A + B have the fastest horizontal velocity so they reach @ the same time. D has a slower horizontal velocity than A+B but a faster horizontal velocity than C.