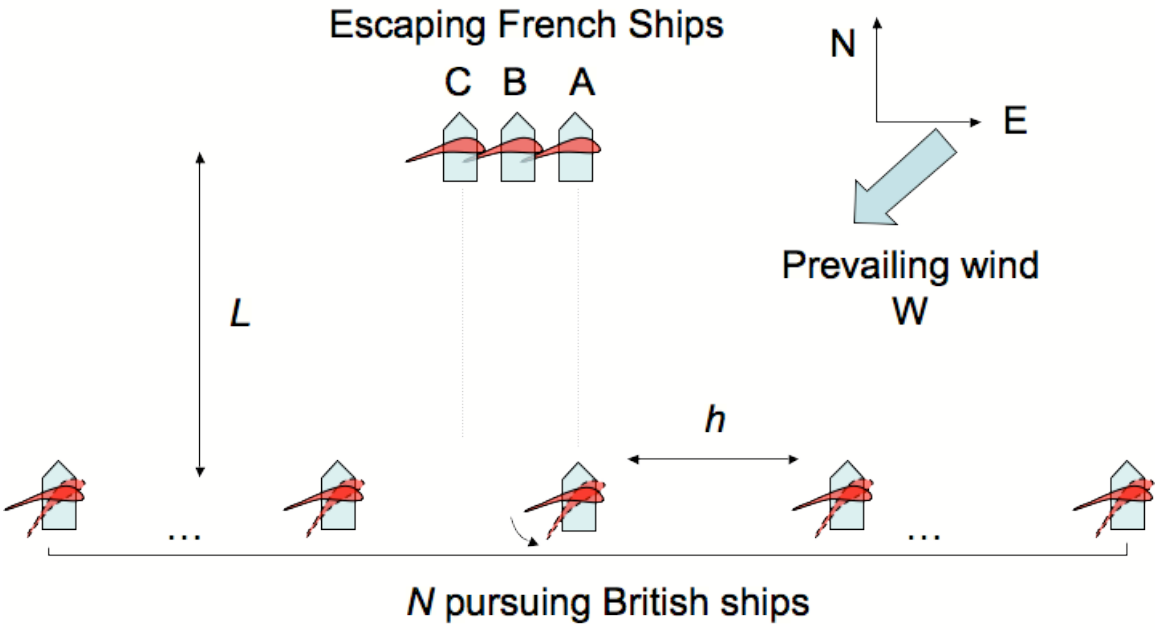
Team Diffuser

Concept Question #1 The battle of Trafalgar

In the battle of Trafalgar, the British Navy broke the line of the Franco-Spanish fleet, completely routing the enemy. In the aftermath, the French flagship *Aigle* (A) and two accompanying cutters *Bucentaure* (B) and *Cornelie* (C) attempted to escape. The British fleet gave pursuit in a line abreast formation as illustrated below.



For some bizarre reason, the pursuing Rear-Admiral Cunningham of the British forces gave the command to his fleet to change the angle of their sails together. At that moment, Admiral Villeneuve in ship A happened to be measuring the air pressure with a surprisingly accurate manomenter. You may assume invisicid flow for the following questions, and the characteristic size of the boat $R \ll h$.

1. How will different British fleet formations affect Admiral Villeneuve's pressure measurements? Describe the pressure change as a function of the distance L, estimate the rate of decay for each of the following region:
    a. If $Nh \gg L$, $h \sim L$, an infinitely long British fleet
    b. If $h \gg L$, the characteristic length is now the chord length of a sail.
    c. If $Nh \ll L$ and $h \ll L$, the British fleet appear to be one large menacing object.
2. Consider Ships A, B and C, which one will feel the largest pressure change. How does the pressure change in the east-west direction?
3. If the magnitude of the prevailing wind W increases,
    a. How does the magnitude of the pressure perturbation change?
    b. How does this change the rate of decay of the pressure perturbation?
4. Rear Admiral Cunningham wanted to know how changing the angle of attack of the sails can affect the French ships. Will it help the British fleet to catch up with the enemy?