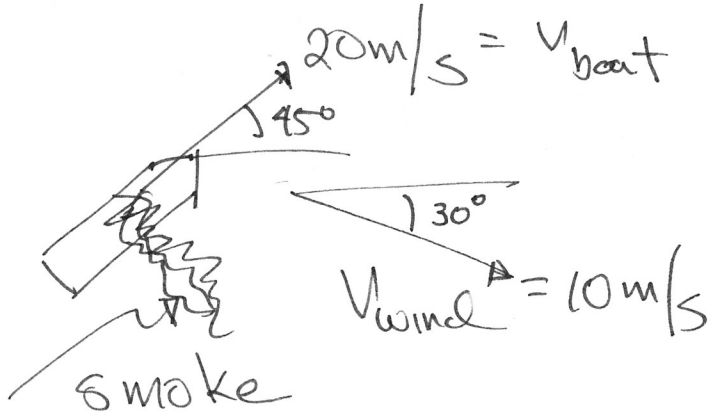
Given:



Reqd: $V_{smoke/boat} = ?$

Assump $\bar{V}_{smoke} = \bar{V}_{air} = \bar{V}_{wind}$, in a well behaved inertial system (no coriollis effects)

Strategy $V_{A/O} + V_{B/A} = V_{B/O}$ and rearrange, just need to get labels figured out.

Estimate Given the directions I expect the smoke to moving away @ an angle of around 75° (45°+30°) and doing so faster than just the wind @ 10 m/s but less than maximum possible of 30 m/s. As I look at the setting I realize the boat is going E @ 14 m/s which is faster than the wind — estimate smoke slowly < 10 m/s!

Soln: $|\bar{v}_{boat/H_2O}| = 20\,m/s \quad |\bar{v}_{wind/H_2O}| = 10\,m/s$

$$v_{smoke/boat} = v_{wind/boat}$$

$$\Rightarrow \bar{v}_{boat/H_2O} + \bar{v}_{wind/boat} = \bar{v}_{wind/H_2O}$$

(unknown)

$$\bar{v}_{wind/boat} = \bar{v}_{wind/H_2O} - \bar{v}_{boat/H_2O}$$

$$= 10\,m/s\left(\frac{\sqrt{3}}{2}\hat{\imath} - \frac{1}{2}\hat{\jmath}\right) - 20\,m/s\left(\frac{\sqrt{2}}{2}\hat{\imath} + \frac{\sqrt{2}}{2}\hat{\jmath}\right)$$

$$= \left(5\sqrt{3} - 10\sqrt{2}\right)\hat{\imath} + \left(-5\,m/s - 10\sqrt{2}\right)\hat{\jmath}$$

$8.66 - 14.1 \qquad -5 \qquad -14.1$

$$\boxed{\bar{v}_{\substack{wind \\ boat}} = -5.44\,m/s\,\hat{\imath} - 19.1\,m/s\,\hat{\jmath}}$$

backwards

$$|\bar{v}_{w/b}| = \sqrt{(-5.44)^2 + (19.1)^2} = \sqrt{29.6 + 364.8} = \boxed{19.9\,m/s}$$

Discussin: Bigger magnitude than I expected but $v_x < 0$ was gratifying.