

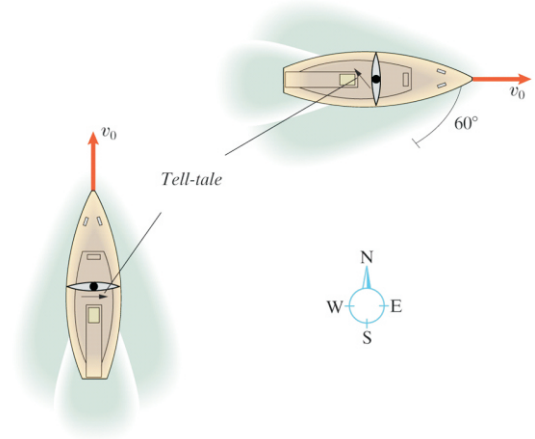
NAME _____

DATE _____

WEEK: _____ **PROBLEM:** _____

GIVEN:

Relative to the earth, the sailboat sails north with speed $v_0 = 6$ knots (nautical miles per hour) and then sails east at the same speed. The tell-tale indicates the direction of the wind *relative to the boat*. Determine the direction and magnitude of the wind's velocity (in knots) relative to the earth.



REQUIRED:

SOLUTION:

Solution:

$$V_{wind/ground} = V_{wind/boat} + V_{boat/ground}$$

In position one we have

$$V_{wind/ground} = U_{wind/boat1} \mathbf{i} + (6 \text{ knots}) \mathbf{j}$$

In position two we have

$$V_{wind/ground} = U_{wind/boat2} (-\cos 60^\circ \mathbf{i} + \sin 60^\circ \mathbf{j}) + (6 \text{ knots}) \mathbf{i}$$

Since the wind has not changed these two expressions must be the same. Therefore

$$\left. \begin{aligned} U_{wind/boat1} &= -U_{wind/boat2} \cos 60^\circ + 6 \text{ knots} \\ 6 \text{ knots} &= U_{wind/boat2} \sin 60^\circ \end{aligned} \right\}$$

$$\Rightarrow \begin{cases} U_{wind/boat1} = 2.536 \text{ knots} \\ U_{wind/boat2} = 6.928 \text{ knots} \end{cases}$$

Using either position one or position two we have

$$\begin{aligned} V_{wind/ground} &= (2.536\mathbf{i} + 6\mathbf{j}) \text{ knots} \\ U_{wind/ground} &= \sqrt{(2.536)^2 + (6)^2} \text{ knots} = 6.51 \text{ knots} \\ \text{direction} &= \tan^{-1} \left(\frac{2.536}{6} \right) = 22.91^\circ \text{ east of north} \end{aligned}$$