

**2023A6****SONIC ANEMOMETERS**

**Level 1:** For a two-transducer sonic anemometer, calculate the wind speed if it takes 0.8 milliseconds to travel from transducer 1 to transducer 2 and 0.9 milliseconds to travel from transducer 2 to transducer 1. The distance between transducers is 30 cm.

To solve this question, we can rearrange our system of equations to solve for the wind speed with this first step.

$$v_{21} = v_s - v_w$$

$$v_s = v_{21} + v_w$$

Then we can plug our equation for the speed of sound into our first equation.

$$v_{12} = v_{21} + v_w + v_w$$

$$v_{12} - v_{21} = 2v_w$$

$$v_w = \frac{1}{2}(v_{12} - v_{21})$$

We can use the definition of velocity ( $v = \frac{d}{t}$ ) to get distance and time into this equation.

$$v_w = \frac{1}{2} \left( \frac{d_{12}}{t_{12}} - \frac{d_{21}}{t_{21}} \right)$$

We can now plug in our distance and times to solve for the wind speed.

$$v_w = \frac{1}{2} \left( \frac{30cm}{0.8ms} - \frac{30cm}{0.9ms} \right)$$
$$v_w = 2.08 \frac{cm}{ms}$$

Now we can convert this answer to miles per hour since that is a unit that most of us are familiar with.

$$v_w = 2.08 \frac{cm}{ms} \left( \frac{1m}{100cm} \right) \left( \frac{1mi}{1609.34m} \right) \left( \frac{1000ms}{1s} \right) \left( \frac{3600s}{1h} \right) = 46.53mph$$

The wind speed that the sonic anemometer reads is 46.53 miles per hour.

**Level 2:** Reflect on the differences between the types of anemometers. Think of some pros and cons of each type.

There are several different points to think about when it comes to pros and cons of different types of anemometers. We've included some thoughts below, but we encourage you to think of more than the ones below.

The biggest difference between the three types of anemometers is their method of measurement. Cup and vane anemometers use mechanical motion to measure wind speed, while sonic anemometers use sound waves to measure wind speed.



Wind Study is intended for grades 5-8 and 8-11  
Questions posted on: Monday    Answers posted on: Friday  
Find downloadable one pages at [www.oneenergy.com/one-energy-feed](http://www.oneenergy.com/one-energy-feed)

A big pro of the vane and cup anemometers is their price. They use simpler components to measure wind speed, whereas a sonic anemometer uses a host of electrical equipment and circuitry.

A big pro of sonic anemometers is accuracy. Sonic anemometers tend to be more accurate than their mechanical counterparts because they have a higher sensitivity to changes in wind speed.