

Your must show your work/reasoning—whether it be in words or equations—neatly and in good form as defined in class. Be sure to use the correct units.

1) Use the following information/ data to answer the following questions.

$$v = 331 + 0.6T \quad L_c = L + 0.4d \quad v = f\lambda$$

a) What is the theoretical speed of sound if the air has a temperature of 24°C?

$$v = \underline{\hspace{2cm}}$$

b) A 400-Hz tuning fork is used to create a standing wave in a tube 68 cm long and 4 cm in diameter. Resonance is first observed to occur 19.5 cm above the surface of the water. Since some air vibrates above the tube, what is the *corrected* (or effective) length of the tube?

$$L_c = \underline{\hspace{2cm}}$$

c) What is the wavelength of the fundamental in meters?

$$\lambda = \underline{\hspace{2cm}}$$

d) What is the actual speed of sound as measured in meters per second?

$$v = \underline{\hspace{2cm}}$$

2) a) If the fundamental of a cello string has a frequency of 440 Hz, what is the frequency of the 3rd harmonic?

$$f = \underline{\hspace{2cm}}$$

b) Sketch the first three 3 harmonics for a vibrating cello string.

3) a) If a Whirly tube is 75 cm long and the second harmonic has a frequency of 450 Hz, what is the speed of sound in meters per second?

What causes the sound in a whirling tube? What would happen if the tube were smooth? What would happen if one end were closed off with masking tape?

b) what causes sound--

c) smooth--

d) one end closed--

4) An aluminum bar resonates at frequency of 2760 Hz when held in the middle by stroking it. Assuming the tone is the fundamental, what is the speed of sound in *aluminum* if the bar is 95 cm long?

$v = \underline{\hspace{2cm}}$

5) At a high school band review in Selma, a conductor attempts to lead 48 bands on the 50-yard line in the stadium simultaneously playing the Star Spangled Banner. The bands are seated all around the entire stadium. The result is disastrous because even though the players obey his hand signals, the bands sound out of sync—no matter where you sit. A band member from San Mateo (who is also taking physics) points out that such an arrangement is doomed to fail no matter how the conductor waves his baton because of the disparity between the speed of sound and the speed of light. Is this true? Why or why not?

6) Suppose the space shuttle comes in for a landing so that the half-angle of the shock wave is 20° (the angle of the cone is 40°).

a) What is the speed of the shuttle?

b) What is the Mach number of the shuttle at that point?

7) You and your friend are sitting at the pier at the Port of Redwood City. Suppose you have some rocks and your wristwatch has a stopwatch function. Propose how you would go about measuring the speed of water waves.