# 6. Resonance Tube

## THEORY

A standing wave occurs when a wave is reflected from the end of the tube and the return wave interferes with the original wave. However, the sound wave will actually be reflected many times back and forth between the ends of the tube, and all these multiple reflections will interfere with one another. In general, the multiply reflected waves will not all be in phase, and the amplitude values of the wave pattern will be small. However, at certain frequencies of oscillation, all of the reflected waves are in phase, resulting in a standing wave with a very high amplitude. These frequencies are known as *resonant* frequencies. In this experiment, standing waves are created and their properties are investigated using a microphone.

Depending on the length of the tube, there are several resonant frequencies. Thus, for a sound wave with a given frequency, there are many possible tube lengths which make the frequency of a standing wave. In this experiment, possible lengths of tube for each frequency are determined.

The speed of light is measured directly by measuring the time interval that a pulse launched from one point requires to reach another point, or measuring the time interval that a reflected wave requires to return to its starting point.

## PROCEDURE

1. Resonant Frequencies of a Tube (Opened, Closed).
   (a) Set up the resonance tube, oscilloscope, and function generator as shown in *Fig. 1*.
   (b) Increase the frequencies gradually and listen to the sound from the tube carefully.
   (c) Decrease the amplitude of the wave from the function generator to 0.2~0.5(V) and observe the signal of the microphone as it is represented on the oscilloscope Find the frequencies of the standing wave.
   (d) While increasing the frequency, find approximately five different resonant frequencies.

2. Standing Waves in a Tube (Opened, Closed).
   (a) The method is identical to that in procedure 1.
   (b) Understand the mechanism of a microphone, and investigate the wave form in the tube.
   (c) Watch the wave form at the end edge of the tube carefully.
3. Tube Length and Resonant Modes (Opened, Closed).

(a) The method is identical to that in procedure 1.

(b) Measure the distance between an antinode (node) and the next node using the microphone, and compare it to the theoretic values.

4. The Speed of Sound in a Tube.

(a) Make a low frequency(< 10Hz) saw tooth wave and tune the system in order to listen to the clacking sound. Set the trigger of the oscilloscope to the launched wave.

(b) Watch both the wave of the speaker and that of the microphone on the oscilloscope.

(c) Measure the time interval of a pulse launched from one point until it reaches another point, and measure the time interval that a reflected wave requires to return to the starting point. Determine which peak is the reflected peak when the echo is used.

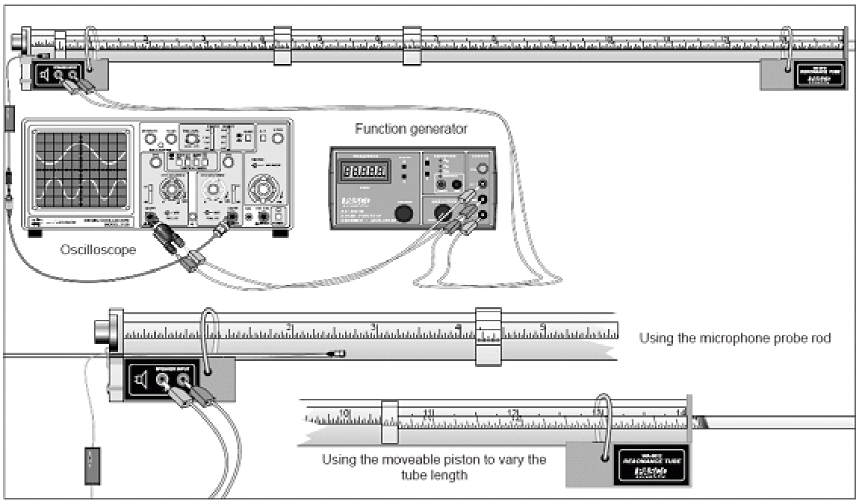


*Fig. 1.* Experiment setup.

## CAUTION

1. Decrease the amplitude of the output waves to less than 1V to observe the high-frequency-range waves for the standing wave experiments.

2. The large amplitude of the output wave allows the measurement of the reflected wave in the experiment of the measurement of the speed of sound wave. This should not bet too large to interrupt experiments by other groups.

3. Turn the microphone off after the experiment.