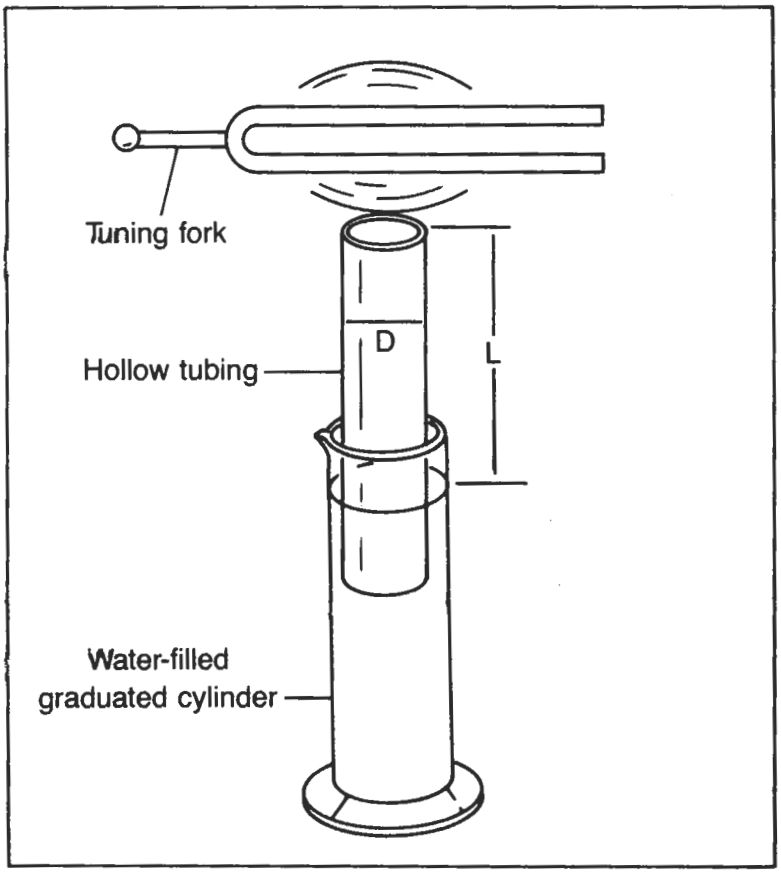
Speed of Sound in Air

Problem
Can the speed of sound in air be calculated?

Materials *(per group)*
1000-mL graduated cylinder
hollow glass tubing, approximately 2.5 cm × 45 cm
tuning fork of known frequency
meterstick
water

Procedure
1. Fill the graduated cylinder with water to about 3 cm from the top.
2. Hold the hollow tubing in the water.
3. Strike the tuning fork against the heel of your shoe. Quickly place the fork just over the top of the hollow tube, as shown in the accompanying figure.
4. Move the hollow tube up and down until the *loudest* sound is heard. If there is more than one position in which the sound appears the loudest, choose the position in which the length of the tube above the water's surface is the shortest.



5. Record the length, L, of the air column to the nearest 0.1 cm.

6. Measure and record the inside diameter of the hollow tube to the nearest 0.1 cm.

7. Record the frequency of the tuning fork.

Observations

1. Calculate the wavelength of the tuning fork using the following formula:

$$\text{wavelength} = (4 \times L) + (1.6 \times D)$$

where L = length of the air column
D = diameter of the tube

2. Calculate the speed of sound in air using the following formula:

$$\text{speed of sound} = \text{frequency} \times \text{wavelength}$$

Conclusions

1. The speed of sound in air is about 34,500 cm/sec. How close is your calculation to this value?

2. How do you account for differences between your calculated value and the given value?

3. If a tuning fork with a different frequency were used, would you expect a different value for the speed of sound? Explain your answer.

4. If this investigation were performed at a temperature of 5C° above or below the actual temperature, would the speed of sound be different? Explain your answer.