Sound of speed

Yunpeng Huang period 11

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1 Problem

To determine the speed of sound in air.

2 Introduction

The speed of sound is the distance traveled per unit time by a sound wave propagating through an elastic medium. In dry air at 68 F (20 C), the speed of sound is 343.2 metres per second (1,126 ft/s). This is 1,236 kilometres per hour (768 mph; 667 kn), or a kilometre in 2.914 s or a mile in 4.689 s. The speed of sound in an ideal gas is independent of frequency, but does vary slightly with frequency in a real gas. It is proportional to the square root of the absolute temperature, but is independent of pressure or density for a given ideal gas. The speed of sound in air varies slightly with pressure only because air is not quite an ideal gas. Although, in the case of gas only the speed of sound is expressed in terms of a ratio of both density and pressure, these quantities cancel in ideal gases at any given temperature, composition, and heat capacity. This leads to a velocity formula for ideal gases which includes only the latter independent variables. In common everyday speech, speed of sound refers to the speed of sound waves in air. However, the speed of sound varies from substance to substance. Sound travels faster in liquids and non-porous solids than it does in air. It travels about 4.3 times as fast in water (1,484 m/s), and nearly 15 times as fast in iron (5,120 m/s), as in air at 20 C. Sound waves in solids are composed of compression waves (just as in gases and liquids), but there is also a different type of sound wave called a shear wave, which occurs only in solids. These different types of waves in solids usually travel at different speeds, as exhibited in seismology. The speed of a compression sound wave in solids is determined by the mediums compressibility, shear modulus and density. The speed of shear waves is determined only by the solid material's shear modulus and density. In fluid dynamics, the speed of sound in a fluid medium (gas or liquid) is used as a relative measure for the speed of an object moving through the medium. The speed of an object divided by the speed of sound in the fluid is called the Mach number. Objects moving at speeds greater than Mach1 are traveling at supersonic speeds.

3 apparatus

1.Tuning fork
2.rubber hammer
3.thermometer
4.water
5.meter stick
6.resonance tubes

4 Concept

Sound moves through air because a vibrating source produces frequent variations in air pressure. The frequency of the wave is the number of cycles of vibration per second. At room temperature (20 degrees C), sound travels at 343 m/s. Certain frequencies are naturally reinforced in hollow tubes. When a tube is closed by a water boundary on one end, and open on the other end, one quarter of a wavelength will resonate.

5 Operate

1. Fill the graduated cylinder with water.
2. Record the frequency of the tuning fork.
3. Place the resonance tube into the graduated cylinder.
4. Strike the tuning fork with the rubber hammer and hold above the top of the tube.
5. Adjust the height of the tube until the sound is loudest. Hold the tube still and measure and record the distance from the water to the top of the tube.
6. Hold a thermometer in the middle of the tube and record the air temperature.

6 Formula

Phycis Wave Wave length= meter Wave speed= V meter/sec Frequency= f Hz/sec

$$V = \lambda f$$

Particle Photon

$$Ephoton = hf$$

$$Ephoton = \frac{hc}{\lambda}$$

7 data

a:512Hz $\lambda = 0.664$
$L = 0.166m$
$b : 384Hz\lambda = 0.888$
$L = 0.222m$
$c : 256Hz\lambda = 1.332$
$L = 0.333m$

8 error

Va=388m/s
Vb=330m/s
Vc=327m/s
a:0.165
b:0.215
c:0.320

9 discussion

A easy lab, but need many thing need to clear, because the sound(wave), will change when the temperature was different,so the lab have many error will make, because we don't know how it will be change