Stray Cats – Lively and Exciting Physics Demonstrations – Group 1b - Talking Cup, Maxwell's Top, and Experiments of Ultrasonic Wave -

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Abstract

As the second presentation of Stray Cats demonstrations, the following experiments for teaching physics to high school students are introduced. The first is a talking cup, which simulates the pronunciation of Japanese vowel. The second is Maxwell's top, where the center of weight and suspension point are exactly identical. The third is experiments on ultrasonic wave propagations.

1 Introduction

Many students say, "Physics is difficult to understand, because it is complex. For example, when we learn about projectile, we must memorize many equations." In order to respond to these opinions, it is effective to simplify the phenomena and to demonstrate them in a visible manner.

2 Talking cups

These cups shown in Figure 1 are models for the mouth talking Japanese vowels: "A", "I", "U", "E", and "O".

A straw is stuck into bottom of the cup and the cups for "I" and "E" are filled with sponge rubbers.

When you rub the straw by wet fingers, the cups will pronounce "A", "I", "U", "E", and "O".

3 Maxwell's top

Another name of Maxwell's top is Ptolemaiose's top.

The center of rotation of this top is exactly the same point as the center of gravity. It has no precession. Its motion is the same as that under the weightless condition.

It goes along with a curve of aluminum wire or finger of an opening.

The structure of Maxwell's top is shown in Figure 2.

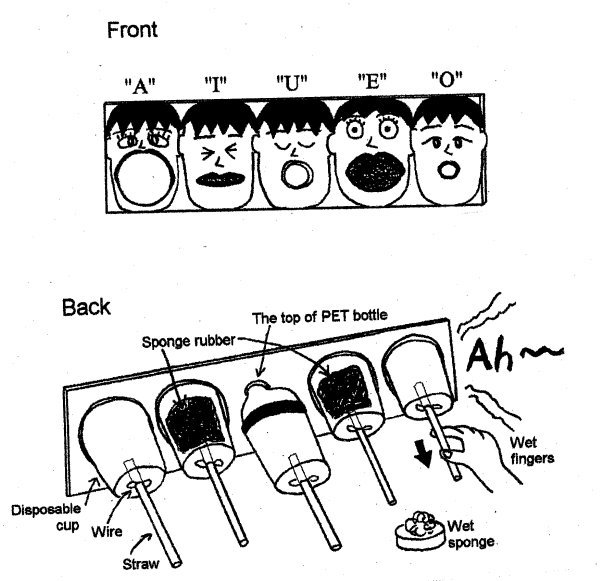

Figure 1. Schematic drawing of the talking cups

4 Experiments on ultrasonic waves

We can't hear the ultrasonic wave, but can recognize it by the use of a detector.

I challenge all experiments of sound, using the detector.

4.1 Interference

The interference of the sound is demonstrated in the following three experiments:

a) The sound from two sources makes interference, as is illustrated in Figure 3.

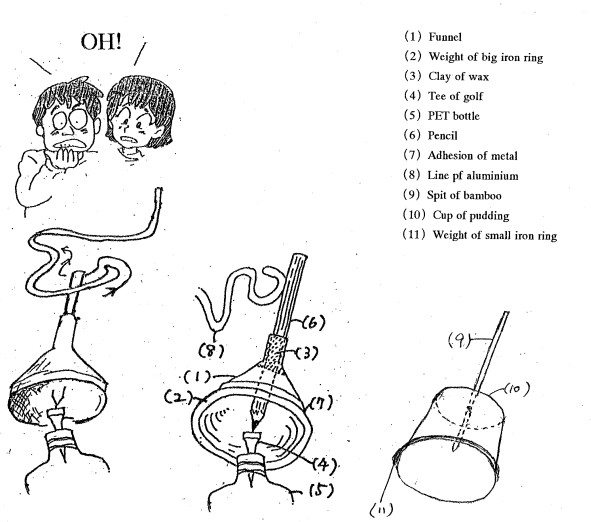

Figure 2. A hand-made Maxwell's top using various materials: (1) funnel, (2) weight of thick iron ring, (3) clay of wax, (4) tee of golf, (5) PET bottle, (6) pencil, (7) adhesive for metal, (8) aluminum wire, (9) bamboo spit, (10) pudding cup, (11) weight of small iron ring

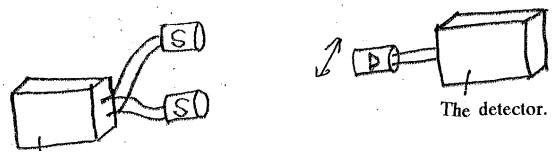

Figure 3. Interference from two sound sources

b) A resonance occurs in the sound through a pipe, as is shown in Figure 4.

Figure 4. Resonance of the sound through a pipe

c) An array of concentric rings makes a lens as is shown in Figure 5.

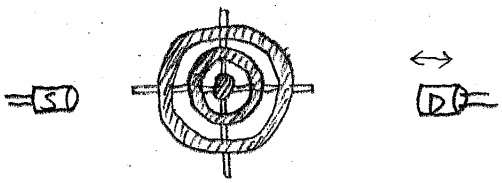

Figure 5. Lens made of concentric rings

4.2 Reflection

The reflection of the sound is demonstrated with an experiment shown in figure 6.

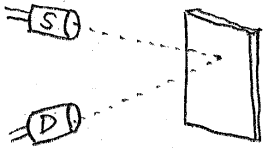

Figure 6. Reflection of the sound

4.3 Refraction

The refraction of the sound is demonstrated with an experiment using a balloon filled with carbon dioxide as is shown in figure 7.

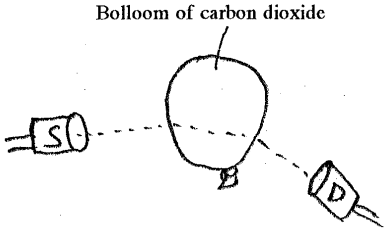

Figure 7. Refraction occurs in the sound through a balloon filled with carbon dioxide

4.4 Doppler effect

Doppler effect is demonstrated with an experiment, moving either the diode or reflector as shown in Figure 6.

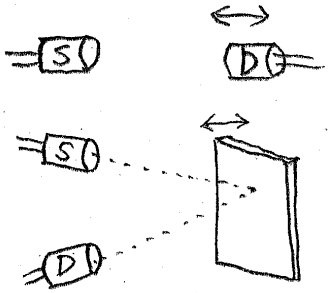

Figure 8. Demonstration of Doppler effect

Conclusion

Three kinds of experiments, talking cups to simulate Japanese vowels, Maxwell's top, and propagation of ultrasonic waves, are introduced in order for high school students to have more interests in physics.