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FOR THE HIGH SCHOOL SCIENCE TEACHER

John T. Johnson

High school science students may obtain cash to buy materials for their exhibits at events such as the Junior Academy of Science meetings and regional science fairs by making requests directly to Dr. W. W. Wyatt, U T College of Education, Knoxville. Dr. Wyatt is in charge of the Junior Academy of Science. The Academy will make the awards, using its own funds and also a grant from the American Association for the Advancement of Science. Letters to Dr. Wyatt should describe the materials to be purchased and should request a definite sum up to $25.00.

DETERMINATION OF THE DURATION OF AUDITORY IMPRESSION[1]

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My project was to determine the period of time which a sound remains impressed upon the auditory nerve, or the duration of auditory impression.

According to The World Book Encyclopedia the normal ear can differentiate about 1,500 differences in pitch. It can hear sounds which vibrate as slowly as twenty times a second or as fast as twenty-thousand times a second. The average person can hear sounds which range from about one decibel to one hundred-twenty decibels.

However, at the time I performed my experiments I had been unable to find any information as to the duration of auditory impression. Since doing them, however, I have found that Millikan and Gale's "New Elementary Physics" lists the time as one tenth of a second.

In order to determine this period, some device had to be provided to produce two successive sharply defined sounds, the time interval between which could be accurately measured and also regulated.

It would be possible to build an electronic timer which would key a sounding device at accurate intervals. This could be built along the same lines as a stroboscope.

I chose, however, to time the interval by making use of Galileo's law of accelerated motion. This law states that if the acceleration of the body is constant, the distance traversed in any given number of seconds is equal to one half the acceleration times the square of the number of seconds. As applied to a freely falling body, this means that the distance a body travels is equal to one half the acceleration due to gravity, times the square of the time the body is falling. By using algebra one may readily

[1]The project described in this paper was exhibited at the Southern Appalachian Science Fair in April, 1956, and was the prize-winning project for boys.

see that the time a body spends in falling can be determined by taking the square root of twice the distance the body falls divided by the acceleration due to gravity. (neglecting air resistance)

In my experiment I decided to drop two objects from different heights at the same instant, and by using the law of accelerated motion to calculate the time each object spent in falling. By subtracting the time the lower object spent in travel from the time the higher object spent in travel, it was possible to get the interval of time between their striking. By using different heights, I adjusted the interval between the objects striking until it became zero as detected to my ear, but in reality was a finite quantity. This was the duration of auditory impression.

It was my original plan to use to steel balls hitting a tin cake pan to make the measured clicks necessary for this experiment. However, after experimenting with dropping balls on a pan, I decided it would be better to substitute a wooden board in place of the cake pan to prevent reverberations from the pan. Around this board I built an enclosure of acoustical tile to deaden reverberations which did occur.

I decided to use electromagnets to drop the balls in order to insure their being released at exactly the same instant.

Since I was unable to find a stand of sufficient height in our school laboratory, I built one to support the magnets. I used three quarters by one inch pine lumber, and two and one quarter by one inch scrap walnut to hold up a sixty-one by two inch strip of one quarter inch plywood.

For the core of my electro-magnets I bound together with copper wire four and one-half inch lengths of soft iron wire. Around these I wrapped approximately forty turns of number eighteen bell wire. I connected these two magnets in series and used a number six, one and one-half volt dry cell to furnish the current.

RESULTS

Trial Number	Distance of Top Ball from Board	Time of Travel of Top Ball	Distance of Bottom Ball from Board	Time of Travel of Bottom Ball	Duration of Auditory Impression
1	50	.508	33.5	.416	.092
2	42	.466	25	.359	.107
3	57.5	.545	36.5	.435	.110

MEAN OF 3 TRIALS = .103 SECOND

After clamping the magnets to the stand I found that the upper one was not providing sufficient magnetism to hold up a ball. I rewound both magnets, this time using two layers or approximately eighty turns. This helped some, but the upper magnet was still not strong enough. Since the lower magnet was doing all right, I decided the difference between the upper and lower magnets must be due to voltage drop. At the time I was using number eighteen bell wire to connect the magnets, the same wire used in winding them. I substituted for this bell wire, lamp cord and used both strands in parallel as one conductor. This solved the problem, for there was no discernible difference between the magnets after the change.

I have calculated the duration of auditory impression of my ear and found it to be .103 second. This was the mean of three trials. This period must undoubtedly vary with different people.

I think further research could be done on the effect of frequency on the duration of auditory impression.

ELECTROPHORESIS IN STABILIZED MEDIA[1]

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In the last few years several new separation techniques have been introduced in organic and inorganic chemistry. Among these has been the development of electrophoresis as a research tool.

Lodge is credited with the first attempt (1886) to measure ionic velocities in a tube filled with jelly containing an indicator. Migration was observed at the color change boundary. The observation of moving boundaries was converted into an analytical method by Tiselius in 1925.

In the past, two general methods have been available for studying the electrophoretic behavior of charged particles in a liquid. The microscope, which depends on direct observation of the motion of the particles with a microscope, is adapted to the study of mobilities of fairly large particles. In the moving-boundary method the displacement of the particles is an electric field is recorded as the movement of a boundary between a dispersed phase and the dispersion medium.

During the last few years a third method of achieving electrophoretic separations and of determining electrophoretic mobilities has come to the fore. This technique depends on the electromigration of charged particles, either ions or colloidally dispersed substances, through conducting solutions which have been stabilized with agar, gelatin, filter paper, cloth, and other materials. The extent of movement is determined by such procedures as developing colored derivatives, incorporating ra-

[1]The project described in this paper was exhibited at the meetings of the Junior Academy of Science in Murfreesboro. November, 1956, and was the project winning first prize for boys.