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Topic: The Research Experiment on Singing Wine Glasses

PURPOSE: The purpose of this lab is to investigate the resonating characteristic for different volume filled wine glasses and study the effects and physical laws in association with it.

BACKGROUND INFORMATION:

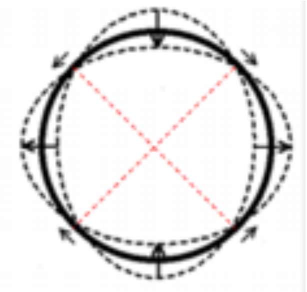
The singing wine glass or the Harmonica is a glass instrument designed in 1714 by Richard Pockrich, and Benjamin Franklin designed a modified form of the Harmonica. The sound of this lovely instrument is made when energy is applied to the glass and the physical properties of the glass begin to resonate. The connected energy will then for this situation be rubbing maybe a couple wet fingers on the edge of a glass, and the glass will then begin to vibrate, at its normal frequency. So my examination inquiry will be:

How does the resonating frequency change with the water in a singing wineglass? The methodology I will use to answer my examination inquiry will be to quantify the frequencies with various measure of water

Resonance Frequency *Frequencies of the relative maximum amplitude of the system at which the response amplitude is a relatively large are resonance frequencies*. This is because the framework stores vibration energy. Resonance happens when a system store and effectively exchange energy between two or more distinctive storage modes.

Slip and Stick effect: The slip and Stick impact is a frictional impact where consecutive surfaces are dragged along each other so that they can stick together and slips with short intervals of time. The primary hypothesis behind it is that contact between two surfaces needs to hold them together, in this manner stick. Nevertheless, the external force on acting from one surface on the other is constantly attempting to pull the two surfaces away, therefore slip. That is the reason it is known as the stick-and-slip effect.

How does the glass vibrate? At the point when the stick-and-slip movement affects the glass since glass is entirely flexible, the edge begins to distort into a curved shape. A. P. French7 demonstrates this through his mathematical model of radial displacement



Where θ = $$x(z, \theta, t) = \Delta_0 f(z) \cos 2\theta \cos \omega t$$

<u>HYPOTHESIS:</u> The reason for my task was to explore the resonating characteristics of the wine glass influence of the measure of fluid in the glass. My hypothesis was the more fluid that is in the wine glass the lower the pitch would be. The materials I utilized as a part of this trial were a wine glass, water, a measuring container, and tuner.

VARIABLES LIST: The resonance is related with many state variables that describe thermodynamic system under consideration. Since we used only a Glass as a base equipment, so shape of the glass will not change, that follows to same frequency for the empty glass. We also consider that temperature affects the volume of the water and density. Height of the glass was also considered as an affective parameter. Here in our experiment following can be considered in our variables list.

- ➢ Independent variables – height of water
- ➢ Dependent variables – Frequency (Hz)
- ➢ Controlled variables – Frequency and resonance can be controlled by shape and volume of water in glass along with temperature.

MATERIALS AND APPARATUSES: Following are apparatus we used:

1. Wine Glasses
2. Tuner
3. CRO device & microphone
4. Water
5. Calculator
6. Measuring cylinder

PROCEDURE:

Firstly, we are going to evaluate the mass/volume .it's result on frequency, and then we check the height with the outcome of frequency. To gauge the accurate volume, we use a weight to discover the volume, in light of the fact that 1 gm of water = 1 ml of water, the weight has a precision of 0.01 g. We utilized a pipette to gradually add drops of water to get the measure of water as exact as could be expected under the circumstances.

Fill the glass about half-full with water. Dunk your pointer finger into the water (or vinegar) to clean it. Utilize a napkin to wipe off any soil or oil on your finger. Clean is great. You will require a little moisture to help, so dunk your finger into the water once more. Set your spotless, clammy finger on the edge of the glass, push down somewhat, and rub it the distance around the edge without stopping. Continue going in a round movement along the lip of the glass while keeping up the weight.

Then we take different measurement taking three conditions of the above-described variables as shown in figure above. In addition, noted the pitch outcome from each of the above arrangement. We required the height of the glass from the definite base, so measuring with a ruler outside the glass would give to a great degree obscure exactness. Therefore, I denoted the spaghetti with terms of 10 mm each.

At that point, put the spaghetti in the glass and attempt to hold it as straight as could be expected under the circumstances, and fill the glass until the imprints were come to. Estimations were taken when the water surface seen from beneath touched the dark line that showed the intervals, the meniscus of the water on the spaghetti straw. To be exact, every interim of examination is measured three times. Measure all the time intervals in the glass once, then begin once again from the base once more, and do this three times for both the mass and the statures. The main estimation is done at the understudy committee office at my school, since that room has great sound sealed, so the sound recording will have least unsettling influence, and this is done when other people at the school was having classes, no one was in the vestibule.

At last the recurrence of a void glass is measured, yet just once is essential, since it will dependably be the same, contrasted with when there is water.

DATA RESULTS/OBSERVATIONS:

Observed outcomes is that the frequencies of the wineglass with water at the base decreased gradually, this is on the grounds that the base part of the wine glass has the stem to lessen the separation the glass can vibrate. The wavelength reduces, and as per the mathematical statement, the recurrence will turn out to be large, reducing the wavelength. There is more space for the glass dividers to vibrate the further up we go, so the recurrence will diminish. We get the "space" from the state of the glass, radius of the top is route greater than at the base, and the glass dividers are more slender at the top. This will give the glass an even more flexibly property at the top, and in this manner make the dividers to vibrate more at the top.

The temperature of the fluid might likewise influence the outcomes because of various thickness of water at various temperatures, so experimenting with hot and icy water will likewise be extremely fascinating.

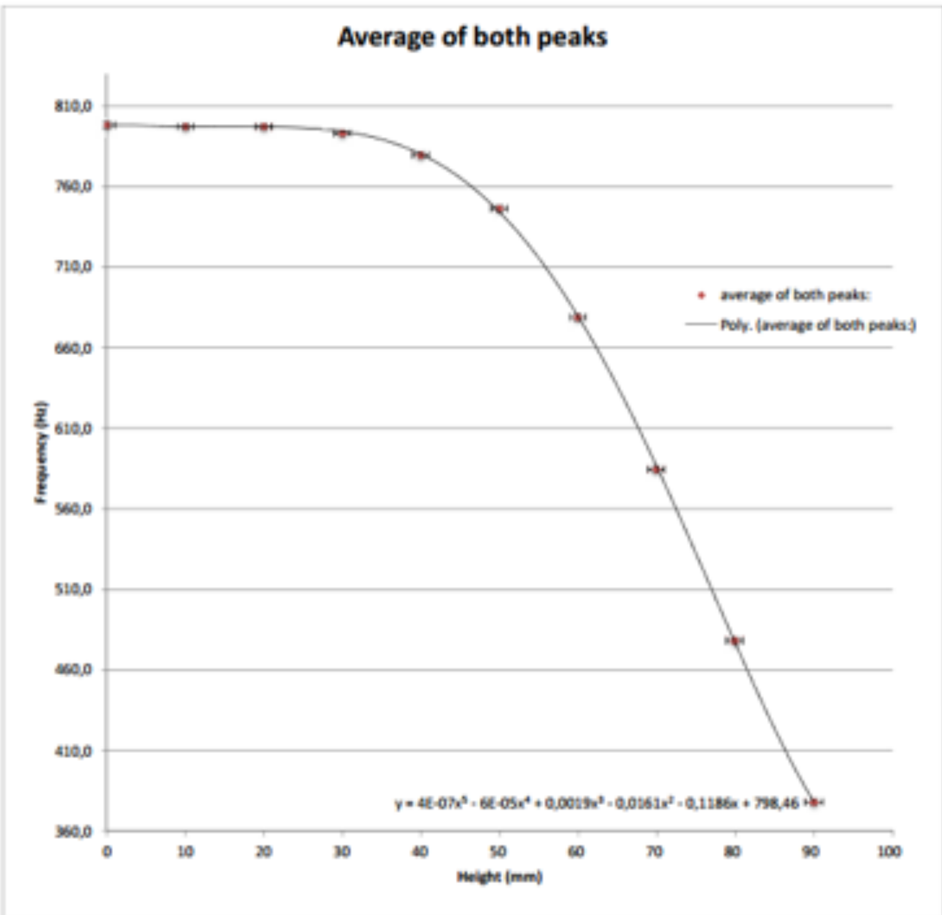
Adding fluid to the glass can change the pitch of frequency. The sound influx of the resonating frequency moves the particles of the fluid around the glass making, generally, little waves. These little waves diminish the energy of the sound wave, which thus brings down the pitch of the resonance that is listened. Since various fluids are denser than others are, we can accept that minor deviation from the density of fluids would create distinctive pitches.

We wondered the variables on which frequency of sound produced while rubbing the rim of a wine glass depends. Our first hypothesis was the wine glass resonating frequency is dependent on geometry and the volume of liquid inside of it. Firstly, in order to investigate the dependency on shape we use four different shape of wine glass. With the aid of a laptop, a digital microphone, and audio editing software the sound produce while rubbing with a wet finger the rim of each shape of the wine glasses was recorded, we analyzed that the natural vibration frequency for each shape obtained. Graphically the results obtained are analyzed and allowed to conclude that the frequency depends on the shape. Therefore, Resonating frequency is greater whenever its shape is identical to that of a cylinder and shows reduced effect when is more spherical.

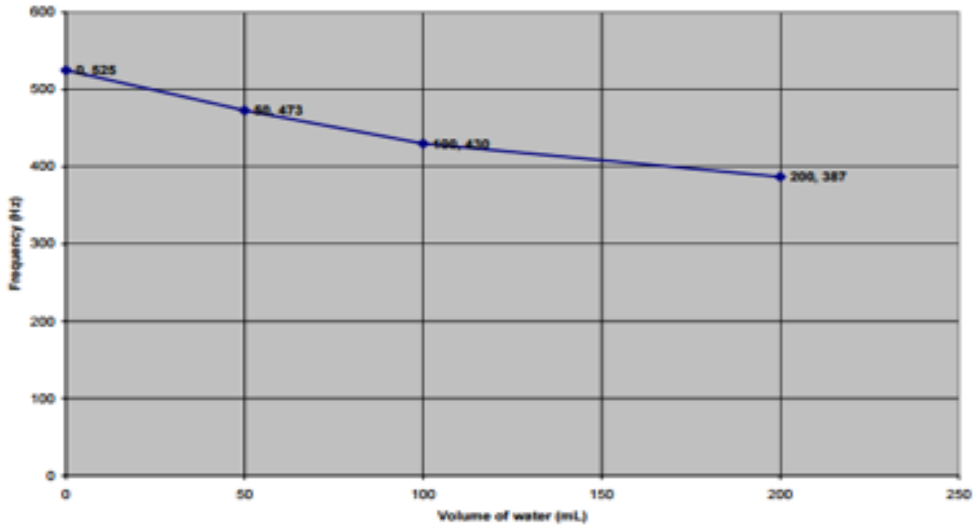
For the coupled glass, amplitude of the discharged signal of empty glass as recorded with our receiver is unequivocally adjusted subsequent to the excitation takes after the finger. As the node passes before the microphone device, amplitude gets to be almost zero when an adequately directional microphone is utilized. At the point when loaded with water, in any case, the amplitude never vanishes completely. As a result, the coupled fluid glass framework plainly acts uniquely in contrast to an unfilled glass

Height (cm) ± 0.5 cm	Average of peak 1 (Hz)	Peak 1 Unc. (Hz)	Average peak 2 (Hz)	Peak 2 Unc. (Hz)	Average of both peaks (Hz)	Av. Of both peaks Unc. (Hz)
0	796.3	0.1	800.2	0.1	798.3	2.0
10	796.0	0.1	799.2	0.3	797.6	1.6
20	795.4	0.5	798.4	0.3	796.9	1.5
30	791.5	0.2	794.7	0.4	793.1	1.6
40	778.2	0.6	781.6	0.5	779.9	1.7
50	744.4	1.6	747.8	1.9	746.1	1.7
60	676.8	1.6	680.2	1.7	678.5	1.7
70	582.6	2.4	586.1	2.2	584.4	1.8
80	476.7	3.3	479.7	2.9	478.2	1.5
90	376.1	0.8	379.4	0.9	377.7	1.7

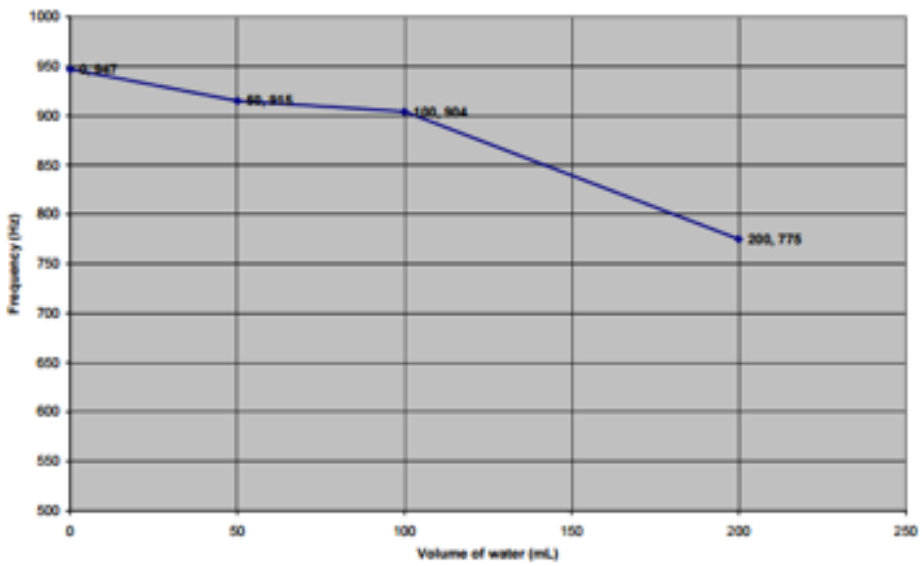
Graphical Representation of Processed Data: (6,7)

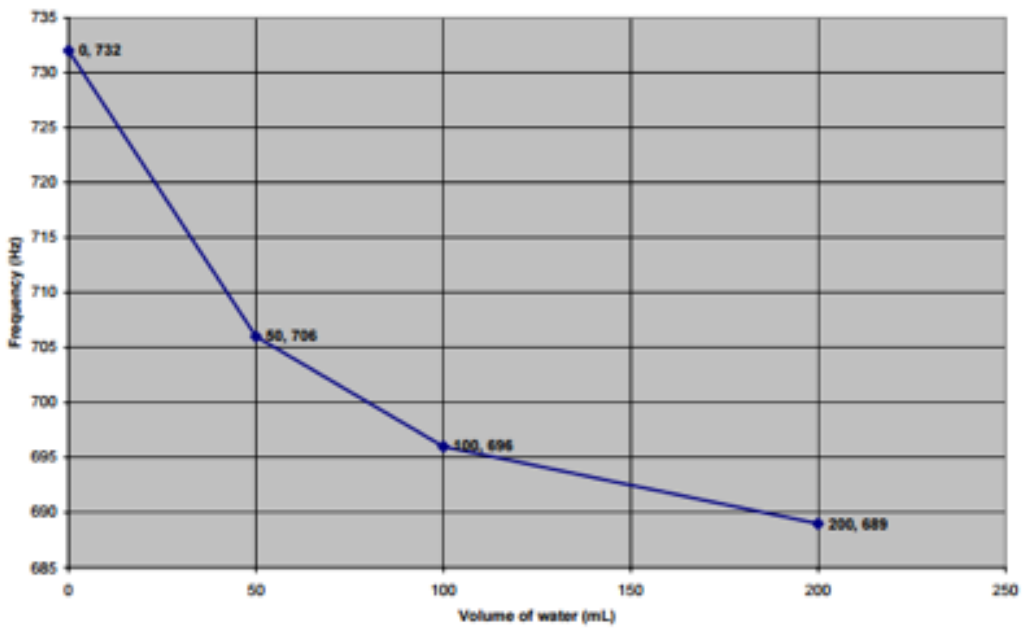


Frequency of first harmonic vs. Volume of water added to glass 2



Frequency of first harmonic vs. Volume of water added to glass 1





CONCLUSION: My theatrical predictions were almost correct. Adding more water to the wine glass did bring about to pitch of the glass to be lower. The more water there was in the glass the reduce effect in vibrations were observed. Slower vibrations cause to pitch of the glass to be lower. The free variable was the wine glasses and the needy variable is the water or whatever other fluid. To improve the examination I would have utilized diverse fluids to see the distinctive results i would have gotten. All the above

A clean dry finger enhances the stick and slide activity. When the initial couple of vibrations are created, the glass resonates. That implies that you are forcing crystals in the glass to vibrate together and make one clear tone. You can change the pitch (height or lowness of the sound) by adding to or subtracting from the measure of water in the glass. The volume (noisy or calm) can be changed just a tiny bit by expanding or diminishing the weight from your finger.

EVALUATING PROCEDURE: This experiment has however some errors ; how you rub the edge is an extraordinary constraint to this examination. In the event that you rub it too hard, the sound would not be coherent, on the off chance that you rub it as well delicate, then you would not get enough of the stick impact to make a reasonable sound. Each time I rubbed the glass; there were constantly a few contrasts, so these instabilities will unquestionably influence the recurrence result. The frequency is found by breaking down the sound over a period, if the time interim was greater, the frequency results would be more exact. Nevertheless, when measuring the sound, there was one and only amplifier set on one side of the wineglass, which created a beating, so on the off chance that we have put a few mouthpieces around the wineglass and recorded with all of them, we may dispense with the beating.

Other sources of error generally come from human error. The complete exactness of the proportions of the arrangements is undoubtedly is not possible. Because of the way that we used family unit measuring glasses, the exactness of the measure of water and other fluids might fluctuate. We quantified it so that there was a slight shade over the highest point of the measuring glass.

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Work Cited

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