Investigating Beats with Tuning Forks

Objective
Observe the beat phenomenon when two tuning forks of different frequencies are sounded together.

Materials
- **Set of Tuning Forks**: Ideally, several pairs with close nearly identical frequencies.
- **Rubber Mallet** or a small striker (to strike the tuning forks gently).
- **Stopwatch** (or a clock/timer, possibly a smartphone timer if permitted).

Procedure
1. Choose two tuning forks that are labelled as the same frequencies (e.g., 256 Hz and 256 Hz).

2. Gently strike the first tuning fork with the rubber mallet. Immediately do the same with the second fork.

3. Bring the ends of the tuning forks close together.

4. If the two frequencies are off even by just a little bit, they will start interfering with each other. Find pairs that interfere with each other. Listen carefully for the "waxing and waning" (getting louder and softer) of the sound—this is the beat phenomenon.

5. Using your stopwatch, count the number of "loud pulses" (amplitude maxima) over10 seconds.

Given Frequency of Forks (Hz)	Number of Beats Counted in 10 seconds				Beats per Second	Probable Actual Frequencies	
	Trial #1	Trial #2	Trial #3	Average		Tuning Fork #1 (Hz)	Tuning Fork #2 (Hz)

Analysis

Why do you think the sound seems to get louder and then softer in a regular pattern?

How accurately did your measured beat frequencies? What might cause discrepancies?

How does the beat frequency change as the frequency difference between the two forks increases?

At what point (if any) do you think it becomes difficult to hear and count distinct beats?

If two tuning forks are exactly the same frequency, what beat frequency would you expect, and why?

How could modern technology (like a microphone and frequency analysis app) help improve the accuracy of your measurements?

Use Desmos to view these three functions, then add a slider for *c, A, and w..*

$$y_1 = A sin\left(\frac{2\pi}{\frac{1}{f_1}} x\right)$$

$$y_2 = A sin\left(\frac{2\pi}{\frac{1}{f_1}} x\right)$$

$$y_3 = y_1 + y_2$$

Set A = 1 and w = period of each tuning fork pair.

Probable Actual Frequencies		Number of Maximums in 10 seconds between x=0 and x=10
Tuning Fork #1 (Hz)	Tuning Fork #2 (Hz)	

Sketch an example of a graph with two different frequencies between x=0 and x=10.

Analysis

Look at the graph of g(x). Describe the resulting maximums when the frequencies are just a little bit different.

How do you expect the difference in frequencies to affect the number of beats you see between x=0 and x=10?

If you were to change one frequency so that it was further from the other, how would you predict the number of maximums to change?

If you were to change one frequency so that it was closer to the other, how would you predict the number of maximums to change?

Explain in your own words why the amplitude oscillates between large (constructive) and small (destructive) values.