World Communicates: Experiment 3
Sound Beats

Aim:
To examine the relationship between the beat frequency and the frequencies of the two interfering sound waves.

Theory:
When two sound waves of slightly different frequency are produced simultaneously, they interfere with each other and the resulting sound that is heard is the superposition of the two waves. The combined sound seems to be one frequency, but the intensity varies. This loudness variation is called beats.
The beat frequency (number of beats per second) should equal the difference between the frequencies of the waves that interfere:

$$f_{beat} = f_1 - f_2$$

A data logger can be used to measure the period of a sound wave by using a sound sensor (microphone). The period can be measured by determining the time from one peak of the wave to an adjacent peak, or by measuring the time separation of a number of peaks and dividing by that number. The frequency of the sound wave is the reciprocal of the period.

Equipment:
Two signal generators with speakers or two tuning forks mounted on sounding boxes (frequencies: 440 Hz, 435 Hz), data logger, sound (microphone) sensor and computer.

Method:
This experiment works best with signal generators, TLI WaveGen, or similar. It is also possible to examine the output from the signal generators with a voltage sensor.

1. Connect a sound sensor to the Ezilog USB data logger and the data logger to the computer.

2. Place the sound sensor between the signal generator speakers.

3. If using TLI WaveGen adjust the sliders to create two frequencies with a difference of 10Hz. In the image below the TLI WaveGen is adjusted to 790 and 800 Hz
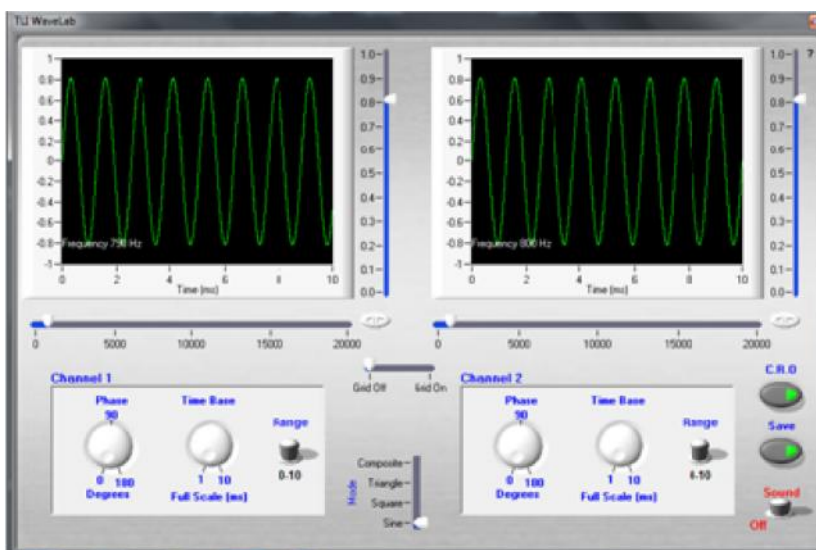
4. View the resulting wave for with the TLI WaveGen Virtual CRO as shown below
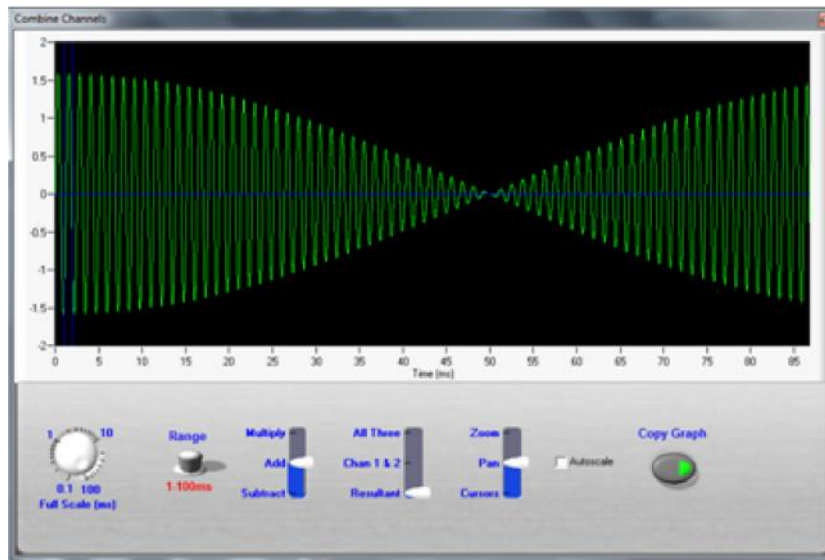
5. With the data logger set a high sampling rate of at least 20,000 Hz.

6. Start logging from your sound sensor. At the high sampling rate used for this experiment your data logger is unlikely to display a graph until after collecting the data. Save this data for later analysis.
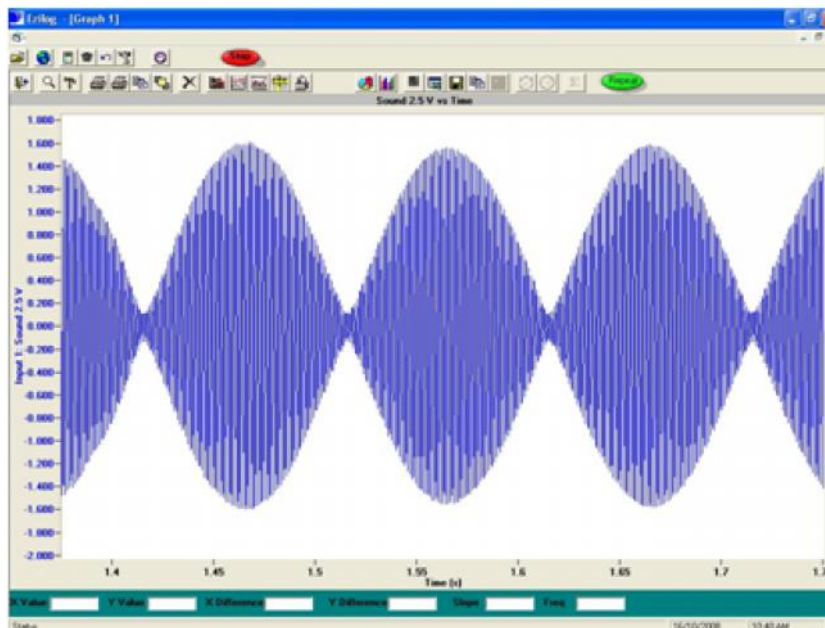
7. Your graph of both signals should be similar to that shown above, a typical beat signal.

Data Analysis:
1. Using the data from each signal generator   measure the period and obtain the frequency for each signal. Compare these values with the expected value.
2. Using the data from both signal generators (tuning forks) (Step 8) measure the period and obtain the frequency for the beat – this is the "envelope" of the combined signal.
3. Use the three values of frequency to verify the Beat Equation in the Theory.

Extensions:
If your software supports addition of data, add the data from each individual signal and compare with that for the combined (beat) signal. This can also be achieved using a spreadsheet such as Excel.

Conclusion:
Write your own conclusion ensuring that it relates to the aim as stated above.