Last Week

Some problems…

There were many problems with units and present your work in a graph. Here is an example from the pendulum experiment.

7. Calculate the correction factor $\delta$.

$0.09$

Many people handed in graphs with wrong points, missing points, or just generally messy and hardly legible presentations

This time we were lenient. Next time, points will be subtracted rigorously
Today: Sound

Sound is a longitudinal wave.

\[ v = \lambda f \]

The speed of the wave depends on the medium.

- Air (20° C): 343 m/s
- Seawater: 1533 m/s
- Iron: 5130 m/s
Longitudinal Wave

\[ v = \lambda f \]

http://paws.kettering.edu/~drussell/Demos/waves/wavemotion.html
- T (period) = 1/f
- Remember that the product of wavelength and frequency is always the same (v=velocity of wave)
Detecting Sound

Two Facts

The strength of a sound wave is measured in the power it carries in a given area; this is also known as the intensity.

In SI units, intensity $I$ is measured in watts per meter squared: $\text{W/m}^2$. 
Our Ears

The human ear can detect an amazing intensities range:

This is a range of 100 billion!!!
So intensity is NOT a convenient measure of loudness. Instead we use decibels.
Decibels

Sound level: $D = 10 \log_{10}(I/10^{-12})$ units are dB (decibels)

The decibel scale is logarithmic. So, a sound wave 1,000,000 times greater is said to 60 decibels louder. Note that a sound wave with an intensity of $10^{-12}$ watts per meter squared is defined as 0 dB.

- Whisper $\rightarrow$ $1 \times 10^{-10}$ W/m$^2$ (20 dB)
- Normal conversation $\rightarrow$ $1 \times 10^{-6}$ W/m$^2$ (60 dB)
- Large orchestra $\rightarrow$ $6.3 \times 10^{-3}$ W/m$^2$ (~90 dB)
- Walkman at maximum level $\rightarrow$ $1 \times 10^{-2}$ W/m$^2$ (100 dB)
Today's Lab

The human ear isn't able to detect all frequencies (pitches) equally. For example, we cannot even hear a dog whistle.

Today you will use 12 sound generators, each with a different frequency, to measure the minimum detectible sound level for your own ears. You will have to convert the reading on the generators to decibels using the formula:

\[ D \text{ (dB)} = \text{constant} - 2 \times \text{(counter reading)} \]

Each generator has a different constant. You will be testing each ear; you should hear the tone on just one side. Turn the head phones around to check the other ear.