Physics of Sound: Review Sheet

The Origins of Music Theory and Pythagoras

- Pythagoras of Samos lived around 570 – 504 BC
- Believed the inherent nature of the universe and all things was mathematical
- Discovered intervals by hearing smiths' hammers of different weights strike simultaneously
- Viewed the universe as a spherical Earth surrounded by heavenly objects connected to crystal spheres that produce wonderful harmonies

Standing Waves, Frequency and Pitch:

- Standing waves are waves that don't travel anywhere but instead oscillate in place.
- Shorter wavelength means lots of waves; high frequency, high sound
- Long wavelength means fewer waves; low frequency, low sound
- Since the sounds are traveling at about the same speed the one with the shorter wavelength will go by more frequency, and has a higher frequency
- The distance between successive nodes or antinodes is one-half wavelength, $\lambda/2$

Resonance

- Resonance is the source of sound production
- Every object has a natural frequency at which it will vibrate the most
- For resonance to occur there must be a stimulating source
- When the vibrations of this stimulating source coincide with the natural frequency of the object, resonance (and a big sound) occurs
- Examples of resonance can be clearly seen in musical instruments, esp. those with a mouthpiece and tubular body

Overtones and Harmony

- An overtone is a sinusoidal component of a waveform that has a higher frequency than its fundamental frequency
- A fundamental frequency is the lowest frequency of the entire waveform, which means it is the most audible pitch to the human ear
- Most of the time, overtones are integer multiple frequencies of the fundamental, which creates harmonic overtones. Sometimes they are not integer multiple frequencies, however, which creates inharmonic overtones
- Harmony is any simultaneous combination of tones
- Some intervals sound good together, creating consonant (and perfect) intervals, and other intervals sound bad together, creating dissonant intervals.

Interference and Beats

- Simple characteristics of the behavior of sound waves
- Sound waves undergo constructive and destructive interference just like water waves and light waves do
- Sound is a pressure wave
- Just like other waves have crests and troughs, sound waves have compressions and rarefactions
- When two compressions or two rarefactions meet, you get constructive Interference—two compressions=higher pressure, two rarefactions=lower
- **Compression=high pressure and rarefaction=low pressure**
- Rarefaction + Compression = Destructive Interference—no sound!
- Beats are simply audible differences in sound intensity when two waves with very similar, yet different frequencies interfere
- Sounding "flat" or "sharp" is a description of a small alteration (due to temperature or some other cause when dealing with instruments) in the frequency of a certain note