**Unit #4 Waves and Sound Review**

1. Characteristics of waves including wavelength, amplitude, in phase and out of phase, reflection from fixed and free ends, pulse, crest, trough, rarefaction, compression and types of waves (transverse, longitudinal, torsional)

Frequency f= cycles/second (Hz) Period T= seconds/cycle (s) **f = 1/T**

Universal Wave Equation **v = fλ** where v = speed, f = frequency and λ = wavelength

1. Speed of sound in air and in other media (Note: sound needs a medium to travel, no sound in space)

**Vs=332 + 0.6(T)** where vs = speed of sound in air (m/s) and T = temperature in oC

Speed changes if the density of the material changes.

1. Mach numbers and sound barrier and sonic booms

**Mach # = vo/vs** where vo is the speed of the object

1. Intensity of sound

**I = P/A** where I=intensity (W/m2), P = power (W) and A= area (m2)

**I2/I1 = r12/r22** where I1 and I2 are intensities and r1 and r2 are distances or radii

1. DeciBel Scale (logarithmic scale)

The threshold of hearing for humans is 0 dB which translates to an intensity of 1 x 10-12 W/m2

**B = 10 log (I2/I0)** where I0 = threshold of hearing always

To reverse this equation I2= Io X 10B/10

1. Doppler Effect (the apparent change in frequency due to the relative motion of the object)

**f2 = f1vs/vs±vo** use + if departing and – if approaching

1. Standing wave patterns and principle of superposition

An interference pattern that results from the incident wave interfering with the reflected wave. Results in series of nodes and antinodes.

Internodal difference **dn = ½ λ** (Note there is always 1 more node then number of λ

The principle of superposition is the pattern that result when two waves interfere. The result is the sum of the amplitudes of both waves.

1. Resonance in air columns

Resonance is when a particular frequency is played and a sympathetic vibration is observed in another object. Example: running your finger around a wine glass, Tacoma Narrows bridge etc.

Close Pipes

**First resonant length happens at ¼ λ (1st harmonic)**

**Second resonant length happens at ¾ λ (3rd harmonic)**

**Third resonant length happens at 5/4 λ (5th harmonic) etc.**

Open Pipes

**First resonant length happens at ½ λ (1st harmonic)**

**Second resonant length happens at λ (2nd harmonic)**

**Third resonant length happens at 3/2 λ (3rd harmonic) etc.**

1. Resonance in strings

**f2/f1 = (√T2/√T1)(√ρ1/√ρ2)(L1/L2)(d1/d2)**

where T = tension, ρ= density of material, L = length, d = diameter

1. Music including pitch, overtones etc.
2. Beats
3. Applications of sound and the human ear

Types of Problem Solving Questions

~ falling down a well ~ open and closed pipe patterns

~ mach values ~ changing characteristics of a string

~ change in intensity from one decibel level to another ~ explosion question

~ doppler effect