

Name: _____

Other group members: _____

Tutorial #6

PHYS 1240: Sound and Music

Monday, July 22, 2019

Instructions: Work in groups of 3 or 4 to answer the following questions. Write your solutions on this copy of the tutorial—each person should have their own copy, but make sure you agree on everything as a group. When you're finished, keep this copy of your tutorial for reference—no need to turn it in (grades are based on participation, not accuracy).

1. A sailor strikes the side of his ship just below the waterline. He hears the echo of the sound reflected from the ocean floor directly below 1.81 seconds later. How deep is the ocean at this point? (Assume the velocity of sound in water is 4.5 times the velocity of sound in air at room temperature.)
2. Your good friend's annoying dog is barking and producing sound with a maximum intensity of $5.0 \times 10^{-5} \text{ W/m}^2$. What is the maximum SIL level in dBs?
3. According to Guinness, the record for the loudest burp is held by Paul Hunn of London. In September of 2008, his burp was measured at 0.05129 W/m^2 . Determine the SIL in dB of Paul's burp.

4. As a part of a performance, a vocal trio sang the following three notes: C 264 Hz, F 352 Hz, and A 440 Hz. After the performance your friend who was at the performance with you makes the following observation: “When the trio sang those three notes it sounded like there were more than three singers. Hey, you took physics! How did they do that?” Explain in no more than three sentences how it is possible for three people to produce more than three notes while singing. What are the frequencies of the extra notes?
5. What’s the frequency of a fan whose blades spin at a rate of 1 cycle every 3.2 milliseconds? Is this audible to humans?
6. Match the following theories/concepts to their definitions:

Fourier’s Theorem

The restoring force of an oscillator depends linearly on its displacement

Pythagorean Hypothesis

The pitch of a sound increases when the observer or source move toward each other

Hooke’s Law

The most consonant intervals are those with low integer frequency ratios

Place Theory

Any complex waveform that is periodic can be written as the sum of pure tones in a harmonic series

Doppler Effect

Different places on the basilar membrane are sensitive to different frequencies of sound

Octave Effect

Tones related to other tones by a frequency ratio of a multiple of 2 sound similar in quality

-
7. Two wine glasses sit on a table, one empty and the other halfway full of water.
- a) If both glasses are rubbed on their rims with a wet finger, which will have a higher pitch? Why (what is vibrating)?

 - b) If both glasses are tapped with a metal rod, which will have a higher pitch? Why (what is vibrating)?

 - c) If both glasses are blown over the top to produce a windy sound, which will have a higher pitch? Why (what is vibrating)?

 - d) If the empty glass is filled with sparkling water (water with air bubbles) to the same level as the other glass, which will have a higher pitch? Why? (*Hint: air is much easier to compress than water*)
8. Define the concepts of damping and resonance and give a real-world example to demonstrate each. Drawing plots of amplitude versus time may help.