Student #: _____ Student Name: _____

Physics 11 Homework Unit 7: Physics of Sound & Music

____ 1. Beats are the result of:

(a) diffraction
(b) constructive interference
(c) destructive interference
(d) both constructive and destructive interference

____ 2. Sound waves are:

(a) longitudinal
(b) transverse
(c) partly longitudinal and partly transverse
(d) torsional

____ 3. Sound travels fastest in:

(a) cool air
(b) water
(c) warm air
(d) vacuum

____ 4. Sound waves do not travel through:

(a) solids
(b) gases
(c) liquids
(d) a vacuum

____ 5. Harmonics are resonance modes that are also called:

(a) pitch
(b) loudness
(c) overtones
(d) resonance

____ 6. The amplitude of a sound wave refers to its:

(a) pitch
(b) loudness
(c) overtones
(d) resonance

____ 7. A pure musical tone causes a thin wooden panel to vibrate. This is an example of:

(a) an overtone
(b) harmonics
(c) resonance
(d) interference

____ 8. A loud boom is heard after an airplane has passed overhead. This means that the airplane:

(a) is accelerating
(b) is climbing
(c) is travelling faster than Mach 1
(d) is travelling faster than the speed of light

____ 9. A spacecraft speeding away from Earth sends out signals of a certain frequency. The signals that are received on the Earth

(a) have a lower speed
(b) have extra harmonics
(c) have a longer wavelength
(d) have all of the above characteristics

____ 10. Two tuning forks of frequencies 310 and 316 Hz vibrate simultaneously. The number of times the resulting sound pulsates per second (beats) is:

(a) 0
(b) 6
(c) 313
(d) 626

____ 11. An octave "up" in music actually involves _____ the frequency. (Google if you didn't understand it in class.)

(a) slightly increasing
(b) doubling
(c) tripling
(d) slightly decreasing

____ 12. A guitar player plays a 440 Hz note, and then increases the effective length of that same guitar string by a factor of two and plays it again. The new frequency is:

(a) 440 Hz
(b) 880 Hz
(c) 220 Hz
(d) 0 Hz

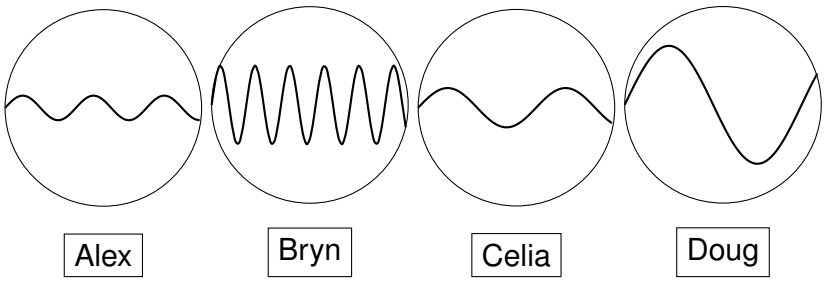
____ 13. The purpose of the intricately shaped and delicately made violin wooden body is to

(a) hold the strings tight
(b) amplify the string vibration
(c) look impressive
(d) strengthen the wood

____ 14. A flute can be tuned to the rest of the orchestra by adjusting its length. A flute player is playing on a very hot day and wishes to play the proper frequencies. Compared to the length in the cooler practice hall, the length of the flute must be:

(a) slightly greater
(b) slightly less
(c) a lot less
(d) unchanged

15. An oscilloscope is used to record the sounds made by four students. The equally scaled wave-forms are shown below:



(a) Which sound is the loudest? _____

(b) Which sound has the highest frequency? _____

(c) Which sound has the longest wavelength? _____

(d) Which sound shows about $1\frac{1}{2}$ cycles? _____

(e) Which person has the lowest voice? _____

16. The sound of a starting pistol can be heard easily from a distance of $800.0\,\text{m}$ but the smoke can be seen much sooner than the sound is perceived. Why is the smoke seen before the sound is heard? What is the time delay for the sound of the pistol if the air temperature is $15\,^{\circ}\text{C}$?

17. Most organ pipes are open at one end and closed at the other, and their lengths are traditionally measured in *feet* (i.e. "$8\,\text{ft}$", "$4\,\text{ft}$" etc.) A particularly church organ uses a semi-open $16\,\text{ft}$ pipe. If the temperature in the church is $20\,^{\circ}\text{C}$, what is the fundamental frequency of that pipe? What is the second resonance frequency? Are these frequencies audible?

18. A student carefully makes the following observations listening for the resonance points from a tuning fork vibrating above an adjustable length pipe that is open on one end:

    - Temperature is $13.3\,^{\circ}\text{C}$
    - First resonant length: $L_1 = 8.3\,\text{cm}$

    Then he rushes his following measurements for additional resonance points to finish the lab:

    - Second resonance length $L_2 = 25\,\text{cm}$
    - Third resonance length $L_3 = 58\,\text{cm}$

    (a) Draw diagrams (waveform inside the pipe) for the first two resonant lengths collected.
    (b) Perform the necessary calculations to find the frequency of the unknown tuning fork.
    (c) Analyze all the data to see if he made any errors in their collection of observations. If he has made an error, what is it?

19. You know that the pitch of a train's whistle is about $5.0\,\text{kHz}$. As you stand at a railway crossing, you hear a train whistle whose frequency is $6.0\,\text{kHz}$. Is the train approaching you or travelling away from you? Explain your answer. If the temperature of that day is a warm $30\,^{\circ}\text{C}$, how fas is the train moving?

20. You decide to create a jug and bottle band where you want to play the bottles and jugs by blowing across the tops of the bottles to generate sounds. What is the largest/longest container you will need based on the human range of hearing? What is the shortest? Are these reasonable jug sizes? Illustrate your explanation with a diagram. (Human can hear approximately from $20\,\text{Hz}$ to $20\,000\,\text{Hz}$.)

21. A skyscraper will often oscillate due to wind blowing against it (gusting). It vibrates like a semi-open air column in fundamental mode (node at the bottom of the building, anti-node at the top). Engineers calculate that the transverse waves will travel through the structure at a speed of $45\,\text{m/s}$. For a wind that typically gusts with a period of $12.0\,\text{s}$, what height of the building will vibrate the most?

22. A clarinet behaves like a semi-open pipe with the open end at the bell and th closed end at the reed. Claudia blows very gently—just enough to play a low A with a frequency of $220\,\text{Hz}$. She then blows harder (overblows) using the same fingering and produce the next higher note (the next resonance mode). What is the frequency of the higher note? Can you determine its pitch?