**Sound and Music Questions**

**Question 1:**

aa. At normal room temperatures, sound waves travel through air at speeds of about \_\_\_\_\_.

a. 1 m/s (as fast as your walking speed between classes)

b. 10 m/s (as fast as a good sprinter)

c. 35 m/s (as fast as very fast car)

d. 350 m/s (considerably faster than a sprinter or a car)

e. 35 000 000 m/s (fast enough to make it around the earth in 10 seconds)

ab. ... nonsense! The speed of sound varies widely since it depend on factors like pitch and loudness.

**Question 2:**

aa. In general, sound waves travel fastest in \_\_\_\_\_.

a. solids b. liquids c. gases

**Questions 3-6:**

aa. The rapid back and forth movement of a loudspeaker creates a sound wave. As the cone of the loudspeaker moves forward, air particles are \_\_\_\_\_ …

a. pushed together b. spaced apart

aa. (Continued from previous question.) … to produce a region of \_\_\_\_\_ pressure.

a. higher than normal b. lower than normal

aa. As the cone of the loudspeaker retreats (moves backwards), air particles are \_\_\_\_\_ …

a. pushed together b. spaced apart

aa. (Continued from previous question.) … to produce a region of \_\_\_\_\_ pressure.

a. higher than normal b. lower than normal

**Question 7:**

aa. Sammy is talking to Sally. Position A is a position in front of Sammy's mouth. Position B is a position in front of Sally's ear. In order for Sally to hear Sammy's voice, air particles must \_\_\_\_.

a. move from A to B

b. move from A to B and then back to A

c. vibrate parallel to a line connecting A and B

d. vibrate perpendicular to a line connecting A and B

**Questions 8-9:**

A sound wave is often called a **pressure wave** because there are regions of high and low pressure established in the medium through which the sound wave travels.

aa. The regions of high pressure are characterized by particles of air \_\_\_\_\_.

a. at a trough position b. at a crest position

c. being compressed together d. being spaced relatively far apart

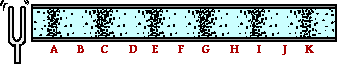
aa. The regions of low pressure are characterized by particles of air \_\_\_\_\_.

a. at a trough position b. at a crest position

c. being compressed together d. being spaced relatively far apart

**Questions 10-11:**

The tines of a vibrating tuning fork create a sound that travels through a long tube. The diagram below portrays the presence of position of air molecules within the tube at an instant in time.



aa. Which of the labeled regions are high-pressure regions?

aa. Which of the labeled regions are low-pressure regions?

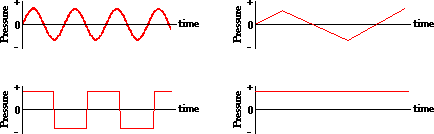
**Question 12:**

aa. In terms of the motion of the particles of the medium, a sound wave can be best described as a \_\_\_\_ wave.

a. circular b. vibratory c. transverse d. longitudinal

**Question 13:**

aa. Suppose your ear was a pressure sensor (which it is) that detected variations in pressure over the course of time. And suppose that it was hooked up to a computer (which it probably isn't) that could display on a graph how the pressure fluctuated over time as sounds were being heard. Which graph below would correctly represents pressure as a function of time? Circle the correct graph.



**Question 14:**

aa. Sound cannot travel through \_\_\_\_. Select all that apply.

a. a vacuum b. a solid substance

c. a liquid substance d. a gaseous substance

e. ... nonsense! Sound can travel through all of these.

**Question 15:**

aa. Suppose that you are watching a science fiction film involving two space ships in the deep void of outer space. In the film, an explosion occurs on space ship A. After seeing the fiery blast from a long distance away, the occupants of space ship B hear the loud boom of the blast. This is an example of \_\_\_\_\_.

a. sound traveling slower than light

b. sound behaving as a pressure wave

c. sound behaving as a mechanical wave

d. sound behaving as an electromagnetic wave

e. bad physics since sound could never traverse the empty space between ship A and ship B

**Question 16:**

aa. A sound wave is traveling through a medium. The diagram below depicts the presence and location of the particles at a given instant in time.



Utilize the ruler to determine the best approximation of the wavelength of the wave. The wavelength is \_\_\_\_ units.

a. 1.2 b. 2.8 c. 3.4 d. 5

e. 6 ab. 18.2 ac. 20

ad. None of these are even close

**Question 17:**

aa. **TRUE**  or **FALSE**:

A loud sound has a greater speed than a soft sound. Yelling loud would make a sound wave travel measurably faster.

a. True b. False

**Question 18:**

aa. **TRUE** or **FALSE**:

While sound waves are indeed waves, they do not always behave like waves. They may have a wavelength, frequency and speed, but they don't reflect, refract and interfere like waves.

a. True b. False

**Question 19:**

aa. **TRUE** or **FALSE**:

The source of all sound is an object moving at high speed.

a. True b. False

**Question 20:**

aa. **TRUE** or **FALSE**:

Sound travels faster in a gas than a solid because gas samples are less dense.

a. True b. False

**Question 21:**

aa. **TRUE** or **FALSE**:

The sound of your parents yelling at you takes longer to get to your ear on a hot evening than a cool evening.

a. True b. False

**Question 22:**

aa. **TRUE** or **FALSE**:

In order to communicate to a group of people, air molecules must move from the speaker's lips to the hearer's ears.

a. True b. False

**Question 23:**

aa. **TRUE** or **FALSE**:

Sound is a mechanical wave that can move through a vacuum.

a. True b. False

**Question 24:**

aa. **TRUE** or **FALSE**:

A compression is a crest where the pressure in the air is highest.

a. True b. False

**Question 25:**

aa. **TRUE** or **FALSE**:

If a sound-producing object vibrates intensely enough, then it will be audible to a nearby observer regardless of the vibration rate.

a. True b. False

**Question 26:**

aa. **TRUE** or **FALSE**:

A 100 dB sound is 10 times more intense than a 90 dB sound.

a. True b. False

**Question 27:**

aa. **TRUE** or **FALSE**:

There is neither a lower nor an upper limit on the level of sound intensity that humans can hear.

a. True b. False

**Question 28:**

aa. **TRUE** or **FALSE**:

A 40 dB sound is 40 times more intense than a 0 dB sound.

a. True b. False

**Question 29:**

aa. **TRUE** or **FALSE**:

The Doppler shift is a phenomenon that is observed only of sound waves.

a. True b. False

**Question 30:**

aa. **TRUE** or **FALSE**:

A shock wave is a loud noise that is produced at the moment an object breaks the sound barrier. Once the sound barrier is broken and the object is moving at supersonic speeds, the sonic boom is no longer audible.

a. True b. False

**Question 31:**

aa. **TRUE** or **FALSE**:

The Doppler shift has to do with an increase in the deciBel level for an approaching sound source.

a. True b. False

**Question 32:**

aa. **TRUE** or **FALSE**:

Ken Fused is standing on a corner when a police car passes by with its siren on. Ken hears a different pitch when the police car is approaching him than when it is past him. This is because the siren on the front of the car is set to a higher pitch than the siren on the back of the car.

a. True b. False

**Question 33:**

aa. **TRUE** or **FALSE**:

When a person blows on a trombone, the mouthpiece vibrates with a single frequency; this forces air inside the trombone to vibrate at that same frequency.

a. True b. False

**Question 34:**

aa. **TRUE** or **FALSE**:

A closed-pipe resonator is a column of air with both ends closed or sealed. An open-pipe resonator is a column of air with both ends open to the surroundings.

a. True b. False

**Question 35:**

aa. **TRUE** or **FALSE**:

A stringed instrument can only vibrate at one specific frequency at any one instant of time and this is called the fundamental frequency.

a. True b. False

**Question 36:**

aa. **TRUE** or **FALSE**:

It is possible to vibrate a string at just the right frequency and produce a vibrational pattern that has a point in the middle that is absolutely stationary.

a. True b. False

**Question 37:**

aa. **TRUE** or **FALSE**:

A forced vibration is a vibration exerted at a high force.

a. True b. False

**Question 38:**

aa. **TRUE** or **FALSE**:

Any sustained forced vibration will always cause an object to vibrate at its resonant frequency.

a. True b. False

**Question 39:**

aa. **TRUE** or **FALSE**:

An object vibrating at one of its resonant frequencies will vibrate with a relatively large amplitude.

a. True b. False

**Question 40:**

aa. **TRUE** or **FALSE**:

When a string is forced to vibrate at one of its resonant frequencies, a standing wave pattern will be produced.

a. True b. False

**Question 41:**

aa. **TRUE** or **FALSE**:

A wine glass can be easily be broken by an opera singer as long as he/she simply sings loud enough so as to create a vibration that has a large amplitude.

a. True b. False

**Question 42:**

aa. **TRUE** or **FALSE**:

In tubes of air, nodes exist at reflecting ends when the air molecules are allowed to move the maximum, thereby causing them to invert.

a. True b. False

**Question 43:**

aa. **TRUE** or **FALSE**:

When beats are formed, a listener will hear a persistently loud sound.

a. True b. False

**Question 44:**

aa. **TRUE** or **FALSE**:

A resonant wave pattern results when waves of the same frequency interfere with each other. A beat wave pattern results when waves of slightly different frequencies interfere with each other.

a. True b. False

**Question 45:**

aa. **TRUE** or **FALSE**:

The note C on a flute and the note C on a clarinet of the same frequency would be indistinguishable if drawn as a wave.

a. True b. False

**Question 46:**

aa. **TRUE** or **FALSE**:

Two equally intense sounds of different frequencies will appear to be equally loud.

a. True b. False

**Question 47:**

aa. The **Doppler effect** is often observed as an ambulance, fire truck or police siren drives towards and past you on a roadway. The effect involves an alteration in the \_\_\_\_\_.

a. pitch of the sound b. color of the vehicle

c. loudness of the sound d. color of the traffic light

**Question 48:**

aa. The Doppler shift involves a shift in the \_\_\_\_. Select all that apply.

a. the loudness of a sound observed by a listener

b. actual frequency produced by the source of sound

c. the perceived pitch of a sound observed by a listener

d. actual intensity produced by the source of sound

**Question 49:**

aa. A source produces sound waves with a frequency of f. As the source of sound moves away from an observer, the \_\_\_\_\_.

a. observer hears sounds with a frequency less than f

b. source produces waves with a frequency less than f

c. observer hears sounds with a frequency greater than f

d. source produces waves with a frequency greater than f

**Question 50:**

aa. The Doppler shift can be observed when \_\_\_\_. Select all that apply.

a. the source of sound moves towards an observer

b. the source of sound moves away from an observer

c. an observer moves towards a stationary sound source

d. an observer moves away from a stationary sound source

e. the observer and sound source move at the same speed in the same direction

**Question 51:**

aa. The Doppler effect is observed \_\_\_\_.

a. only of sound waves

b. of both sound waves and light waves

c. of all sound waves and some (but not all) light waves

d. ... nonsense! The Doppler effect is just a theory that has never been observed.

**Questions 52-55:**

aa. Humans hear sounds because vibrating air particles push upon the \_\_\_\_\_.

a. eyelid b. cochlea c. eardrum d. belly button hole

aa. (Continued from the previous question.) … The vibrational movement of this membrane causes \_\_\_\_\_ to vibrate, …

a. earwax b. nose hairs c. three tiny bones d. the hairs on your head

aa. (Continued from the previous question.) … thus transferring the sound signal to the inner ear. As the vibrations reach the inner ear, small \_\_\_\_\_ in the

a. nose hairs b. internal speakers

c. hair-like nerve cells d. drum-like amplifiers

aa. (Continued from the previous question.) … \_\_\_\_\_ are stimulated. This results in signals being sent to the brain where they are interpreted as sounds of varying pitches and varying loudness.

a. brain b. cochlea c. Eustachian tube d. back of the nose

**Question 56:**

aa. The pitch of a sound is related to the \_\_\_\_\_ of the sound wave.

a. speed b. intensity c. frequency d. amplitude

**Question 57:**

aa. Humans have a \_\_\_\_\_ of frequencies to which their ears are sensitive.

a. very wide range b. very narrow range

**Question 58:**

aa. The **deciBel scale** gives an indication of a sound's variations in \_\_\_\_\_.

a. speed b. pressure c. frequency d. wavelength

**Question 59:**

aa. If a sound has a high deciBel level, then that sound also has a \_\_\_\_.

a. high speed b. high frequency c. high sound intensity

d. low speed e. low frequency ab. low sound intensity

**Questions 60-63:**

aa. Sound waves are produced by vibrating objects. The sound of the human voice results from vibrations of the \_\_\_\_\_,

a. teeth b. nose c. lungs d. vocal cords

aa. (Continued from the previous question.) … The sound of a tuba results from vibrations of \_\_\_\_\_.

a. a string b. the player's vocal cords

c. a reed inside the mouthpiece d. the player's lips on the mouthpiece

aa. (Continued from the previous question.) … The sound of a saxophone results from vibrations of \_\_\_\_\_.

a. a string b. the player's vocal cords

c. a reed inside the mouthpiece d. the player's lips on the mouthpiece

aa. (Continued from the previous question.) … And the sound of a piano results from vibrations of \_\_\_\_\_.

a. a string b. the ivory keys

c. the player's vocal cords d. the player's fingers on the ivory keys

**Question 64:**

aa. Vibrating strings do not disturb enough air to produce a loud sound. So the sound of the vibrating string of an acoustic guitar is amplified by \_\_\_\_\_.

a. the player's voice

b. small speakers inside the guitar

c. the vibrations of the player's hand

d. the soundboard to which it is attached

e. one large speaker in the center of the guitar

**Question 65:**

aa. The frequency with which the column of air inside of a trombone vibrates is determined primarily by the \_\_\_\_\_.

a. mass of air b. density of air

c. length of the column of air d. width of the column of air

**Question 66:**

aa. A hollow plastic tube is placed in a water filled cylinder. A tuning fork is forced into vibration and held above the open end of the plastic tube. The plastic tube is gradually raised and lowered in the water as the vibrating tuning fork is held above it. What will eventually happen?

a. The plastic will eventually shatter.

b. At a particular height, a loud sound will be heard.

c. A magnetic field will be created surrounding the cylinder.

d. The water will increase its temperature and could eventually boil.

**Questions 67-70:**

Open and closed pipes can resonate at a variety of frequencies. Each frequency is characterized by a standing wave pattern. It ends up that each possible frequency is some multiple of the first frequency. Use your understanding of this concept to complete the ideas in this paragraph.

aa. Suppose that the lowest possible frequency (longest wavelength) to which the pipe can resonate is called the **fundamental frequency**. For a closed pipe, the next highest resonant frequency is \_\_\_\_\_ the fundamental frequency.

a. one-half b. one-third c. two times

d. three times e. the same value as

aa. (Continued from the previous question.) … The second next highest frequency is \_\_\_\_\_ times the fundamental frequency.

a. one-third b. one-fourth c. one-fifth d. three times

e. four times ab. five times ac. the same value as

aa. For an open pipe, the lowest possible frequency to which the pipe can resonate is called the **fundamental frequency**. The next highest resonant frequency is \_\_\_\_\_ the fundamental frequency.

a. one-half b. one-third c. two times

d. three times e. the same value as

aa. (Continued from the previous question.) … The second next highest frequency is \_\_\_\_\_ times the fundamental frequency.

a. one-third b. one-fourth c. one-fifth d. three times

e. four times ab. five times ac. the same value as

**Question 71:**

aa. The nodal positions on a standing wave pattern for an open and a closed pipe are \_\_\_\_.

a. always located a full wavelength apart

b. always located one-half wavelength apart

c. usually located one-half wavelength apart

d. usually (but not always) located a full wavelength apart

e. distanced varying number of wavelengths apart, depending upon the harmonic number

**Question 72:**

aa. A string on a string instrument is clamped at both ends. The string is plucked in the middle and begins to vibrate with the pattern of a standing wave. The clamped ends of the string always display a displacement \_\_\_\_\_.

a. antinode b. node

**Question 73:**

aa. The fundamental frequency of a guitar string is \_\_\_\_\_.

a. the harmonic number for any given standing wave pattern

b. the highest audible frequency which a typical human could hear

c. the lowest possible frequency at which the guitar string would resonate

d. the number of waves present in the standing wave pattern for a harmonic

e. the multiplier used to relate one natural frequency to another natural frequency

**Question 74:**

aa. A harmonic is \_\_\_\_.

a. the number of waves present in a standing wave pattern

b. a point on the standing wave pattern which is oscillating rapidly

c. one of the frequencies at which an instrument naturally vibrates

d. the multiplier used to relate one natural frequency to another natural frequency

**Question 75:**

aa. Suppose two sounds are produced by two different sources and heard at the same time. If the two sounds seem pleasant, they are said to be \_\_\_\_\_.

a. beats b. timbre c. dissonant

d. consonant e. fundamental

**Question 76:**

aa. Suppose two sounds are produced by two different sources and heard at the same time. If the two sounds seem unpleasant, they are said to be \_\_\_\_\_.

a. beats b. timbre c. dissonant

d. consonant e. fundamental

**Question 77:**

aa. Joel and Jill are in the choir. Joel sings a pitch that has a frequency of 256 Hz. Jill sings a pitch that has a frequency of 512 Hz. Jill is said to be singing \_\_\_\_\_ above Joel.

a. a harmonic b. a second c. an octave d. a fifth e. a note

**Questions 78-79:**

aa. Three notes - referred to here as X, Y and Z - have frequencies that are mathematically related by the 4:5:6 frequency ratios (respectively). The three notes together make up a sweet-sounding **major chord**. Note Y is \_\_\_\_\_ above note X and …

a. a third b. a fourth c. a fifth d. an octave

aa. (Continued from the previous question.) … note Z is \_\_\_\_\_ above note X.

a. a third b. a fourth c. a fifth d. an octave

**Questions 80-81:**

aa. **Beats** result whenever two sounds with \_\_\_\_\_ are heard together.

a. a 2:1 frequency ratio b. a 3:2 frequency ratio

c. perfectly identical frequencies d. similar, but slightly different frequencies

aa. When beats are heard, one perceives \_\_\_\_\_.

a. a rapid alteration in the loudness of the sound

b. a rapid alteration in the sound from high to low pitch

c. two sounds which are pleasing when heard together

d. a very gradual and steady increase in the pitch of the sound

**Question 82:**

aa. The speed of a wave within a string depends upon the \_\_\_\_\_. Select all that apply.

a. length of the string

b. tension of the string

c. linear density (mass/length) of the string

d. frequency with which the string vibrates

e. wavelength of the waves within the string

**Question 83:**

aa. A guitarist notices that a particular string is vibrating such that the sounds it produces are too high in pitch. To correct the problem, the guitarist should \_\_\_\_\_ the string.

a. loosen b. tighten

**Question 84:**

aa. Which of the following best explain why a string on an instrument is attached to a sounding board (or sounding box)?

a. A sounding board serves to amplify the sound of the vibrating string.

b. A sounding board serves to produce the various harmonics that are associated with each string.

c. A sounding board increases the speed of sound waves so that the higher frequencies can be played.

d. A sounding board decreases the speed of sound waves so that the lower frequencies can be played.

**Question 85:**

aa. Why is the clarinet waveform so much different than that of the tuning fork?

a. The clarinet vibrates with a higher frequency than the frequency of the tuning fork.

b. The clarinet vibrates with a lower frequency than the frequency of the tuning fork.

c. The tuning fork vibrates so as to create a sound wave and the clarinet vibrates but not as a wave.

d. The clarinet vibrates with more than one frequency and the tuning fork vibrates with a single frequency.

**Question 86:**

aa. The meeting of a rarefaction from one sound wave and a rarefaction from a second sound wave will result in \_\_\_\_\_ interference.

a. constructive b. destructive

c. ... nonsense! This would not be interference.

**Question 87:**

aa. When a standing wave is produced on a vibrating string, the \_\_\_\_\_ is the point that does not move and the \_\_\_\_\_ is the point that has the largest amplitude.

a. node, antinode b. antinode, node

**Question 88:**

aa. The nodes on a standing wave pattern are located \_\_\_\_\_ apart from each other.

a. 0.25 b. 0.5  c. 0.75  d. 1 

e. 2  ab. a variable number of wavelengths

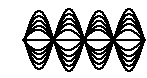
**Question 89:**

aa. Which of the following relationships are true for the fundamental frequency pattern for a standing wave on a string? Select all that apply.

a.  = 2L b. f = v/ c. L = 1/2

d. L =  e. f = v/(2)

**Questions 90-94:**

The diagram at the right shows a string vibrating in one of its harmonic patterns. Use the diagram to answer the following questions.

aa. This standing wave pattern corresponds to the \_\_\_\_ harmonic.

a. 1st b. 2nd c. 4th

d. 8th e. can't tell

aa. This pattern shows \_\_\_\_ antinodes.

a. 2 b. 4 c. 5 d. 8

e. can't tell

aa. This pattern shows \_\_\_\_\_\_ nodes.

a. 2 b. 4 c. 5 d. 8

e. can't tell

aa, The relationship between the length of the string and the wavelength () is \_\_\_\_\_. Select all that apply.

a.  = 0.5 L b. L = 2  c.  = 2 L d. L = 0.5 

e. none of these

aa. If the string length is 2.4 m long, then the wavelength is \_\_\_\_\_\_.

a. 0.6 m b. 1.2 m c. 2.4 m d. 4.8 m

e. 9.6 m ab. none of these

**Questions 95-97:**

Use the standing wave pattern below to answer the next three questions.



aa. This is the \_\_\_\_ harmonic.

a. 3rd b. 4th c. 5th

d. 6th e. 7th

aa. There are \_\_\_ antinodes in the pattern.

a. 3 b. 4 c. 5 d. 8

e. none of these

aa. If the length of this air tube is 1.4 m, then the wavelength is \_\_\_\_\_\_\_\_ m.

**Question 98:**

aa. A pipe that is open at both ends has a fundamental frequency of 200 Hz. The frequency of the next highest harmonic is \_\_\_\_.

a. 100 Hz b. 201 Hz c. 400 Hz d. 600 Hz

e. not enough info to tell.

**Question 99:**

aa. A pipe that is closed at one end has a fundamental frequency of 200 Hz. The frequency of the next highest harmonic is \_\_\_\_.

a. 100 Hz b. 201 Hz c. 400 Hz d. 600 Hz

e. not enough info to tell.

**Questions 100-102:**

aa. Use the standing wave pattern at the right to answer the next three questions.



aa. This is the \_\_\_\_\_\_ harmonic.

a. 2nd b. 3rd c. 4th d. 5th e. 8th

aa. There are \_\_\_\_\_ antinodes in the pattern.

a. 3 b. 4 c. 5 d. 8

e. none of these

aa. If the length of this air tube is 1.2 m, then the wavelength is \_\_\_\_\_ m.

a. 0.4 b. 0.8 c. 0.9 d. 1.2

e. 1.6 ab. 3.6 ac. 4.8

**Question 103:**

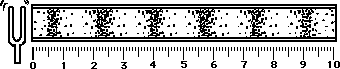
aa. A piano tuner plucks a piano string and a tuning fork which plays 262 Hz. She hears a beat frequency of 3 Hz. The string is tuned to a frequency of \_\_\_\_ Hz. Select all that could apply.

a. ~87 b. 259 c. 265 d. 786

e. none of these

**Question 104:**

aa. A sound wave pattern is shown below. A cm-*ruler* is provided to assist in measuring distances.



The wavelength is closest to \_\_\_\_\_.

a. 1.7 cm b. 3.4 cm c. 5 cm

d. 6 cm e. 10 cm

**Question 105:**

aa. Compared to the wavelengths of high-pitched sounds, the wavelengths of low-pitched sounds are \_\_.

a. short b. long

c. ...nonsense! No such generalization can be made.

**Question 106:**

aa. Which of the following would affect the speed of a sound wave traveling through air? Select all that apply.

a. density of air b. intensity of sound

c. amplitude of sound d. frequency of sound

e. temperature of air

**Question 107:**

aa. A wave transports \_\_\_\_ from one location to another.

a. energy b. matter c. both matter and energy

**Question 108:**

aa. If an airplane is flying at Mach 2, then the plane's speed is \_\_\_\_ times the speed of sound.

a. 0.0349 b. 0.5 c. 2 d. 30

e. none of these

**Calculations and Short Answer Questions:**

**Question 109:**

aa. What is the speed (in m/s) of sound in air at 14.7 degree Celcius?

**Question 110:**

aa. What is the speed (in m/s) of sound in air at 34.7 degree Celcius?

**Question 111:**

aa. The dB level at a distance of 3.0 m from a sound source is 100.0 dB.

a. What is the dB level at the distance of 6.0 m?

b. What is the dB level at the distance of 9.0 m?

c. What is the dB level at the distance of 12.0 m?

**Question 112:**

aa. Miles Tugo is camping in Glacier National Park. In the midst of a glacier canyon, he makes a loud holler. He hears an echo 2.0 seconds later. The air temperature is 20ºC. How far away (in meters) are the canyon walls?

**Question 113:**

aa. A group of hikers hear an echo 2.39 seconds after they shout. If the air temperature is 19.5 degree Celcius, how far away (in meters) is the mountain that reflected the sound wave? Relate the air temperature to the speed of sound using the simplified formula presented in class.

**Question 114:**

aa. What is the decibel level of a sound wave of intensity of 4.17x10-6 W/m2?

**Question 115:**

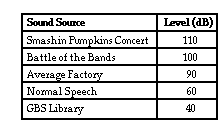
aa. What is the decibel level of a sound wave of intensity of 2.82x10-8 W/m2?

**Question 116:**

aa. What is the intensity of a sound (in W/m2) whose intensity level is 37.0 dB?

**Question 117:**

aa. What is the intensity of a sound (in W/m2) whose intensity level is 74.0 dB?

**Questions 118-121:**

The table at the right represents the deciBel level for several sound sources. Use the table to make comparisons of the **intensities** (and NOT the pressures) of the following sounds. The Smashin' Pumpkins concert is \_\_\_\_\_ times more intense than ...

aa. ... the Battle of the Bands.

aa. ... the average factory.

aa. ... normal speech.

aa. ... the GBS library.

**Question 122:**

Use the Doppler effect to answer the following questions. For each question, use 344 m/s as the speed of sound.

Suppose you are parked on the side of the road. A friend in a car is traveling towards you with his horn depressed. The horn produces a sound with a frequency of 364 Hz. What frequency will you hear when your friend's car is moving at ...

aa. ... 5 m/s?

aa.... 16 m/s?

aa.... 33 m/s?

aa.... 54 m/s?

**WARNING:** Don't try this at home!

**Question 123:**

The table below shows the various standing wave patterns (*displacement patterns*) for a vibrating string. Complete the table by indicating the harmonic number, and the length of the string or the wavelength of the wave.

|  |  |  |  |
| --- | --- | --- | --- |
| **Standing Wave Pattern** | **Harmonic**  **#** | **String**  **Length (cm)** | **Wavelength**  **(cm)** |
|  |  | 54.0 |  |
|  |  | 36.0 |  |
|  |  |  | 32.0 |
|  |  | 24.0 |  |
|  |  |  | 12.8 |

**Question 124:**

The table below shows the various standing wave patterns (*displacement patterns*) for a closed pipe. Complete the table by indicating the harmonic number, and the length of the pipe or the wavelength of the wave.

|  |  |  |  |
| --- | --- | --- | --- |
| **Standing Wave Pattern** | **Harmonic**  **#** | **Pipe**  **Length (cm)** | **Wavelength**  **(cm)** |
|  |  | 36.0 |  |
|  |  | 36.0 |  |
|  |  |  | 19.2 |
|  |  | 48.0 |  |
|  |  |  | 24.0 |

**Question 125:**

The table below shows the various standing wave patterns (*displacement patterns*) for an open pipe. Complete the table by indicating the harmonic number, and the length of the pipe or the wavelength of the wave.

|  |  |  |  |
| --- | --- | --- | --- |
| **Standing Wave Pattern** | **Harmonic**  **#** | **Pipe**  **Length (cm)** | **Wavelength**  **(cm)** |
|  |  | 36.0 |  |
|  |  | 36.0 |  |
|  |  |  | 16.0 |
|  |  | 48.0 |  |
|  |  |  | 21.6 |

**Questions 126-129:**

The frequency of the first harmonic of a string is 254 Hz. Determine the frequency of ....

aa. ... the second harmonic of the same string. \_\_\_\_\_\_\_\_\_\_\_\_\_ Hz

aa. ... the sixth harmonic of the same string. \_\_\_\_\_\_\_\_\_\_\_\_\_ Hz

aa. ... the first harmonic of a string which is 2.6 times as long. \_\_\_\_\_\_\_\_\_\_\_\_\_ Hz

aa. ... the fourth harmonic of a string which is two-fifths the length. \_\_\_\_\_\_\_\_\_\_\_\_\_ Hz

**Questions 130-134:**

The frequency of the first harmonic of an open pipe is 240 Hz. Determine the frequency of ....

aa. ... the second harmonic of the same open pipe: \_\_\_\_\_\_\_\_ Hz

aa. ... the sixth harmonic of the same open pipe: \_\_\_\_\_\_\_\_ Hz

aa. ... the first harmonic of a closed pipe with the same length: \_\_\_\_\_\_\_\_ Hz

aa. ... the first harmonic of an open pipe that is 2.6 times as long: \_\_\_\_\_\_\_\_ Hz

aa. ... the fourth harmonic of an open pipe that is two-fifths the length: \_\_\_\_\_\_\_\_ Hz

**Questions 135-139:**

The frequency of the first harmonic of a closed pipe is 240 Hz. Determine the frequency of ....

aa. ... the third harmonic of the same closed pipe: \_\_\_\_\_\_\_\_ Hz

aa. ... the seventh harmonic of the same closed pipe: \_\_\_\_\_\_\_\_ Hz

aa. ... the first harmonic of an open pipe with the same length: \_\_\_\_\_\_\_\_ Hz

aa. ... the first harmonic of a closed pipe that is three times as long: \_\_\_\_\_\_\_\_ Hz

aa. ... the fifth harmonic of a closed pipe that is one-third as long: \_\_\_\_\_\_\_\_ Hz

**Questions 140-144:**

Use your understanding of the relationship between the resonant frequencies of an open pipe in order to answer the following questions.

aa. Diagram A below represents the standing wave pattern for a string when it vibrates with a frequency of 480 Hz. With what resonant frequency must the same string be vibrating in order to vibrate with the pattern shown in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for a string vibrating at 422 Hz, then with what frequency is the same string vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for a string vibrating at 512 Hz, then with what frequency is the same string vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for a string vibrating at 469 Hz, then with what frequency is the same string vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for a string vibrating at 591 Hz, then with what frequency is the same string vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_\_\_\_\_ Hz

**Questions 145-149:**

Use your understanding of the relationship between the resonant frequencies of an open pipe in order to answer the following questions.

aa. Diagram A below represents the standing wave pattern for an open pipe when it vibrates with a frequency of 576 Hz. With what resonant frequency must the same open pipe be vibrating in order to vibrate with the pattern shown in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for an open pipe vibrating at 524 Hz, then with what frequency is the same pipe vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for an open pipe vibrating at 617 Hz, then with what frequency is the same pipe vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for an open pipe vibrating at 658 Hz, then with what frequency is the same pipe vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for an open pipe vibrating at 690 Hz, then with what frequency is the same pipe vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_\_\_\_\_\_ Hz

**Questions 150-154:**

Use your understanding of the relationship between the resonant frequencies of a closed pipe in order to answer the following questions.

aa. Diagram A below represents the standing wave pattern for a closed pipe when it vibrates with a frequency of 576 Hz. With what resonant frequency must the same closed pipe be vibrating in order to vibrate with the pattern shown in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for a closed pipe vibrating at 524 Hz, then with what frequency is the same pipe vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for a closed pipe vibrating at 617 Hz, then with what frequency is the same pipe vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for a closed pipe vibrating at 658 Hz, then with what frequency is the same pipe vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_ Hz

aa. If Diagram A represents the pattern for a closed pipe vibrating at 690 Hz, then with what frequency is the same pipe vibrating to produce the pattern in Diagram B?



Frequency for Diagram B = \_\_\_\_\_\_\_\_ Hz

**Question 155:**

aa. The fundamental frequency of a 132-cm long wire is 162 Hertz. Determine the frequency (in Hertz) of the 6th harmonic of a 66.0-cm section of the same string (assume the same tension).

**Question 156:**

aa. A standing wave pattern is established in a string that is 259 cm long and fixed at both ends. The string vibrates in a pattern that displays five loops (antinodes) between its ends when there is a frequency of 196 Hz.

a. Determine the wavelength (in centimeters) associated with this vibration pattern.

b. What is the fundamental frequency (in Hertz) of this string?

**Question 157:**

aa. If the frequency of the first harmonic of a guitar string is 250 Hz, then the frequency of the fourth harmonic is \_\_\_\_ Hz.

**Question 158:**

aa. If the frequency of the sixth harmonic of a guitar string is 900 Hz, then the frequency of the second harmonic is \_\_\_\_ Hz.

**Question 159:**

aa. A certain pipe organ is closed at one end and sounds out a fundamental frequency of 243 Hertz. What would be the fundamental frequency (in Hertz) of the same organ pipe produce if it were open at both ends?

**Question 160:**

aa. A closed-end organ pipe produces a 5th harmonic with a frequency of 910 Hertz. (Assume a speed of sound in air of 340 m/s.)

a. Determine the length (in cm) of the organ pipe.

b. Determine the fundamental frequency (in Hertz) of an open-end organ pipe that is twice as long?

**Question 161:**

aa. A physics student is doing a resonance tube lab. She notices that resonance is observed for the first harmonic when the length of the closed-end air column is 16.8 cm. Determine the third harmonic frequency (in Hertz) for this air column. (Assume a speed of sound in air of 344 m/s.)

**Question 162:**

aa. A string has a mass of 37.8 g and a length of 7.69 m. The tension in the string is 58.3 N. What is the vibration frequency (in Hertz) for this third harmonic?

**Question 163:**

aa. A string that is 44.7 cm long has a mass per unit length equal to 1.31 x 10-3 kg/m. To what tension (in Newton) should this string be stretched if its fundamental frequency is to be 40.2 Hz?

**Question 164:**

aa. One end of a 2.10-meter long string is attached to a vertical support while the other end hangs over a pulley and is attached to a hanging 3.00-kg mass. This creates a tension of 29.40 N. The speed of the pulse on the string is observed to be 15.1 m/s. What is the mass (in grams) of the string?

**Question 165:**

aa. A physics teacher stretches a string to a length of 1.07 meters and uses a mechanical oscillator to vibrate the string in its 5th harmonic. The oscillator's frequency is 469 Hertz.

a. What is the speed (in meters/second) at which the waves travel through the string?

b. The same string held at the same tension is vibrated at a frequency of 293 Hertz to create a different standing wave pattern. Determine the wavelength (in centimeters) of waves for this particular frequency.