Physics Waves and Sound Study Guide

Part A: Vocabulary

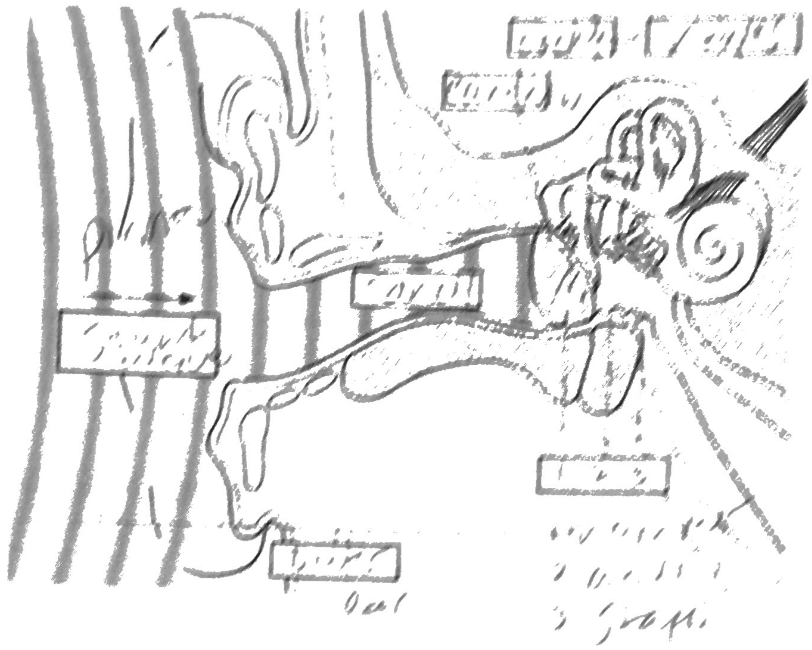
wavelength: The distance between successive identical parts of a wave
medium: The material through which a wave moves/propagates
amplitude: The wave characteristic that demonstrates the energy in the wave
frequency: The number of events per unit of time
Period: The amount of time required to complete one cycle
Interference: When wave occupy the same space at the same time
standing wave: An interference pattern that creates a wave that appears to stand still.
node: The point on a standing wave of no displacement
antinode: The point on a standing wave that undergoes maximum displacement.
longitudinal: A wave where the motion of the wave is parallel to the motion of the particles.
compression: an area of high pressure on a longitudinal wave
rarefaction: an area of low pressure on a longitudinal wave
mechanical: The category of wave that requires a medium through which to travel.
vibration: creates a wave
beats: difference in frequencies of two interfering waves
decibel: measurement of the intensity of a sound wave
fundamental: another name for the 1st Harmonic
diffraction: ~~bending~~ spreading of a wave around the edge of a boundary or through a small opening
reflection: bouncing back a wave
refraction: bending of a wave due to change in speed through a new medium
echo: a reflected sound wave
infrasonic: frequencies below 20 Hz
ultrasonic: frequencies above 20,000 Hz
pitch: qualitative term for frequency
loudness: qualitative term for intensity
resonance: when one object vibrating at the same natural frequency of a second object forces that second object into vibrational motion.
octave: musical interval that separates two of the same notes

Part B: Fill in the Blank

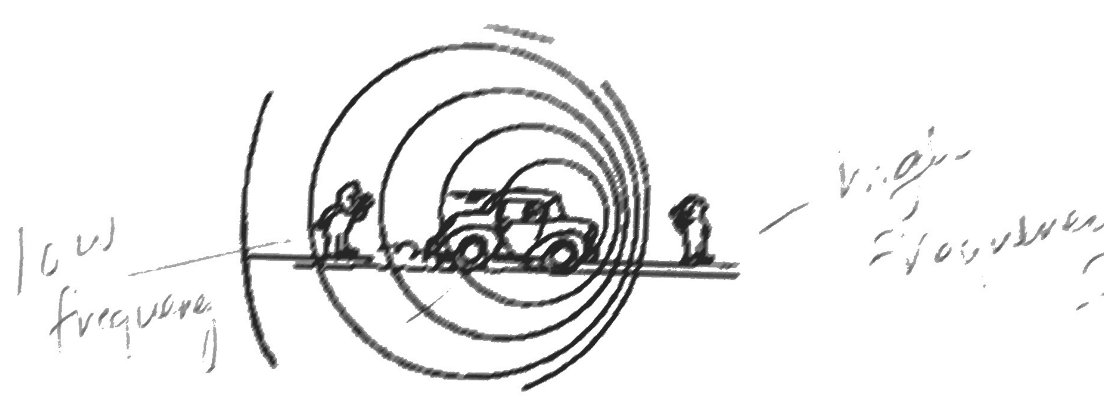
A sound wave is created by a Vibrating object. The type of wave is longitudinal and has areas of high and low density known as compressions and rarefactions. Sound cannot travel in a vacuum because it is a mechanical wave. Sound travels fastest through a solid, then through a liquid and is slowest in a gas. The velocity of sound in air is dependent on temperature. Compared to the speed of light, the speed of sound is slower. A standing wave wave pattern is created on a string or a pipe. The air in the pipe will resonate at the natural frequency or the first harmonic. The average human can hear in the range of 20 - 20,000 Hz. The volume of a sound is demonstrated by the amplitude. The intensity of sound is measured on the decibel Scale. This scale is a log 10 scale. Hearing loss can occur when the hair cells inside the cochlea are damaged.

Part C: Diagrams

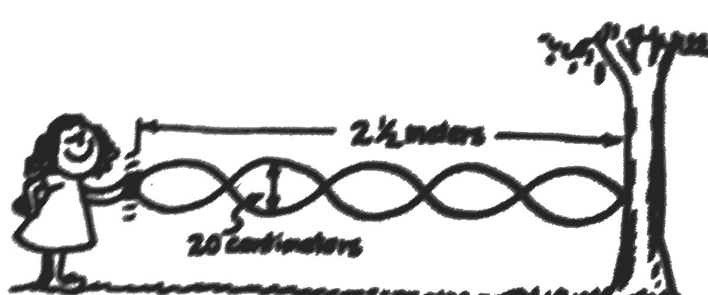
Identify and label the parts of the ear. Explain how sound travels and energy is passed through the ear.



Name the phenomenon demonstrated below. Describe what the two observer hear and why.



For the image below, identify the type of wave pattern, determine the number of nodes and antinodes, length of 1 wavelength and the height of the amplitude.



Standing wave
6 nodes
5 antinodes
λ = 1.0 m
amplitude = 10 cm

Part D: Practice Problems

1. What is the velocity of sound through air if the temperature is 4°C? 38°C? What do these two answers show you about velocity and temperature?

   331 + .6(4) = 333 m/s   331 + .6(38) = 353.8 m/s   v ↑ as temp ↑

2. Scientists have detected sounds with frequencies as low as 13Hz produced by elephants. Assuming a speed of sound of 350m/s, determine the wavelength of these sound waves.

   350 m/s = λ(13 Hz)   λ = 26.9m

3. George yelled across a canyon and heard an echo 1.8 seconds later. Determine the distance of the canyon.

   v = 343   t = .9   v = d/t   343 = d/.9   d = 308.7m

4. By how much more intense is an 80dB sound than a 50 dB sound?

   80 - 50 = 30   10³ = 10·10·10 ⇒ 1000 times more intense

5. Two tuning forks, one of frequency 340Hz and the other of 335Hz, are played together. What is the frequency of the beat?

   340 - 335 = 5 Hz   (subtract)

6. A sound wave has a frequency of 4700 Hz and travels along a steel rod. If the distance between compressions is 1.1 m, what is the speed of the wave? How would your answer change if the sound was traveling in the air? Justify your answer mathematically.

   v = d/t   v = λf   v = 4700(1.1m) = 5170 m/s   Slow down

7. A train is moving at 35 m/s and blows a 305 Hz whistle. What frequency is detected by

   a. a passenger on the train? 305 Hz

   b. a stationary observer as the train moves toward them? $f_o = f_s\left(\frac{v + v_o}{v - v_s}\right)$ $f_o = 305\frac{(343 + 0)}{(343 - 35)}$

   $f_o = 340$Hz

Part E: Short Answer

1. When waves hit each other do they pass through each other or bounce off each other? Explain your answer.

   pass through - interference - either constructive or destructive

2. Explain why the moon is known as the "silent planet".

   No air - no sound

3. Describe what happens when you force an object to vibrate at its natural frequency.

   Resonance - a second object vibrates same as first

4. If a person talks in a high pitched loud voice; describe the sound waves' amplitude, wavelength, velocity, frequency and period versus when they talk normally.

   higher   lower   high   short   same