

Learning Intention

- Learn some of the properties of sound waves.

Definitions

1. _____ frequency is the frequency at which an object will vibrate if struck.
2. _____ vibration occurs when an object is physically touched to an object that is vibrating.
 - a. _____ occurs when an object undergoes _____ vibration at its natural frequency.
3. In a _____ wave, there is _____ and _____ interference between the incident waves and the reflected waves.
 - a. A _____ is the point in a standing wave where, due to _____ interference, the medium does not undergo any displacement.
 - b. An _____ is the point in a standing wave where, due to _____ interference, the medium undergoes the maximum displacement in each direction.
4. In music, the term _____ is used to refer to the amplitude of a sound wave.
5. In music, the term _____ is used to refer to the frequency of a sound wave.

6. When a guitar string is plucked, it produces _____ waves in the string.

a. Each standing wave is called a _____.

b. The lowest frequency is known as the _____ frequency, or the _____.

c. The second lowest frequency standing wave is known as the _____, or the _____.

d. The third lowest frequency standing wave is known as the _____, or the _____.

7. An air column is a tube that is open at either _____ end or _____ ends.

a. At a _____ end, the standing wave is not free to move longitudinally through the air:

b. At an _____ end, the standing wave is free to move longitudinally through the air:

8. Young humans can generally hear sounds from around _____ Hz to _____ kHz.

- a. Dog whistles make a noise at 23 to 54 kHz, which is considered the _____ range.

9. In air, at sea level (normal atmospheric pressure), the speed of sound is given by:

10.A _____ plane can fly faster than the speed of sound in air.

- a. The _____ number indicates how fast the plane is flying.
- b. When a plane breaks the _____ barrier (Mach 1.0), a _____ is generated.

11.The loudness of sounds is measured using the _____ scale.

- a. An increase of 10 dB results in _____ times as much power in the sound wave.
- b. _____ dB: Limit of human hearing
- c. _____ dB: Human voice
- d. _____ dB: Rock concert
- e. _____ dB: Painful to the ears, can cause permanent damage

Questions

1. For a 440 Hz tone
 1. What is the first harmonic?
 2. What is the first overtone?
 3. What is the second overtone?
 4. What is the third overtone?
2. What is the fundamental frequency, if the first overtone is 680 Hz?
3. What is the first harmonic, if the second overtone is 680 Hz?
4. What is the second harmonic, if the third overtone is 680 Hz?
5. How fast will sound travel at:
 1. 0.00 °C
 2. 25.0 °C
 3. 0 K
6. A camper sees a flash of lightning, and immediately begins counting until they hear the sound of the thunder. The air is 21 °C. How far from the lightning is the camper if the thunder arrives in:
 1. 9.0 seconds?
 2. 6.0 seconds?
 3. 3.0 seconds?
7. What is the rule of thumb for finding the distance from a lightning strike?
8. How fast is a plane travelling, in m/s, if it is going at a speed of:
 1. Mach 3.0 in 21 °C air.
 2. Mach 10.0 in -55 °C air.
9. How many times louder than a 40 dB library is a 110 dB concert?
10. How many times louder than a 60 dB air conditioner is a 120 dB jet engine?

Answers

1. 1. 440 Hz
2. 880 Hz
3. 1300 Hz
4. 1800 Hz
2. $f_0 = 340 \text{ Hz}$
3. $f_0 = 230 \text{ Hz}$
4. $f_1 = 340 \text{ Hz}$
5. 1. $v = 331 \text{ m/s}$
2. $v = 346 \text{ m/s}$
3. $v = 167 \text{ m/s}$
6. 1. $d = 3,100 \text{ m} = 3.1 \text{ km}$
2. $d = 2,100 \text{ m} = 2.1 \text{ km}$
3. $d = 1,000 \text{ m} = 1.0 \text{ km}$
7. The distance in kilometers is equal to the time in seconds between the lightning and the thunder, divided by 3.
8. 1. $v = 1,000 \text{ m/s} = 1.0 \text{ km/s}$
2. $v = 3,000 \text{ m/s} = 3.0 \text{ km/s}$
9. 130 times
10. 64 times