Waves Practice Items

1. The wavelength of a harmonic wave divided by its speed of propagation is equal to

A. the frequency
B. the angular frequency
C. the wave number
D. the period

2. The greater the amplitude of a sound wave, the greater its

A. frequency
B. wavelength
C. wave number
D. energy

3. The speed of sound through air is approximately 343 m/s at normal room temperature. An E note produced by a piano has a frequency of 660 Hz. What is its wavelength?

A. 0.5 m
B. 2.0 m
C. 11 m
D. 20 m

4. Which of the following statements about sound wave is true?

A. They can pass through a vacuum.
B. Their speed does not depend upon the medium of propagation.
C. They travel as longitudinal waves.
D. They cannot be reflected.

5. Which of the following phenomena is **not** characteristic of sound waves:

A. reflection
B. polarization
C. diffraction
D. interference

6. Without changing the length of the string, the tension of a stretched string is increased 9 times. The fundamental frequency

A. increases 9 times
B. decreases 9 times
C. increases 3 times
D. remains the same

7. The fundamental frequencies of a set of banjo strings of different gauge but fixed length and tension are

A. the same
B. inversely proportional to string diameter
C. directly proportional to Young's modulus
D. distributed in simple integer ratios

8. Sound travels at a lower speed through air than through water. Which of the following is the best explanation for this?

A. Water is less dense than air.
B. Water is more dense than air.
C. Air is more compressible than water.
D. Water is more structured at the intermolecular level than air.

9. When two-out-of-tune flutes attempt to play the same note, one produces a tone that has a frequency of 392 Hz, while the other produces 406 Hz. When a tuning fork is sounded together with the 392 Hz tone, the combined notes quaver at a frequency of 9 Hz. When the same tuning fork is sounded together with the 406 Hz tone, a frequency of 5 Hz is produced. What is the frequency of the tuning fork?

A. 383 Hz
B. 397 Hz
C. 401 Hz
D. 411 Hz

10. During the day, the upper atmosphere is cooler than air at ground level, while during the night, the upper levels are warmer than the lower levels. Traveling more slowly through more dense media, the tendency during the day is for sound waves to veer upwards through the atmosphere, while at night the sound waves veer more downwards. To which of the following is this situation most analogous?

A. the refraction of light
B. convection currents in the ocean
C. the Doppler effect
D. the thermal equilibrium of radiation

11. An organ pipe with one closed end is 0.75 m long. The speed of sound in the room is 330 m/s. Which of the following notes does the pipe produce as its fundamental mode?

A. A (110 Hz)
B. A (220 Hz)
C. B (248 Hz)
D. E (660 Hz)

12. The trombone is the loudest instrument in the orchestra. A trombone produces a loudness of 110 dB from one meter away. Two trombones from one meter away will produce a loudness of

A. 113 dB
B. 120 dB
C. 130 dB
D. 220 dB

13. The sound level at a distance 5 m from a point sourcce is 100 dB. At what distance will the sound level be 80 dB?

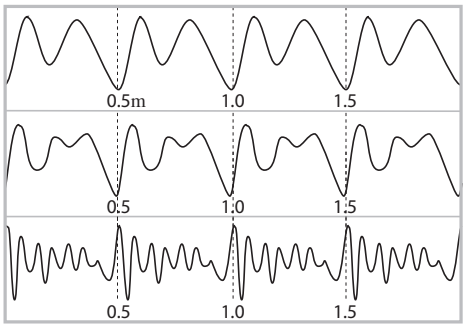
A. 20 m
B. 25 m
C. 50 m
D. 500 m

14. A low flying jet zooms past an airport tower. The speed of sound in the warm air of the airfield is 350 m/s. The pitch frequency of its engine noise shifts from 440 Hz from the listener's perspective as it is flying towards the tower to 330 Hz after it has passed. What is its approximate speed?

A. 50 m/s
B. 65 m/s
C. 70 m/s
D. 110 m/s

15. The three complex sound waves depicted in the figure below

A. have the same wavelength
B. are traveling through different media
C. possess different amplitudes
D. are transverse waves



Passage (Questions 16-21)

Seismic waves are waves of energy that travel through the Earth's layers, and are a result of an earthquake, explosion, or a volcano that imparts low-frequency acoustic energy. The propagation velocity of the waves depends on density and elasticity of the medium. Velocity tends to increase with depth, and ranges from approximately 2 to 8 km/s in the Earth's crust up to 13 km/s in the deep mantle.

There are two types of waves which travel within the body of the Earth. P waves are sometimes called compressional waves or primary waves or push-pull waves and they are propagated by movements of the material in the Earth parallel to the direction in which the wave is moving. S waves are also called shear waves or secondary waves and they propagate by movements of the Earth perpendicular to the direction in which the wave is moving.

P wave velocity depends on the bulk modulus, shear modulus and the density of the medium

$$v = \sqrt{\frac{\frac{4}{3}B + S}{\rho}}$$

S wave velocity depends on the shear modulus and density of the medium

$$v = \sqrt{\frac{S}{\rho}}$$

The crust mantle boundary was discovered in 1909 by a seismologist named Mohorovici (Yugoslav), as a result of his study of an earthquake in Croatia at that time. He found that, out to about 150 km, the time it took for the earthquake waves to reach each seismograph station was proportional to the distance the station was from the earthquake. He determined that the P wave velocity of the upper crust must be about 6 km/s. However, for stations greater than about 150 km from the earthquake, waves arrived with a higher average velocity.

Mohorovici calculated that the distance at which the change in velocity occurred (about 150 km) can be used to calculate the depth to velocity increase. He calculated that the depth to this velocity jump was about 30 km. We interpret this velocity jump as the crust-mantle boundary. At short distances, the "direct waves" that travel along the surface will arrive first. However, at greater distances, the P waves that travel down to the mantle, and are bent and travel along the top of the mantle at the higher velocity, can arrive before the waves traveling directly along the surface.

16. The velocity of seismic waves tends to increase with depth because

A. the medium is both more compressible and less dense at greater depth
B. the density and plasticity of the medium both increase with depth
C. elastic modulus and density both increase at greater depth
D. pressure and rigidity increase faster than density with depth

17. Which of the following may be observed with S waves but not with P waves?

A. polarization
B. constructive interference
C. travel through unsaturated sediments
D. amplitude

18. Within a geological medium through which both P waves and S waves are traveling, which seismic waves are faster?

A. P waves
B. S waves
C. It depends on the medium.
D. Both travel at the same speed.

19. When a seismic body wave encounters a lithological boundary layer, the incident ray can transform into several new rays. Some of the energy goes into the new layer but is bent, and some is reflected back up to the surface. The ray entering the new layer has undergone

A. wave splitting
B. refraction
C. polarization
D. interference

20. The higher velocity P waves observed by Mohorovici as described in the passage

A. had struck the crust mantle interface at the critical angle
B. had undergone conversion from S waves to P waves at the crust mantle interface
C. had been reflected by the crust mantle interface
D. had traveled a greater overall distance

21. From the S wave shadow zone observed with seismic readings taken on the opposite side of the Earth from an earthquake, it has been deduced that no S waves pass through the outer core. The most likely reason is that

A. The greater pressure at deeper levels opposes the perpendicular displacements of the S waves.
B. It is impossible to produce a shearing stress by displacing a section of liquid.
C. The S waves are reflected by the denser strata at that depth.
D. The S waves reach a threshold beyond which the gravitational force can no longer act to restore wave displacement.