Physics 200 (Stapleton) Name: Key

2019-2020 Test: Chapter 16-17- Waves and Sound

I. Matching (Select the correct SI unit for each wave parameter).

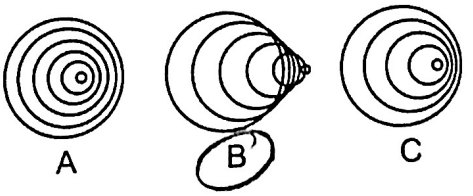
1. B frequency
2. A T
3. D wavelength x frequency
4. C λ
5. C amplitude

A. seconds
B. Hertz
C. meters
D. meters per second

II. Multiple Choice (Choose the one best answer for each question.)

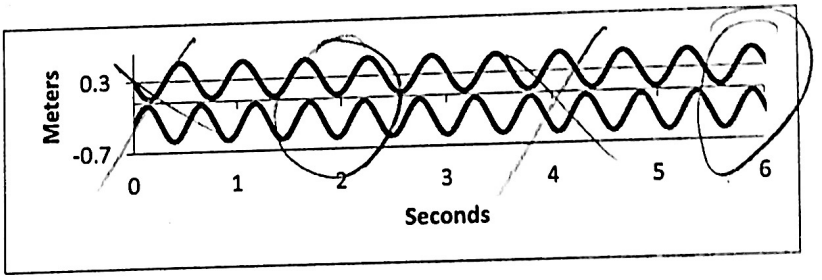
6. For sound traveling through air at 0.0°C, which of the following changes as the sound travels farther from the source?
A. Wavelength B. Period (C.) Amplitude D. Velocity E. None of these

7. The pictures on the right show sound waves produced by a moving object. In which case is the object is moving the **fastest?**



8. The two sets of waves on the right interact to produce beats. How many beats can you identify during the time span shown on the graph?

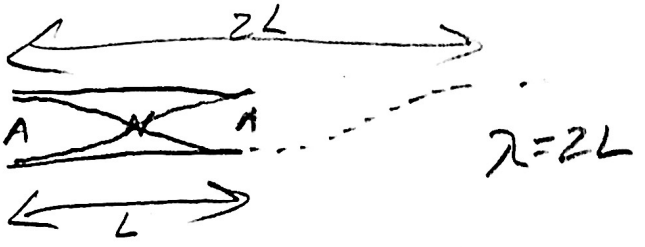
a. 0 b. 1 (c. 2) d. 3 e. 4



9. As the temperature of air increases, the speed of sound in that air...
(A. increases) B. decreases C. stays the same

10. A beat frequency of 6Hz is heard when a 600Hz tuning fork and a ____ tuning fork are struck at the same time.
A. 6Hz B. 100 Hz (C. 594 Hz) D. 660 Hz E. 3600 Hz

11. For a tube of length L that is open on both ends, the wavelength of the fundamental is?
A. 1/4L B. 1/2L C. L (D. 2L) E. 4L



12. The parts of a standing wave that have no movement are called
A. fundamentals B. harmonics C. nodes D. antinodes

13. Longitudinal waves have a disturbance that is
A. parallel to the motion of the wave.
B. perpendicular to the direction of motion of the wave.
C. counterclockwise to the direction of the wave.
D. clockwise to the direction of the wave.

14. A sound wave is an example of a transverse wave.
A. True B. False

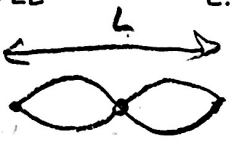
15. A child picks up one end of a garden hose that is stretched out, lying horizontally on the ground. The child jerks the hose directly upward and then directly downward, causing a _____ wave to travel along the length of the hose.
A. Transverse B. Longitudinal

16. How many of the following phenomena can occur when two waves are added together?
Phenomena: Silence; Beats; Increased Volume
A. 0 B. 1 C. 2 D. 3

17. A sound source moving toward you (compared to the same sound source at rest) will have
A. a lower pitch
B. a lower speed of sound
C. a lower frequency
D. a shorter wavelength
E. the same frequency

18. A tone is produced by a computer. As the frequency of the tone is decreased,
A. the speed of the sound increases.
B. the speed of the sound decreases.
C. the sound wave's period increases.
D. the sound wave's period decreases.
E. the sound's wavelength decreases.

19. A vibrating string has a standing wave pattern with exactly 3 nodes and 2 antinodes. If the length of the string is L, what is the wavelength of the standing wave pattern?
a. 1/2L b. L C. 2/3 D. 3/2L E. 2L



$d = rt$

III. Problems f=1/T $v = f\lambda$ v= 331.3 + 0.606 T or $v = 331.3 + \sqrt{1 + \frac{T}{273.15}}$

1. A bat finds a moth by sending a sound pulse through the air and listening for the echo. If the distance between the moth and the bat is 15m, how long after it makes a sound does the bat hear its echo? (Assume that the speed of sound is 340m/s)

$d = 2(15m) = 30m$ (15m)

$d = rt$ $\quad 30m = 340m/s\,(t)$

$t = 0.088s$

2. The eruption of the island of Krakatoa in 1883 was extremely loud. In fact, the sound was reportedly heard about 3.8 hours later at distant locations on the Earth. Assuming a constant air temperature of 28°C, how far would the sound have traveled in 3.8 hours? Answer in kilometers (1km = 10^3m).

$V = 331.3 + 0.606T$ $\quad V = 331 + 0.606(28) = 348 m/s$

$3.8 hours \left(\frac{3600s}{1hr}\right) = 13,680s$

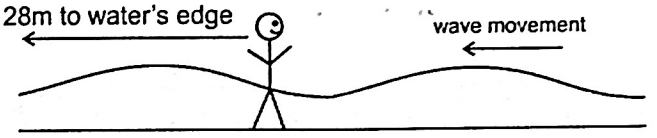
$d = rt \Rightarrow d = 348 m/s\,(13,680s)$

$= 4,760,000m = 4,760 km$

3. Calculate the speed of sound on a day when sound with a frequency of 440Hz frequency has a wavelength of 0.79 m.

$v = f\lambda$ $\quad v = 440Hz\,(0.79m) = 347.6 m/s$

4. You're standing motionless in the waves at the beach. You are 28m from the water's edge. A wave crest hits you every 5 seconds. After the waves pass you, it takes them 7 seconds to travel to the water's edge. Find...



a. The frequency of the waves

$f = \frac{waves}{t} = \frac{1}{5s} = 0.2Hz$

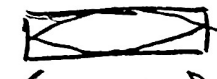
b. The speed of the waves.

$d = rt$ $\quad 28m = r(7s) \Rightarrow r = 4m/s$

c. The wavelength of the waves

$v = f\lambda$ $\quad 4m/s = 0.2Hz\,(\lambda) \Rightarrow \lambda = 20m$

5. The velocity of a standing sound wave in a pipe is 300m/s. The pipe is closed on both ends. If the pipe length is 0.63m, what is its fundamental frequency?



$\lambda_{fundamental} = 2(0.63m) = 1.26m$

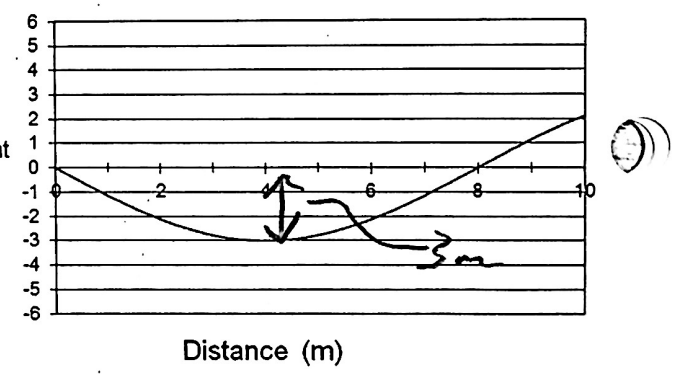
$V = f\lambda$ $\quad 300m/s = f(1.26m) \Rightarrow f = 238Hz$

6. An overheated bicyclist traveling at a rate of 15m/s approaches a stationary ice cream truck that is playing *Pop Goes The Weasel*. When the ice cream truck loudspeaker plays a note with a frequency of 600Hz, what frequency is heard by the approaching bicyclist? Assume that the speed of sound is 340m/s.

$f_o = f_s \dfrac{V \pm V_o}{V \pm V_s}$ $\quad f_o = 600Hz \dfrac{340m/s + 15m/s}{340m/s} = 626Hz$

because approaching makes frequency increase

7. Given that the velocity of the wave shown on the right is 120 m/s, find each of the following.



V = 120 m/s

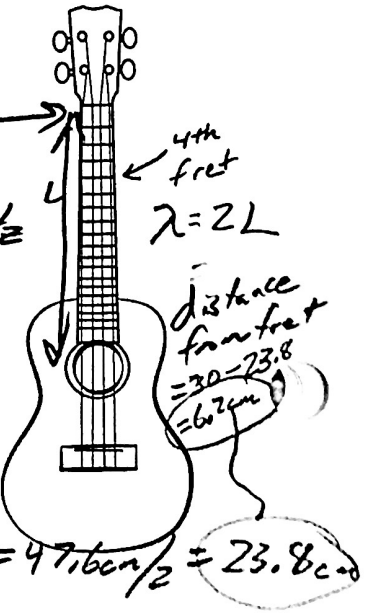
A. $\lambda =$ 16m

B. $f =$ 7.5Hz $\quad 120m/s = f(16m)$, $f = 7.5Hz$

C. $T =$ 0.133Hz $\quad T = \frac{1}{7.5Hz} = 0.133s$

D. $A =$ 3m

8. The ukulele on the right has a saddle that is positioned a distance of 30cm away from its nut. How far from the nut should the instrument's 4th fret be located?



$V = \lambda f$

Assume $f_{nut} = 100Hz$

$\lambda = 2L$

The long way...

$f_{4th\,fret} = f_{nut}\left(2^{\frac{n}{12}}\right)$

$f_{4th\,fret} = 100Hz\left(2^{4/12}\right)$

$f_{4th} = 126Hz$

$V = 60cm(100Hz)$ (full string) $= 6000cm/s$

$6000cm/s = \lambda_{4th\,fret}(126Hz)$

$\lambda_{4th\,fret} = 47.6cm \Rightarrow L = 47.6cm/2 = 23.8cm$