KFUPM – Physics Department

PHYS102 – Chapter 17 (Instructor: Dr. Ali Al–Shukri)

1. A police car is approaching a stationary observer at 34.0 m/s with its siren emitting a frequency of 450 Hz. What is the frequency heard by the observer? [v_{sound} in air = 343 m/s].

a. 500 Hz. b. 485 Hz. c. 405 Hz.
d. 525 Hz. e. 475 Hz.

2. A 1.5×10^{-6} W point source emits sound waves isotropically. What is the sound level 2.5 m from the source?

a. 43 dB. b. 39 dB. c. 55 dB.
d. 16 dB. e. 30 dB.

3. Two identical traveling waves, with a phase difference, are moving in the same direction. If they are interfering and the combined wave has an amplitude 0.5 times that of the common amplitude of the two waves, calculate phase difference (in radians).

a. 2.64 b. 3.50 c. 0.75 d. 1.30 e. 0.13

4. The maximum pressure amplitude that the human ear can tolerate in loud sounds is 28 Pa. What is the displacement amplitude for such a sound in air of density 1.21 kg/m^3 at a frequency of 5.0×10^3 Hz? [speed of sound in air = 343 m/s].

a. 2.15×10^{-6} m. b. 8.30×10^{-6} m.
c. 5.55×10^{-6} m. d. 11.0×10^{-6} m.
e. 4.15×10^{-6} m.

5. Two sound waves, from two different sources with the same frequency, 660 Hz, travel at a speed of 330 m/s. The sources are in phase. What is the phase difference of the waves at a point that is 5.0 m from one source and 4.0 m from the other? (The waves are traveling in the same direction.)

a. 4π. b. 5π. c. π. d. 2π. e. 3π.

6. Sound waves

a. are mechanical waves b. are matter waves.
c. are transverse waves. d. are electromagnetic waves
e. travel at the same speed in all media.

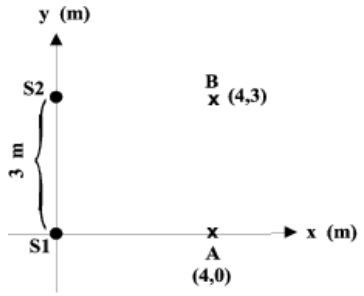
7. A sinusoidal sound wave is described by the displacement S (x,t) = 2×10^{-8} cos [1.25 x - 1850 t], where x is in meters and t is seconds. What is the pressure amplitude of this wave if it is traveling in a material with a bulk modulus of 2.1×10^9 N/m^2 ?

a. 52.5 Pa b. 42.5 Pa c. 62.5 Pa
d. 72.5 Pa e. 82.5 Pa

8. Two sound waves, from two different sources with the same frequency, 540 Hz, travel in the same direction at 344 m/s. The sources are in phase. What is the phase difference of the waves at a point that is 4.40 m from one source and 4.00 m from the other source?

a. 3.95 rad b. 1.97 rad c. 0.64 rad
d. 1.27 rad e. 1.59 rad

9. Two point sources S1 and S2 are placed on the y-axis as shown in the **Figure.** The two sources are in phase and emit identical sound waves with frequency 860 Hz. An observer starts at point A and moves to point B along a straight line parallel to the y-axis. How many points of maximum intensity (constructive interference) will he observe? (v_{sound} in air = 344 m/s).



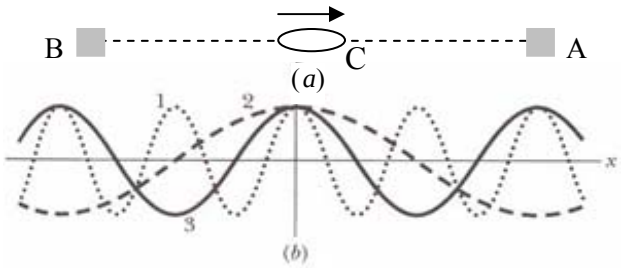
a. 5 b. 4 c. 0
d. 1 e. 3

10. A sound source located at the origin emits sound with an average power of 0.04 W. Two detectors are located on the positive x-axis. Detector A is at x = 3.0 m and detector B is at 5.0 m. What is the difference in sound level between A and B?

a. 4.4 dB b. 1.1 dB c. 2.2 dB
d. 3.3 dB e. 5.5 dB

11. A car (C) emitting a sound wave at a certain frequency moves along an x-axis (**Figure a**). The car moves directly toward detector A and directly away from detector B. The superimposed three plots of **Figure b** indicate the displacement function s (x) at some time t of the sound wave as measured by detector A, by detector B, and by someone in C. Which plot corresponds to which measurement?

a. 1 to A , 2 to B , 3 to C b. 1 to A , 3 to B , 2 to C



c. 2 to A , 1 to B , 3 to C d. 2 to A , 3 to B , 1 to C
e. 3 to A , 2 to B , 1 to C

12. A listener hears two sound waves from two loud-speakers that are in phase. At the listener's location a phase difference of 450 degrees is detected. What is the path difference if the wavelength of the waves is 4 m.

a. 5 m b. 10 m c. 99 m. d. 1 m. e. zero.

13. If an observer's distance from a point source is doubled, the sound intensity level will be

a. decreased by 6 dB. b. increased by 6dB.
c. decreased by 36 dB. d. increased by 36 dB.
e. decreased by 4 dB.

14. A bat is moving toward a wall with a velocity of 30 m/s. The bat is emitting a sound with frequency 40.0 kHz. The frequency of the reflected sound as heard by the bat is: [take the speed of sound in air = 340 m/s]

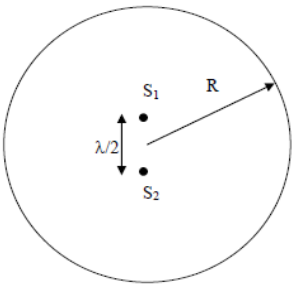
a. 47.7 kHz. b. 33.5 kHz. c. 43.9 kHz.
d. 43.5 kHz. e. 40.0 kHz.

15. Two waves are given by the equations:
$y_1(x, t) = 5.0 \sin(0.25 x + 45 t)$
$y_2(x, t) = 5.0 \sin(0.50 x + 90 t)$

where x and y are in meters and t is in seconds. The intensity ratio of I_1/I_2 of the two waves is:

a. ¼ b. ½ c. ⅛ d. 4 e. 2

16. Two transmitters, S_1 and S_2 shown in the **Figure**, emit identical sound waves of wavelength λ. The transmitters are separated by a distance λ /2. Consider a big circle of radius R with its center halfway between these transmitters. How many interference maxima are there on this big circle?



a. 2. b. 6. c. 8.
d. 5. e. 1.

17. Sound waves are not:

a. transverse waves. b. pressure waves.
c. compression waves. d. longitudinal waves.
e. mechanical waves.

18. A person closes his windows to reduce the street noise from 1.0×10^{-4} W/m^2 to 1.0×10^{-8} W/m^2. What is the change in the intensity level in dB?

a. – 40 b. – 20 c. 40 d. 20 e. – 60

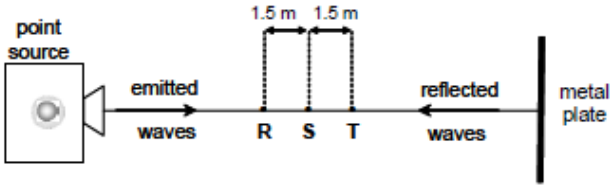
19. A stationary observer hears a frequency of 760 Hz of a whistle of a train moving at a speed of 40 m/s towards him. If the train is moving away with the same speed, then the frequency detected by the observer will be:
[Take the speed of sound in air = 340 m/s].

a. 600 Hz. b. 700 Hz. c. 963 Hz.
d. 500 Hz. e. 540 Hz.

20. Organ pipe A, with both ends open, has a fundamental frequency of 340 Hz and length 0.4 m. The third harmonic of organ pipe B, with one end open, has the same frequency as the second harmonic of pipe A. How long is pipe B?

a. 0.3 m b. 2.0 m c. 1.5 m. d. 0.1 m e. 0.4 m

21. A point source emits sound waves which are reflected from a metal plate with air in between, as shown in the **Figure**. Standing waves are produced in between the source and the plate. If the points R, S and T are three successive



nodes, what is the frequency of the wave? [Speed of sound in air is 342 m/s].

a. 114 Hz b. 158 Hz c. 225 Hz
d. 312 Hz e. Not enough information.

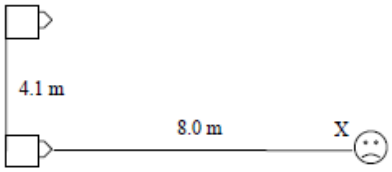
22. An ambulance emits sound with a frequency of 2600 Hz. After passing a motorist driving (in the same direction of the ambulance) with a speed of 5 m/s, the motorist receives the sound with frequency of 2424 Hz. Calculate the speed of the ambulance.
[speed of sound in air is 340 m/s]

a. 30.0 m/s b. 50.0 m/s c. 5.0 m/s.
d. 15.0 m/s e. 1.0 m/s

23. The intensity of sound wave A is 800 times that of sound wave B at a fixed point from both sources. If the sound level of sound A is 110 dB. What is the sound level of wave B:

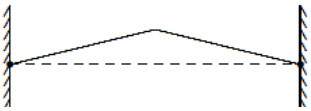
a. 81 dB b. 50 dB c. 73 dB d. 69 dB e. 55 dB

24. In the **Figure**, two small identical speakers are connected (in phase) to the same source. The speakers are 4.10 m apart and at ear level. An observer stands at X, 8.00 m in front of one speaker. In the frequency range 200 Hz-500 Hz, the sound he hears will be most intense if the frequency is: [v_{sound} in air = 343 m/s]



a. 346 Hz. b. 422 Hz. c. 500 Hz.
d. 210 Hz. e. 600 Hz

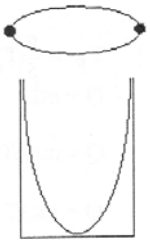
25. A stretched wire of length 0.6 m is clamped at both ends. It is plucked at its center as shown. The two longest wavelengths in the wire are (in meters):



a. 1.2 & 0.4 b. 0.6 & 0.3
c. 1.2 & 0.6 d. 0.6 & 0.4
e. 0.9 & 0.6

26. A plane produces a sonic boom only when:

a. it flies faster than the speed of sound
b. it emits sound waves of very long wavelength
c. it emits sound waves of high frequency
d. it flies at high altitudes
e. it flies on a curved path



27. A tube 1.5 m long is closed at one end. A stretched wire is placed near the open end, see the **Figure**. The wire is 0.33 m long and has a mass of 9.8 g. It is fixed at both ends and vibrates in its fundamental mode. By resonance, it sets the air column in the tube into oscillation at that column's fundamental freq. Find the tension in the wire. [v_{sound} in air = 343 m/s].

a. 42 N b. 77 N c. 98 N d. 30 N e. 64 N.

28. A person is listening to sounds from two different sources simultaneously. One source has sound level of 80.0 dB, while the other has 90.0 dB. What combined sound level will the person hear?

a. 90.4 dB b. 94.0 dB c. 85.3 dB d. 12.0 dB e. 230 dB

29. In Fig. 17-35, sound with a 40.0 cm wavelength travels rightward from a source and through a tube that consists of a straight portion and a half-circle. Part of the sound wave travels through the half-circle and then rejoins the rest of the wave, which goes directly through the straight portion. This rejoining results in interference. What is the smallest radius r that results in an intensity minimum at the detector?

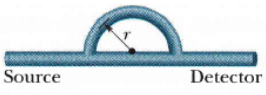


FIG. 17-35 Problem 18.

$\Delta L = \pi r - 2r = \lambda/2 \Rightarrow r = \lambda/2(\pi - 2) = 40/2(\pi - 2) = 17.5$ m