Chapter 17
Waves - II

A man strikes one end of a long steel pipe of length L, filled with water, by a hammer. A detector attached to the other end of the pipe receives two sounds signals, one from the wave that travels through the pipe and the other from the wave that travels through the water. If the time difference between the two wave signals is 0.02 s, what is the length of the pipe? (Speeds of sound in steel and water are V_s = 5940 m/s and V_w = 1480 m/s, respectively).

A) 21 m
B) 30 m
C) 45 m
D) 39 m
E) 18 m

Answer D

M1-042

In a liquid having density 1.30×10^3 kg/m^3, longitudinal waves with frequency of 400 Hz are found to have a wavelength of 8.0 m. Calculate the bulk modulus of the liquid.

A) 3.12×10^6 Pa.
B) 1.33×10^{10} Pa.
C) 9.62×10^7 Pa.
D) 6.64×10^{12} Pa.
E) 1.20×10^{11} Pa.

Answer B

17-5 Interference
M1-072

Two speakers S1 and S2 are placed on the y-axis as shown in figure 1. The speakers are in phase and emit identical sound waves with a given frequency. An observer, standing at point A, hears a sound of maximum intensity. As the observer moves along a straight line parallel to the y-axis and reaches point B, he hears first minimum of sound intensity. The frequency of sound emitted by the speakers is? (speed of sound in air = 343 m/s).

A) 121 Hz
B) 520 Hz
C) 250 Hz
D) 100 Hz
E) 370 Hz

y-axis

12 m

S1

B

3 m

6 m

A

S2
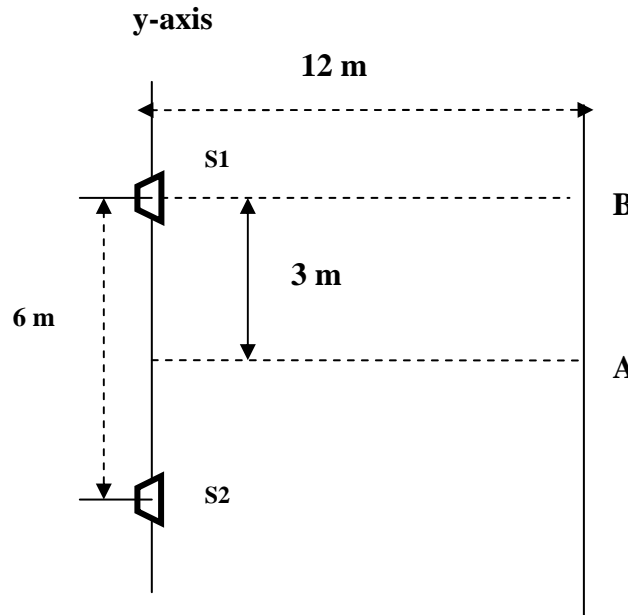
Answer A

In figure 1, two speakers, A and B, are driven by the same oscillator at a frequency of 170 Hz and face each other at a distance of 2.0 m. What is the number of minima along the line joining the two sources? [Consider only the nodes between the two sources.] [Take the speed of sound in air = 340 m/s]
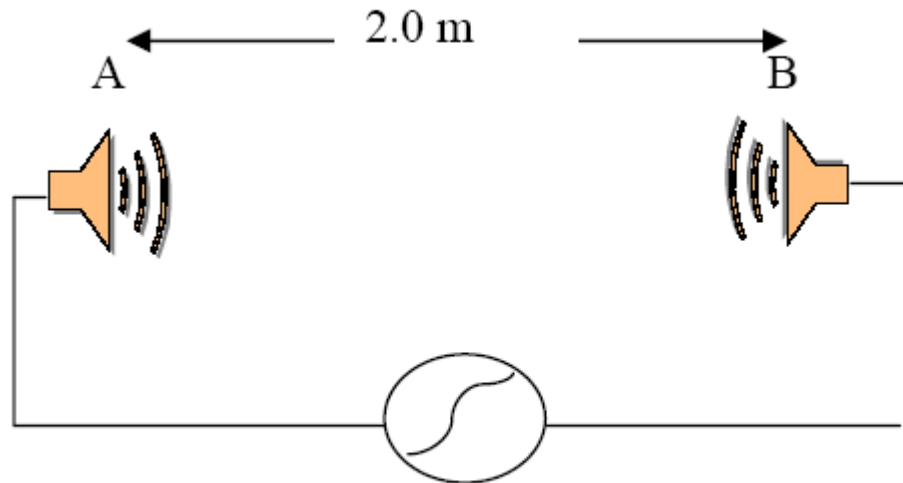
A)4
B)2
C)5
D)1
E)zero

2.0 m

A

B

Figure 1

Answer B

M1-062

A person is listening to sounds from two different sources simultaneously. One source has sound level of 80 dB, while the other has 90 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

Answer A

M1-062

The intensity of a sound wave of frequency 360 Hz is 1.6×10^{-6} W/m^2. If the speed of sound in air is 343 m/s, what is the displacement amplitude of the air molecules oscillation caused by this wave? ($\rho_{air} = 1.21$ kg.m^3).

A) 18 m
B) 1.67×10^{-6} m
C) 8.1×10^{-6} m
D) 8.5×10^{-7} m
E) 3.88×10^{-8} m

Answer E

17-6 Intensity and Sound Level
M1-061

The intensity of a sound wave is 10^{-7} W/m^2 at a distance of 30.0 m from a speaker emitting sound waves at a the frequency of 2.0×10^3 Hz. What is the sound level at a distance of 50.0 m from the speaker?

A) 51 dB
B) 35 dB
C) 46 dB
D) 12 dB
E) 23 dB

Answer C

M1-042

A person is hearing a sound level of 70 dB at a distance of 3.0 m from a point source. Assuming that the sound is emitted isotropically, find the power of the source.

A) 8.6×10^{-6} W.
B) 2.3×10^{-4} W.
C) 1.1×10^{-3} W.
D) 2.9×10^{-5} W.
E) 7.7×10^{-3} W.

Answer C

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)7.3 dB.
B)50 dB.
C)81 dB.
D)690 dB.
E)555 dB.

Answer C

M1-062

A 2.5 m long tube, open at both ends, is filled with a gas. The frequency of a certain harmonic is 500 Hz and the frequency of the next harmonic is 600 Hz. What is the speed of sound in the tube?

A) 999 m/s
B) 400 m/s
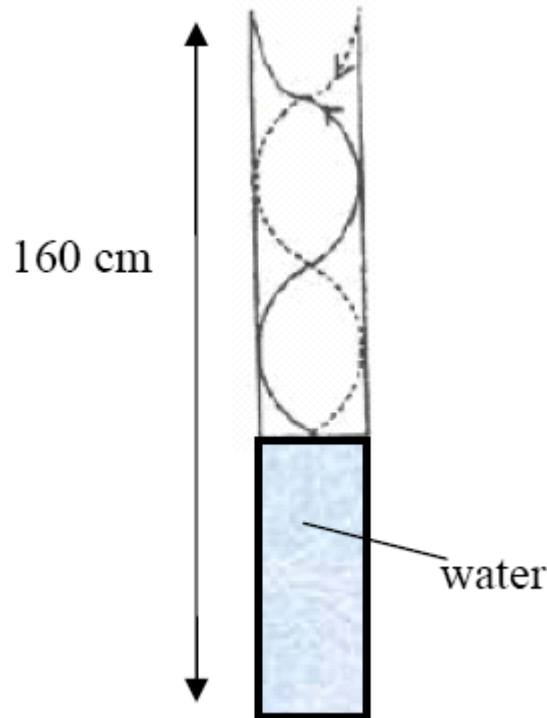C) 336 m/s
D) 500 m/s
E) 343 m/s

Answer D

17-7 Sources of Musical Sound (Sound Waves Resonances)
M1-061

Sound waves of frequency 340 Hz are sent into the top of a vertical tube containing water, as shown in the figure. If standing waves are produced, as shown, what is the height level of the water?. [Speed of sound in air = 340 m/s]

A) 1.2 m
B) 35 cm
C) 25 cm
D) 55 cm
E) 1.6 m

160 cm

water

Answer B

The frequency of the fundamental mode of a sound wave in a 30.0 cm long tube closed at one end is 256 Hz. When the tube length is shortened to 12.0 cm, what is the new fundamental frequency?

A) 102 Hz.
B) 162 Hz.
C) 416 Hz.
D) 256 Hz.
E) 640 Hz.

Answer E

Two pipes have the same length L. Pipe B open at one end and closed at the other, while pipe A open both ends. Which harmonic of pipe B matches the second harmonic of pipe A?

A) The fundamental.
B) The fourth.
C) The second.
D) Never match.
E) One needs to know the exact length.

Answer D

In figure 4, 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: [speed of sound in air is 343 m/s]

A) 346 Hz.
B) 422 Hz.
C) 500 Hz.
D) 210 Hz.
E) 600 Hz.

Figure 4

4.1 m

8.0 m

X
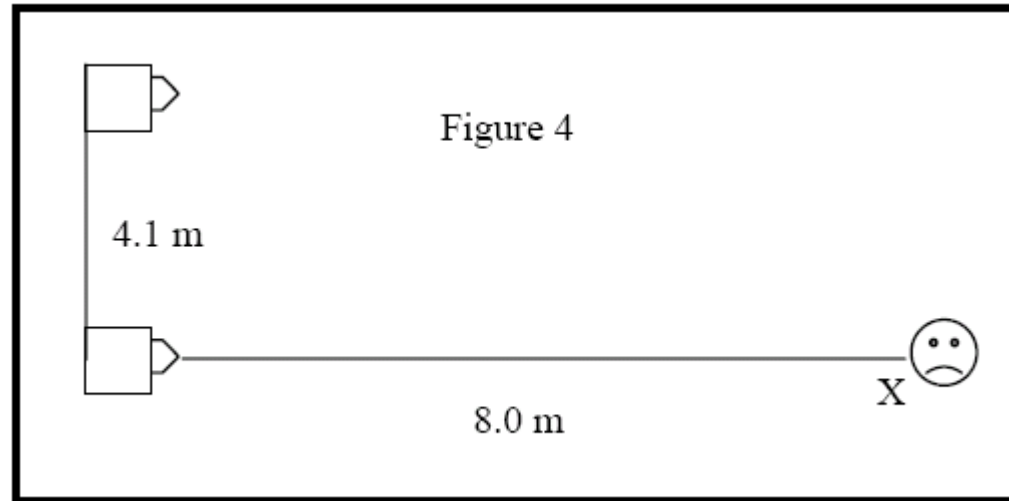
Answer A

M1-062

Two trucks are heading straight toward each other with the same speed "U". The horn of one, with frequency f = 3000 Hz, is blowing, and is heard to have a frequency of 3200 Hz by the people in the other truck. Find "U" if the speed of sound is 340 m/s.

A) 20 m/s
B) 14 m/s
C) 31 m/s
D) 25 m/s
E) 11 m/s

Answer E

M1-061

A truck emits sound with a frequency of 620 Hz. A person is riding a bike that moves at a speed of 3.0 m/s and is following the truck. If the person hears a frequency of 560 Hz, how fast is the truck moving? (Take the speed of sound in air as 343 m/s).

A) 40 m/s
B) 35 m/s
C) 50 m/s
D) 25 m/s
E) 20 m/s

Answer A

M1-042

An ambulance emits sound of frequency 300 Hz and is moving with a speed of 45.0 m/s away from a moving car. If the car is moving towards the ambulance with a speed of 15.0 m/s, what frequency does a person in the car hear? [The speed of sound in air is 343 m/s].

A) 300 Hz.
B) 333 Hz.
C) 277 Hz.
D) 370 Hz.
E) 250 Hz.

Answer C

M1-041

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)5.0 m/s.
B)50.0 m/s.
C)30.0 m/s.
D)15.0 m/s.
E)1.0 m/s.

Answer C