WAVES – II

The speed of a sound wave is determined by:

its amplitude
its intensity
its pitch
number of harmonics present
the transmitting medium
ans: E

Take the speed of sound to be 340 m/s. A thunder clap is heard about 3 s after the lightning is seen. The source of both light and sound is:

moving overhead faster than the speed of sound
emitting a much higher frequency than is heard
emitting a much lower frequency than is heard
about 1000 m away
much more than 1000 m
away ans: D

A sound wave has a wavelength of 3.0 m. The distance from a compression center to the adjacent rarefaction center is:

0.75 m
1.5 m
3.0 m
need to know wave speed
need to know
frequency ans: B

A fire whistle emits a tone of 170 Hz. Take the speed of sound in air to be 340 m/s. The wavelength of this sound is about:

0.5 m
1.0 m
2.0 m
3.0 m
340 m
ans: C

During a time interval of exactly one period of vibration of a tuning fork, the emitted sound travels a distance:

equal to the length of the tuning fork
equal to twice the length of the tuning fork
of about 330 m
which decreases with time
of one wavelength in
air ans: E

At points in a sound wave where the gas is maximally compressed, the pressure

is a maximum
is a minimum
is equal to the ambient value
is greater than the ambient value but less than the maximum
is less than the ambient value but greater than the minimum
ans: A

You are listening to an “A” note played on a violin string. Let the subscript “s” refer to the violin string and “a” refer to the air. Then:

$f_s = f_a$ but $\lambda_s = \lambda_a$
$f_s = f_a$ and $\lambda_s = \lambda_a$
$\lambda_s = \lambda_a$ but $f_s = f_a$
$\lambda_s = \lambda_a$ and $f_s = f_a$
linear density of string = volume density of air
ans: A

“Beats” in sound refer to:

interference of two waves of the same frequency
combination of two waves of slightly different requency
reversal of phase of reflected wave relative to incident wave
two media having slightly different sound v locities
effect of relative motion of source a d
observer ans: B

To produce beats it is necessary to use two waves:

traveling in opposite directio s
of slightly different frequencies
of equal wavelengths
of equal amplitudes
whose ratio of frequencies is n
integer ans: B

10. In order for two sound aves to produce audible beats, it is essential that the two waves have:

the same amplitude
the same frequency
the same number of harmonics
slightly different amplitudes
slightly different
frequencies ans: E

The largest number of beats per second will be heard from which pair of tuning forks?

200 and 201 Hz
256 and 260 Hz
534 and 540 Hz
763 and 774 Hz
8420 and 8422
Hz ans: D

Two stationary tuning forks (350 and 352 Hz) are struck simultaneously. The resulting sound is observed to:

beat with a frequency of 2 beats/s
beat with a frequency of 351 beats/s
be loud but not beat
be Doppler shifted by 2 Hz
have a frequency of 702
Hz ans: A

When listening to tuning forks of frequency 256 Hz and 260 Hz, one hears the following number of beats per second:

zero
2
4
8
258
ans: C

Two identical tuning forks vibrate at 256 Hz. One of them is then loaded with a drop of wax, after which 6 beats/s are heard. The period of the loaded tuning fork is:

0.006 s
0.005 s
0.004 s
0.003 s
none of
these ans: C

Which of the follo ing properties of a sound wave determine its "pitch"?

Amplitude
Distance from source to detector
Frequency
Phase
Speed
ans: C

Two notes are an “octave” apart. The ratio of their frequencies is:

8
10
$\sqrt{8}$
2
$\sqrt{2}$
ans: D

Consider two imaginary spherical surfaces with different radii, each centered on a point sound source emitting spherical waves. The power transmitted across the larger sphere i~~s the~~ power transmitted across the smaller and the intensity at a point on the larger sphere i~~s the~~ intensity at a point on the smaller.

greater than, the same as
greater than, greater than
greater than, less than
the same as, less than
the same as, the same
as ans: D

The sound intensity 5.0 m from a point source is 0.50 W/m^2. The power output of the source is:

39 W
160 W
266 W
320 W
390 W
ans: B

The standard reference sound level is about:

the threshold of human hearing at 1000 Hz
the threshold of pain for human hearing at 1000 Hz
the level of sound produced when the 1 kg standard mass is dropped 1 m onto a concrete floor
the level of normal conversation
the level of sound emitted by a standard 60 Hz tuning
fork ans: A

The intensity of sound ave A is 100 times that of sound wave B. Relative to wave B the sound level of wave A is:

−2 db
+2 db
+10 db
+20 db
+100 db
ans: D

The intensity of a certain sound wave is 6 µW/cm^2. If its intensity is raised by 10 db, the new intensity (in µW/cm^2) is:

60
6.6
6.06
600
12
ans: A

If the sound level is increased by 10 db the intensity increases by a factor of:

2
5
10
20
100
ans: C

The sound level at a point P is 14 db below the sound l v l at a point 1.0 m from a point source. The distance from the source to point P is:

4.0 cm
20 2m
2.0 m
5.0 m
25 m
ans: D

To raise the pitch of a certain pia o stri g, the piano tuner:

loosens the string
tightens the string
shortens the string
lengthens the string
removes some
mass ans: B

A piano wire has length L and mass M. If its fundamental frequency is f, its tension is:

2Lf /m
4M Lf
2M f^2/L
$4f^2L^3$/M
4LM f^2
ans: E

If the length of a piano wire (of given density) is increased by 5%, what approximate change in tension is necessary to keep its fundamental frequency unchanged?

Decrease of 10%
Decrease of 5%
Increase of 5%
Increase of 10%
Increase of 20%
ans: C

A piano wire has a length of 81 cm and a mass of 2.0 g. If its funda ental frequency is to be 394 Hz, its tension must be:

0.32 N
63 N
130 N
250 N
none of
these ans: B

A stretched wire of length 1.0 m is clamped at both ends. It is plucked at its center as shown. The three longest wavelengths in the wire are (in meters):

4,2,1
2, 1, 0.5
2, 0.67, 0.4
1, 0.5, 0.33
1, 0.67,
0.5 ans: C

Two identical strings, A and B, have nearly the same tension. When they both vibrate in their fundamental resonant modes, there is a beat frequency of 3 Hz. When string B is tightened slightly, to increase the tension, the beat frequency becomes 6 Hz. This means:

that before tightening A had a higher frequency than B, but after tightening, B has a higher frequency than A
that before tightening B had a higher frequency than A, but after tightening, A has a higher frequency than B
that before and after tightening A has a higher frequency than B
that before and after tightening B has a higher frequency than A
none of the
above ans: D

Two pipes are each open at one end and closed at the other. Pipe A has length L and pipe B has length 2L. Which harmonic of pipe B matches in frequency the fundamental of pipe A?

The fundamental
The second
The third
The fourth
There are
none ans: E

A column of argon is open at one end and closed at the other. The shortest length of such a column that will resonate with a 200 Hz tuning fork is 42.5 cm. The speed of sound in argon must be:

85.0 m/s
170 m/s
340 m/s
470 m/s
940 m/s
ans: C

A tuning fork produces sound waves of wavelength λ in air. This sound is used to cause resonance in an air column, closed at one end and open at the other. The length of this column CANNOT be:

λ/4
2λ/4
3λ/4
5λ/4
7λ/4
ans: B

A 1024 Hz tuning fork is used to obtain a series of resonance levels in a gas column of variable length, with one end closed and the other open. The length of the column changes by 20 cm from resonance to resonance. From this data, the speed of sound in this gas is:

20 cm/s
51 cm/s
102 cm/s
205 m/s
410 m/s
ans: E

A vibrating tuning fork is held over a water column with one end closed and the other open. As the water level is allowed to fall, a loud sound is heard for water levels separated by 17 cm. If the speed of sound in air is 340 m/s, the frequency of the tuning fork is:

500 Hz
1000 Hz
2000 Hz
5780 Hz
578, 000
Hz ans: B

An organ pipe with one end open and the other closed is operating at one of its resonant frequencies. The open and closed ends are respectively:

pressure node, pressure node
pressure node, displacement node
displacement antinode, pressure node
displacement node, displacement node
pressure antinode, pressure
node ans: B

An organ pipe with one end closed and the other open has length L. Its fundamental frequency is proportional to:

L
1/L
$1/L^2$
L^2
$\sqrt{L}$
ans: B

Five organ pipes are described below. Which one has the highest frequency fundamental?

A 2.3-m pipe with one end open and the other closed
A 3.3-m pipe with one end open and the oth r closed
A 1.6-m pipe with both ends open
A 3.0-m pipe with both ends open
E. A pipe in which the displacement odes are 5 m apart
ans: C

If the speed of sound is 340 m/s, the le gth of the shortest closed pipe that resonates at 218 Hz is:

23 cm
17 cm
39 cm
78 cm
1.56 cm
ans: C

The lowest tone produced by a certain organ comes from a 3.0-m pipe with both ends open. If the speed of sound is 340 m/s, the frequency of this tone is approximately:

7 Hz
14 Hz
28 Hz
57 Hz
70 Hz
ans: D

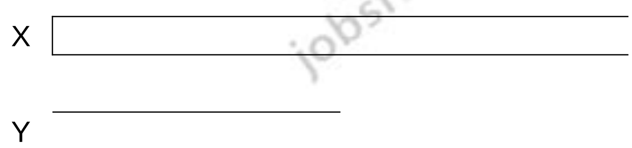
The speed of sound in air is 340 m/s. The length of the shortest pipe, closed at one end, that will respond to a 512 Hz tuning fork is approximately:

4.2 cm
9.4 cm
17 cm
33 cm
66 cm
ans: C

If the speed of sound is 340 m/s, the two lowest frequencies of an 0.5-m organ pipe, closed at one end, are approximately:

170 and 340 Hz
170 and 510 Hz
340 and 680 Hz
340 and 1020 Hz
57 and 170
Hz ans: B

Organ pipe Y (open at both ends) is half as long as organ pipe X (open at one end) as shown. The ratio of their fundamental frequencies f_X: $_Y$ is:



1:1
1:2
2:1
1:4
4:1
ans: A

A 200-cm organ pipe with one end open is in resonance with a sound wave of wavelength 270 cm. The pipe is operating in its:

fundamental frequency
second harmonic
third harmonic
fourth harmonic
fifth harmonic
ans: B

An organ pipe with both ends open is 0.85 m long. Assuming that the speed of sound is 340 m/s, the frequency of the third harmonic of this pipe is:

200 Hz
300 Hz
400 Hz
600 Hz
none of
these ans: D

The “A” on a trumpet and a clarinet have the same pitch, but the two are clearly distinguishable. Which property is most important in enabling one to distinguish between these two instruments?

Intensity
Fundamental frequency
Displacement amplitude
Pressure amplitude
Harmonic
content ans: E

The valves of a trumpet and the slide of a trombone are for the purpose of:

playing short (staccato) notes
tuning the instruments
changing the harmonic content
changing the length of the air column
producing gradations in
loudness ans: D

Two small identical speakers are c nnected (in phase) to the same source. The speakers are 3 m apart and at ear level. An bserver stands at X, 4 m in front of one speaker as shown. If the amplitudes are not changed, the sound he hears will be most intense if the wavelength is:

1 m
2 m
3 m
4 m
5 m
ans: A

Two small identical speakers are connected (in phase) to the same source. The speakers are 3 m apart and at ear level. An observer stands at X, 4 m in front of one speaker as shown. The sound she hears will be most intense if the wavelength is:

5 m
4 m
3 m
2 m
1 m
ans: E

The rise in pitch of an approaching siren is an apparent increase in its:

speed
amplitude
frequency
wavelength
number of harmonics ans: C

The diagram shows four situati ns in which a source of sound S with variable frequency and a detector D are either moving or stationary. The arrows indicate the directions of motion. The speeds are all the same. Detector 3 is stationary. The frequency detected is the same. Rank the situations according to the frequency of the source, lowest to highest.

1,2,3,4
4,3,2,1
1,3,4,2
2,1,2,3
None of the above ans: B

A stationary source generates 5.0 Hz water waves whose speed is 2.0 m/s. A boat is approaching the source at 10 m/s. The frequency of these waves, as observed by a person in the boat, is:

5.0 Hz
15 Hz
20 Hz
25 Hz
30 Hz
ans: E

A stationary source S generates circular outgoing waves on a lake. The wave speed is 5.0 m/s and the crest-to-crest distance is 2.0 m. A person in a motor boat heads directly toward S at 3.0 m/s. To this person, the frequency of these waves is:

1.0 Hz
1.5 Hz
2.0 Hz
4.0 Hz
8.0 Hz
ans: D

A stationary source emits a sound wave of equency f. If it were possible for a man to travel toward the source at the speed of sound, he would observe the emitted sound to have a frequency of:

zero
f /2
2f /3
2f
infinity
ans: D

A source emits sound with a frequency of 1000 Hz. It and an observer are moving in the same direction with the same speed, 100 m/s. If the speed of sound is 340 m/s, the observer hears sound with a frequency of:

294 Hz
545 Hz
1000 Hz
1830 Hz
3400 Hz
ans: C

A source emits sound with a frequency of 1000 Hz. It and an observer are moving toward each other, each with a speed of 100 m/s. If the speed of sound is 340 m/s, the observer hears sound with a frequency of:

294 Hz
545 Hz
1000 Hz
1830 Hz
3400 Hz
ans: D

A source emits sound with a frequency of 1000 Hz. It is moving at 20 m/s toward a stationary reflecting wall. If the speed of sound is 340 m/s an observer at rest directly behind the source hears a beat frequency of:

11 Hz
86 Hz
97 Hz
118 Hz
183 Hz
ans: D

In each of the following two situations a source emits sound with a frequency of 1000 Hz. In situation I the source is moving at 100 m/s toward an observer at rest. In situation II the observer is moving at 100 m/s toward the source, which is stationary. The speed of sound is 340 m/s. The frequencies heard by the observers in the two situations are:

I: 1417 Hz; II: 1294 Hz
I: 1417 Hz; II: 1417 Hz
I: 1294 Hz; II: 1294 Hz
I: 773 Hz; II: 706 Hz
I: 773 Hz; II: 773 Hz
ans: A

The Doppler shift formula for the frequency d t cted is

$$= f \frac{v \pm v_D}{v \mp v_S},$$

where f is the frequency emitted, v is the speed of sound, v_D is the speed of the detector, and v_S is the speed of the source. Suppose the source is traveling at 5 m/s away from the detector, the detector is traveling at 7 m/s t ward the source, and there is a 3-m/s wind blowing from the source toward the detector. The values that should be substituted into the Doppler shift equation are:

v_D = 7 m/s and v_S = 5 m/s
v_D = 10 m/s and v_S = 8 m/s
v_D = 4 m/s and v_S = 2 m/s
v_D = 10 m/s and v_S = 2 m/s
v_D = 4 m/s and v_S = 8 m/s
ans: B

A plane produces a sonic boom only when:

A. it emits sound aves of very long wavelength
B. it emits sound aves of high frequency
it flys at high altitudes
it flys on a curved path
it flys faster than the speed of
sound ans: E

If the speed of sound is 340 m/s a plane flying at 400 m/s creates a conical shock wave with an apex half angle of:

0 (no shock wave)
32°
40°
50°
58   Anc E

The speed of sound is 340 m/s. A plane flys horizontally at an altitude of 10, 000 m and a speed of 400 m/s. When an observer on the ground hears the sonic boom the horizontal distance from the point on its path directly above the observer to the plane is:

5800 m
6200 m
8400 m
12, 000 m
16000 m   ANS: B