Name: _____ Date: _____

1. 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:

   A) 200 Hz
   B) 300 Hz
   C) 400 Hz
   D) 600 Hz
   E) none of these

2. "Beats" in sound refer to:

   A) interference of two waves of the same frequency
   B) combination of two waves of slightly different frequency
   C) reversal of phase of reflected wave relative to incident wave
   D) two media having slightly different sound velocities
   E) effect of relative motion of source and observer

3. 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:

   A) 7 Hz
   B) 14 Hz
   C) 28 Hz
   D) 57 Hz
   E) 70 Hz

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

   A) 23 cm
   B) 17 cm
   C) 39 cm
   D) 78 cm
   E) 1.56 cm

Write the letter for the correct answer on the answer sheet. Write clearly.

5. 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:

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

6. A source emits sound with a frequency of 1000 Hz. Both 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:

   A) 294 Hz
   B) 545 Hz
   C) 1000 Hz
   D) 1830 Hz
   E) 3400 Hz

7. 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:

   A) 500 Hz
   B) 1000 Hz
   C) 2000 Hz
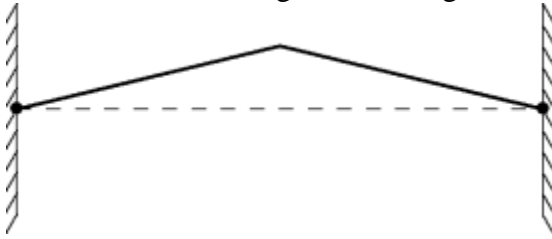   **D)** 5780 Hz
   E) 578,000 Hz

8. 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:f_Y is:

X

Y

A) 1:1
B) 1:2
C) 2:1
D) 1:4
E) 4:1

9. 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:

A) 20 cm/s
B) 51 cm/s
C) 102 cm/s
D) 205 m/s
E) 410 m/s

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

A) L
B) $1/L$
C) $1/L^2$
D) L^2
E) $\sqrt{L}$

Write the letter for the correct answer on the answer sheet. Write clearly.

11. 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:

A) 4, 2, 1 m
B) 2, 1, 0.5 m
C) 2, 0.67, 0.4 m
D) 1, 0.5, 0.33 m
E) 1, 0.67, 0.5 m

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

A) 0.32 N
B) 63 N
C) 130 N
D) 250 N
E) none of these

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

A) beat with a frequency of 2 beats/s
B) beat with a frequency of 351 beats/s
C) be loud but not beat
D) be Doppler shifted by 2 Hz
E) have a frequency of 702 Hz

14. 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:

A) 170 and 340 Hz
B) 170 and 510 Hz
C) 340 and 680 Hz
D) 340 and 1020 Hz
E) 57 and 170 Hz

Write the letter for the correct answer on the answer sheet. Write clearly.

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

A) 2
B) 5
C) 10
D) 20
E) 100

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

A) 0.75 m
B) 1.5 m
C) 3.0 m
D) need to know wave speed
E) need to know frequency

17. 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:

A) 294 Hz
B) 545 Hz
C) 1000 Hz
D) 1830 Hz
E) 3400 Hz

18. 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 is _____ the power transmitted across the smaller and the intensity at a point on the larger sphere is _____ the intensity at a point on the smaller.

A) greater than, the same as
B) greater than, greater than
C) greater than, less than
D) the same as, less than
E) the same as, the same as

Write the letter for the correct answer on the answer sheet. Write clearly.

19. 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:

A) 0.006 s
B) 0.005 s
C) 0.004 s
D) 0.003 s
E) none of these

20. 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:

A) I: 1417 Hz; II: 1294 Hz
B) I: 1417 Hz; II: 1417 Hz
C) I: 1294 Hz; II: 1294 Hz
D) I: 773 Hz; II: 706 Hz
E) I: 773 Hz; II: 773 Hz

21. Two notes are an "octave" apart. The ratio of their frequencies is:

A) 8
B) 10
C) $\sqrt{8}$
D) 2
E) $\sqrt{2}$

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

A) zero
B) 2
C) 4
D) 8
E) 258

Write the letter for the correct answer on the answer sheet. Write clearly.

23. 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:

A) $\lambda/4$
B) $2\lambda/4$
C) $3\lambda/4$
D) $5\lambda/4$
E) $7\lambda/4$

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

A) is a maximum
B) is a minimum
C) is equal to the ambient value
D) is greater than the ambient value but less than the maximum
E) is less than the ambient value but greater than the minimum

25. The standard reference sound level is about:

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

Answer Key

1. D
2. B
3. D
4. C
5. D
6. D
7. B
8. A
9. E
10. B
11. C
12. B
13. A
14. B
15. C
16. B
17. C
18. D
19. C
20. A
21. D
22. C
23. B
24. A
25. A

Write the letter for the correct answer on the answer sheet. Write clearly.