Sound & Waves PT

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 1. Sound waves are produced by
a. radio stations.
b. vibrating objects.
c. soft objects.
d. objects under pressure.
e. none of the above

____ 2. Sound waves in air are a series of
a. periodic disturbances.
b. periodic condensations and rarefactions.
c. high- and low-pressure regions.
d. all of the above
e. none of the above

____ 3. Which of the following would be most likely to transmit sound with the highest speed?
a. Steel in a bridge
b. Wood in a cabinet
c. Water in the ocean
d. Water in a swimming pool
e. Air in your classroom

____ 4. A sound wave is a
a. standing wave.
b. longitudinal wave.
c. transverse wave.
d. shock wave.
e. none of the above

____ 5. The speed of a sound wave depends on
a. the air temperature.
b. its frequency.
c. its wavelength.
d. all of the above
e. none of the above

____ 6. A tuning fork of frequency 300 Hz will resonate if a sound wave incident on it has a frequency of
a. 150 Hz.
b. 600 Hz.
c. both A and B
d. none of the above

____ 7. In which one of the following does sound travel the fastest?
a. Water
b. Ice
c. Steam
d. Sound travels at the same speed in all of the above.

____ 8. An explosion occurs 340 km away. Given that sound travels at 340 m/s, the time the sound takes to reach you is
   a. 1 s.
   b. 10 s.
   c. 100 s.
   d. 200 s.
   e. more than 200 s.

____ 9. The Tacoma Narrows Bridge collapsed due to
   a. resonance.
   b. frequency modulation.
   c. beats.
   d. destructive interference.

____ 10. A general rule for estimating the distance in kilometers between an observer and a lightning bolt is to count the number of seconds between seeing and hearing the bolt, and divide by
   a. 2.
   b. 3.
   c. 4.
   d. 5.
   e. none of the above

____ 11. Compared to a sound of 10 decibels, a sound of 50 decibels has
   a. 40 times the intensity.
   b. 400 times the intensity.
   c. 10,000 times the intensity.

____ 12. Beats are produced when two tuning forks, one of frequency 240 Hz and the other of frequency 248 Hz, are sounded together. The frequency of the beats is
   a. 8 Hz.
   b. 16 Hz.
   c. 240 Hz.
   d. 247 Hz.
   e. none of the above

____ 13. Two whistles produce sounds of wavelengths 3.4 m and 3.2 m. What is the beat frequency produced?
   a. 0.2 Hz
   b. 2.0 Hz
   c. 4.0 Hz
   d. 6.3 Hz
   e. 8.3 Hz

____ 14. Suppose you sound a tuning fork at the same time you hit a 1053-Hz note on the piano and hear 3 beats/sec. You tighten the piano string very slightly and now hear 4 beats/sec. What is the frequency of the tuning fork?
   a. 1049 Hz
   b. 1050 Hz
   c. 1053 Hz
   d. 1056 Hz
   e. 1057 Hz

____ 15. A sound wave that has a wavelength of 2 m in room-temperature air has a frequency of about
   a. 170 Hz.
   b. 1360 Hz.

c. 2040 Hz.
d. none of the above

____ 16. You are water-skiing on a lake, and you are being pulled by a noisy motorboat. Another motor boat is speeding through the water a bit ahead of your boat so that rarefactions from its motor hit you when compressions from your boat's motor hit you. You hear
a. almost nothing due to constructive interference.
b. almost nothing due to destructive interference.
c. louder noise than if you were only listening to one boat.
d. louder noise than if you were only listening to two boats.

____ 17. The time needed for a wave to make one complete cycle is its
a. frequency.
b. velocity.
c. amplitude.
d. period.
e. wavelength.

____ 18. The distance between successive identical parts of a wave is called its
a. frequency.
b. period.
c. velocity.
d. amplitude.
e. wavelength.

____ 19. The Hertz is a
a. special radio wave.
b. type of car.
c. unit of period.
d. unit of wavelength.
e. unit of frequency.

____ 20. A wave created by shaking a rope up and down is called a
a. Doppler wave.
b. standing wave.
c. longitudinal wave.
d. constructive wave.
e. transverse wave.

____ 21. Sound is an example of a
a. longitudinal wave.
b. constructive wave.
c. Doppler wave.
d. transverse wave.
e. standing wave.

____ 22. A longitudinal wave lacks which of the following properties?
a. speed.
b. frequency.
c. wavelength.
d. amplitude.
e. A longitudinal wave has all of the above.

____ 23. As the sound of a car's horn passes and recedes from you, the pitch of the horn seems to
a. increase.
b. stay the same.
c. decrease.

____ 24. When a sound source moves towards you, what happens to the wave speed?
a. It decreases.
b. It increases.
c. It stays the same.

____ 25. The amplitude of a particular wave is 4.0 m. The top-to-bottom distance of the disturbance is
a. 2.0 m.
b. 4.0 m.
c. 8.0 m.
d. none of the above

____ 26. When a pendulum clock is taken from sea level to the top of a high mountain, it will
a. neither lose nor gain time.
b. gain time.
c. lose time.

____ 27. During a single period, the distance traveled by a wave is
a. two wavelengths.
b. one wavelength.
c. one half wavelength.

____ 28. A child swings back and forth on a playground swing. If the child stands rather than sits, the time for a to-and-fro swing is
a. unchanged.
b. lengthened.
c. shortened.

____ 29. A horse would be able to run faster if most of the mass in its legs were concentrated
a. in the upper part, nearer the horse's body.
b. halfway up its legs.
c. toward its feet.
d. uniformly all along its legs.
e. none of the above

____ 30. What happens when an airplane is flying faster than the speed of sound?
a. There is no sonic boom.
b. It becomes very quiet inside the plane.
c. Nobody can hear the plane fly overhead.
d. A shock wave is produced.
e. none of the above

____ 31. An observer on the ground hears a sonic boom that is created by an airplane flying at a speed
a. equal to the speed of sound.
b. greater than the speed of sound.
c. just below the speed of sound.
d. none of the above

____ 32. The Doppler effect occurs when a source of sound moves

a. away from you.
b. toward you.
c. both A and B
d. none of the above

____ 33. The frequency of the second hand on a clock is
a. $\frac{1}{60}$ hertz.
b. 1 hertz.
c. 60 hertz.

____ 34. Two waves arrive at the same place at the same time exactly in step with each other. Each wave has an amplitude of 2.5 m. The resulting wave has an amplitude of
a. 0.6 m.
b. 1.3 m.
c. 2.5 m.
d. 5.0 m.
e. 10.0 m.

____ 35. A certain ocean wave has a frequency of 0.07 hertz and a wavelength of 10 meters. What is the wave's speed?
a. 0.07 m/s
b. 0.70 m/s
c. 1.0 m/s
d. 10 m/s
e. 143 m/s

____ 36. A cork floating in a pool oscillates up and down three complete cycles in 1 second as a wave passes by. The wave's wavelength is 2 meters. What is the wave's speed?
a. 1 m/s
b. 2 m/s
c. 6 m/s
d. 12 m/s
e. More than 12 m/s

____ 37. A wave travels an average distance of 6 meters in 3 seconds. What is the wave's velocity?
a. Less than 0.5 m/s
b. 3 m/s
c. 1 m/s
d. 2 m/s
e. More than 2 m/s

____ 38. A wave has two crests and two troughs each second. If the wave travels an average distance of 8 meters in 4 seconds, its wavelength is
a. 20 m.
b. 15 m.
c. 10 m.
d. 1 m.
e. 0 m.

____ 39. Radio waves travel at the speed of light, 300,000 km/s. The wavelength of a radio wave received at 200 megahertz is
a. 0.7 m.
b. 1.5 m.

c. 6.7 m.
d. 15 m.

____ 40. A skipper on a boat notices wave crests passing the anchor chain every 6.0 seconds. The skipper estimates the distance between crests at 30.0 m. What is the speed of the water waves?
a. 5.0 m/s
b. 6.0 m/s
c. 30.0 m/s
d. not enough information given

True/False
Indicate whether the statement is true or false.

____ 41. When an object is forced to vibrate at its natural frequency, resonance occurs.

____ 42. Sound can travel through solids, liquids, gases, and even a vacuum.

____ 43. In order for sound from a speaker to reach a listener, air near the speaker must travel to the listener.

____ 44. Almost everything that exists has a natural frequency.

____ 45. Even a steel bridge can collapse because of resonance.

____ 46. The word "pitch" refers to the period of a sound wave.

____ 47. If you strike a tuning fork and hold it on a table, the sound becomes relatively loud.

____ 48. When an object is forced to vibrate at its natural frequency, its vibration amplitude increases.

____ 49. The time for a complete to and fro swing of a pendulum is its frequency.

____ 50. The amplitude of a wave is the vertical distance from the midpoint to either the crest or the trough of the wave.

____ 51. The distance between successive identical parts of a wave is its displacement.

____ 52. The number of times a wave vibrates each second is its period.

____ 53. A wave on a rope whose motion is at right angles to the direction of wave propagation is a longitudinal wave.

____ 54. Sound waves are examples of longitudinal waves.

____ 55. When the high part of one wave fills in the low part of another wave, constructive interference occurs.

____ 56. Nodes in a standing wave normally remain stationary.

____ 57. Galaxies show a red shift in their spectrums.

____ 58. We hear a sonic boom just at the moment a supersonic plane flies directly overhead.

____ 59. As a train sounding a horn goes away from you, both the sound speed and the pitch of the horn fall.

____ 60. As a light source is coming towards you, you see light of a frequency higher than the source it emits.

Essay

61. What is resonance and what conditions cause it? Give examples.

62. Write a short paragraph on beats and how they are produced. Give examples.

63. What is the difference between a transverse wave and a longitudinal wave? Give examples of each.

64. What is a standing wave? A node? An antinode?

65. What is the Doppler effect? How does it work? If a star looks bluer to us than it should, is the star moving away from us or toward us? Explain.

Problem

66. If you wished to produce a sound with a wavelength in air equal to the length of a 5-m room, what would its frequency be?

67. You note a 2.0-second delay for an echo in a canyon. What is the distance to the wall of the canyon?

68. Ten violins produce a sound intensity level of 50 dB in a concert hall. How many violins are needed in the hall to produce a level of 60 dB?

69. What beat frequency is produced by two tuning forks that vibrate simultaneously with frequencies 300 Hz and 311 Hz?

70. A supersonic aircraft produces a shock wave that describes a 30° cone. What happens to the angle of the cone as the aircraft travels faster?

Sound & Waves PT
Answer Section

MULTIPLE CHOICE

1. ANS: B PTS: 1 DIF: L1 OBJ: 26.1 The Origin Of Sound
   STA: Ph.V.1.f KEY: sound | vibration BLM: knowledge
2. ANS: D PTS: 1 DIF: L2 OBJ: 26.2 Sound In Air
   KEY: sound | pressure | disturbance BLM: comprehension
3. ANS: A PTS: 1 DIF: L2 OBJ: 26.3 Media That Transmit Sound
   KEY: sound | speed BLM: comprehension
4. ANS: B PTS: 1 DIF: L1 OBJ: 26.1 The Origin Of Sound
   STA: Ph.V.1.f KEY: longitudinal | wave BLM: knowledge
5. ANS: A PTS: 1 DIF: L1 OBJ: 26.4 Speed Of Sound
   KEY: speed | temperature BLM: knowledge
6. ANS: A PTS: 1 DIF: L2 OBJ: 26.8 Resonance
   KEY: fork | resonate | frequency BLM: application
7. ANS: B PTS: 1 DIF: L2 OBJ: 26.4 Speed Of Sound
   KEY: speed | medium | sound BLM: comprehension
8. ANS: E PTS: 1 DIF: L2 OBJ: 26.4 Speed Of Sound
   KEY: time | distance BLM: application
9. ANS: A PTS: 1 DIF: L1 OBJ: 26.8 Resonance
   KEY: Tacoma | resonance BLM: knowledge
10. ANS: B PTS: 1 DIF: L1 OBJ: 26.4 Speed Of Sound
    KEY: estimate | lightning BLM: knowledge
11. ANS: C PTS: 1 DIF: L2 OBJ: 26.5 Loudness
    KEY: sound | decibel BLM: comprehension
12. ANS: A PTS: 1 DIF: L2 OBJ: 26.1 The Origin Of Sound
    STA: Ph.V.1.f KEY: beats | tuning fork BLM: application
13. ANS: D PTS: 1 DIF: L2 OBJ: 26.1 The Origin Of Sound
    STA: Ph.V.1.f KEY: wavelength | frequency BLM: application
14. ANS: B PTS: 1 DIF: L2 OBJ: 26.1 The Origin Of Sound
    STA: Ph.V.1.f KEY: tuning fork | frequency BLM: application
15. ANS: A PTS: 1 DIF: L2 OBJ: 26.4 Speed Of Sound
    KEY: frequency | wavelength BLM: application
16. ANS: B PTS: 1 DIF: L2 OBJ: 26.9 Interference
    KEY: interference | constructive interference | destructive interference
    BLM: application
17. ANS: D PTS: 1 DIF: L1 OBJ: 25.1 Vibration Of A Pendulum
    KEY: time | period BLM: knowledge
18. ANS: E PTS: 1 DIF: L1 OBJ: 25.2 Wave Description
    STA: Ph.V.1.a KEY: distance | wavelength BLM: knowledge
19. ANS: E PTS: 1 DIF: L1 OBJ: 25.2 Wave Description
    STA: Ph.V.1.a KEY: Hertz | unit BLM: knowledge
20. ANS: E PTS: 1 DIF: L1 OBJ: 25.5 Transverse Waves
    KEY: transverse | wave BLM: knowledge
21. ANS: A PTS: 1 DIF: L1 OBJ: 25.6 Longitudinal Waves

KEY: sound | wave BLM: knowledge

22. ANS: E PTS: 1 DIF: L2 OBJ: 25.6 Longitudinal Waves
KEY: longitudinal | wave BLM: comprehension

23. ANS: C PTS: 1 DIF: L2 OBJ: 25.9 The Doppler Effect
KEY: Doppler | pitch BLM: comprehension

24. ANS: C PTS: 1 DIF: L2 OBJ: 25.9 The Doppler Effect
KEY: speed | source | sound BLM: comprehension

25. ANS: C PTS: 1 DIF: L2 OBJ: 25.2 Wave Description
STA: Ph.V.1.a KEY: amplitude | distance BLM: application

26. ANS: C PTS: 1 DIF: L2 OBJ: 25.1 Vibration Of A Pendulum
KEY: pendulum | clock | time BLM: application

27. ANS: B PTS: 1 DIF: L1 OBJ: 25.2 Wave Description
STA: Ph.V.1.a KEY: period | distance BLM: knowledge

28. ANS: C PTS: 1 DIF: L2 OBJ: 25.1 Vibration Of A Pendulum
KEY: pendulum | time BLM: comprehension

29. ANS: A PTS: 1 DIF: L2 OBJ: 25.1 Vibration Of A Pendulum
KEY: mass | speed BLM: analysis

30. ANS: D PTS: 1 DIF: L2 OBJ: 25.11 Shock Waves
KEY: plane | speed | sound BLM: comprehension

31. ANS: B PTS: 1 DIF: L2 OBJ: 25.11 Shock Waves
KEY: observer | boom | speed BLM: comprehension

32. ANS: C PTS: 1 DIF: L1 OBJ: 25.9 The Doppler Effect
KEY: Doppler | source BLM: knowledge

33. ANS: A PTS: 1 DIF: L2 OBJ: 25.2 Wave Description
STA: Ph.V.1.a KEY: frequency | clock BLM: application

34. ANS: D PTS: 1 DIF: L2 OBJ: 25.7 Interference
KEY: amplitude | interference BLM: application

35. ANS: B PTS: 1 DIF: L2 OBJ: 25.4 Wave Speed
STA: Ph.V.1.d KEY: wavelength | speed BLM: application

36. ANS: C PTS: 1 DIF: L2 OBJ: 25.4 Wave Speed
STA: Ph.V.1.d KEY: cycle | speed | wavelength BLM: application

37. ANS: D PTS: 1 DIF: L2 OBJ: 25.4 Wave Speed
STA: Ph.V.1.d KEY: distance | velocity BLM: application

38. ANS: D PTS: 1 DIF: L2 OBJ: 25.4 Wave Speed
STA: Ph.V.1.d KEY: crest | trough |wavelength BLM: application

39. ANS: B PTS: 1 DIF: L2 OBJ: 25.4 Wave Speed
STA: Ph.V.1.d KEY: wave | radio | hertz BLM: application

40. ANS: A PTS: 1 DIF: L2 OBJ: 25.4 Wave Speed
STA: Ph.V.1.d KEY: distance | speed BLM: application

TRUE/FALSE

41. ANS: T PTS: 1 DIF: L1 OBJ: 26.8 Resonance
KEY: resonance BLM: knowledge

42. ANS: F PTS: 1 DIF: L1 OBJ: 26.3 Media That Transmit Sound
KEY: sound | vacuum BLM: knowledge

43. ANS: F PTS: 1 DIF: L2 OBJ: 26.2 Sound In Air
KEY: sound | air BLM: comprehension

44. ANS: T PTS: 1 DIF: L1 OBJ: 26.7 Natural Frequency
KEY: frequency | natural BLM: knowledge
45. ANS: T PTS: 1 DIF: L2 OBJ: 26.8 Resonance
KEY: resonance | bridge BLM: comprehension
46. ANS: F PTS: 1 DIF: L1 OBJ: 26.1 The Origin Of Sound
STA: Ph.V.1.f KEY: pitch | period BLM: knowledge
47. ANS: T PTS: 1 DIF: L1 OBJ: 26.6 Forced Vibration
KEY: loud | tuning fork BLM: knowledge
48. ANS: T PTS: 1 DIF: L2 OBJ: 26.7 Natural Frequency
KEY: amplitude | frequency | natural BLM: comprehension
49. ANS: F PTS: 1 DIF: L1 OBJ: 25.1 Vibration Of A Pendulum
KEY: pendulum | frequency BLM: knowledge
50. ANS: T PTS: 1 DIF: L1 OBJ: 25.2 Wave Description
STA: Ph.V.1.a KEY: amplitude | crest BLM: knowledge
51. ANS: F PTS: 1 DIF: L1 OBJ: 25.2 Wave Description
STA: Ph.V.1.a KEY: distance | displacement BLM: knowledge
52. ANS: F PTS: 1 DIF: L1 OBJ: 25.2 Wave Description
STA: Ph.V.1.a KEY: vibrate | period BLM: knowledge
53. ANS: F PTS: 1 DIF: L1 OBJ: 25.5 Transverse Waves
KEY: longitudinal | wave BLM: knowledge
54. ANS: T PTS: 1 DIF: L1 OBJ: 25.6 Longitudinal Waves
KEY: sound | longitudinal BLM: knowledge
55. ANS: F PTS: 1 DIF: L1 OBJ: 25.7 Interference
KEY: constructive | destructive BLM: knowledge
56. ANS: T PTS: 1 DIF: L1 OBJ: 25.8 Standing Waves
KEY: node | standing BLM: knowledge
57. ANS: T PTS: 1 DIF: L1 OBJ: 25.9 The Doppler Effect
KEY: galaxy | red shift | Doppler BLM: knowledge
58. ANS: F PTS: 1 DIF: L2 OBJ: 25.11 Shock Waves
KEY: sonic | boom | plane BLM: comprehension
59. ANS: F PTS: 1 DIF: L2 OBJ: 25.9 The Doppler Effect
KEY: Doppler | speed | pitch BLM: comprehension
60. ANS: T PTS: 1 DIF: L2 OBJ: 25.9 The Doppler Effect
KEY: light | frequency BLM: comprehension

ESSAY

61. ANS:
Resonance is an unusually large increase in amplitude when a system is driven at its natural frequency by an outside force. A good example of resonance is someone pushing another person on a swing. The pushing person pushes with small pushes in rhythm with the natural swing motion. Soon the swing is very high in the air but with little effort on the part of the pushing person. Another example is the sounding of a tuning fork by the vibrations of another fork of matched frequency. An unfortunate example is the destruction of a bridge when small pushes are applied in rhythm with the natural frequency of the bridge.

PTS: 1 DIF: L2 OBJ: 26.8 Resonance
KEY: resonance BLM: comprehension
62. ANS:

Beats occur when two waves with almost the same frequency interfere. Beats have a frequency of their own equal to the difference between the two wave frequencies. Sounding two tuning forks slightly out of tune with each other produces beats. Beats are produced by a pair of whining diesel engines running side by side.

PTS: 1 DIF: L2 OBJ: 26.1 The Origin Of Sound
STA: Ph.V.1.f KEY: beats | interference BLM: comprehension

63. ANS:
In a transverse wave, oscillations are perpendicular to the wave velocity. Oscillations in a longitudinal wave are forward and backward in the direction of the wave's velocity. Waves on a string, waves on the surface of water, and electromagnetic waves are transverse waves; sound waves and waves along the axis of a coil spring are longitudinal waves.

PTS: 1 DIF: L2 OBJ: 25.5 Transverse Waves | 25.6 Longitudinal Waves
KEY: transverse | longitudinal BLM: comprehension

64. ANS:
A standing wave occurs when a wave is reflected back on itself in such a way that the reflected wave is always out of phase with the incident wave at fixed places called nodes. Nodes are parts of the wave pattern that do not move. At other places, called antinodes, the waves are always in phase with each other. These are places that vibrate at full amplitude.

PTS: 1 DIF: L1 OBJ: 25.8 Standing Waves
KEY: standing | node | antinode BLM: knowledge

65. ANS:
The Doppler effect is an increase or decrease in frequency due to relative motion of the source of a wave with respect to the receiver. If a wave source approaches a receiver, its frequency increases. If the source is going away from a receiver, its frequency decreases. If a star looks blue to us, the star is coming toward us. The reason for this is that the frequency of light from the star has increased.

PTS: 1 DIF: L2 OBJ: 25.9 The Doppler Effect
KEY: Doppler | star | blue shift BLM: analysis

PROBLEM

66. ANS:
68 Hz

PTS: 1 DIF: L2 OBJ: 26.4 Speed Of Sound
KEY: wavelength | frequency BLM: application

67. ANS:
340 m

PTS: 1 DIF: L2 OBJ: 26.4 Speed Of Sound
KEY: echo | distance BLM: application

68. ANS:
100

PTS: 1 DIF: L2 OBJ: 26.5 Loudness
KEY: intensity | decibel BLM: application

69. ANS:
11 Hz

PTS: 1 DIF: L2 OBJ: 26.5 Loudness
KEY: frequency | beat BLM: application

70. ANS:
the angle decreases

PTS: 1 DIF: L2 OBJ: 25.10 Bow Waves
KEY: supersonic | angle BLM: application