The Nature of Sound

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Review Questions

Select the best answer for each question.

1. Sound waves carry _____ from one place to another.
- **a.** Matter
- **b.** Energy
- **c.** Particles
- **d.** Soft tissue

2. Like electromagnetic waves, sound waves can propagate in a vacuum.
- **a.** True
- **b.** False

3. If the physical characteristics of a medium remain constant, sound waves will:
- **a.** Continue to travel in a straight line
- **b.** Will be reflected at right angles
- **c.** Will be refracted according to Snell's law
- **d.** Not be attenuated

4. Transverse waves are also called:
- **a.** Longitudinal waves
- **b.** Harmonic waves
- **c.** Shear waves
- **d.** Huygens waves

5. Sounds waves are _____
- **a.** Electromagnetic in nature
- **b.** Mechanical in nature
- **c.** Radiation-based
- **d.** Thermal in nature

6. Each individual sound wave consists of an area of _____ and_____.
- **a.** Amplitude, interference
- **b.** Power, intensity
- **c.** Period, wavelength
- **d.** Compression, rarefaction

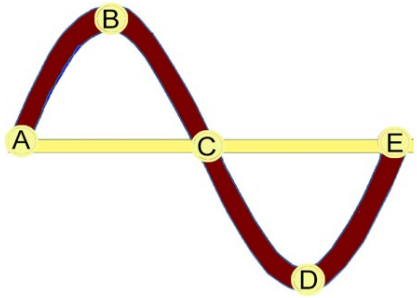
7. Acoustic energy is transmitted through a medium by:
- **a.** Electromagnetic forces
- **b.** Radiation forces
- **c.** Particle displacement
- **d.** Harmonic convergence

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8. In discussions of ultrasound wave parameters, sine waves represent the relationship between _____ and _____.

a. An acoustic variable, time
b. An acoustic variable, distance,
c. Frequency, wavelength
d. Velocity, wavelength



9. In the accompanying illustration of a sine wave, the points A,C,E represent:

a. Equilibrium
b. Maximum value of parameter
c. Minimum value of parameter
d. Average value of parameter

10. In the accompanying illustration of a sine wave, point B represents:

a. Equilibrium
b. Maximum value of parameter
c. Minimum value of parameter
d. Average value of parameter

11. In the accompanying illustration of a sine wave, the point D represents:

a. Equilibrium
b. Maximum value of parameter
c. Minimum value of parameter
d. Average value of parameter

12. All of the following are considered acoustic wave parameters except:

a. Wavelength
b. Period
c. Amplitude
d. Harmonics

13. The wave formula relates which three variables?

a. Velocity, wavelength, time
b. Wavelength, frequency, period
c. Frequency, velocity, time
d. Wavelength, velocity, frequency

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14. The speed with which an acoustic wave propagates through a medium is called:
- **a.** Period
- **b.** Amplitude
- **c.** Frequency
- **d.** Velocity

15. Propagation velocity is measure in which units?
- **a.** m/sec
- **b.** cm/sec
- **c.** m/sec
- **d.** All of the above

16. Propagation velocity of an acoustic wave through a medium is primarily dependent upon _____ and _____ of the medium:
- **a.** Density, stiffness
- **b.** Density, temperature
- **c.** Compressibility, temperature
- **d.** Compressibility, volume

17. Propagation velocity of an acoustic wave is greater in water than it is in bone.
- **a.** True
- **b.** False

18. Propagation velocity of an acoustic wave is greater in muscle than it is in air.
- **a.** True
- **b.** False

19. As the density of a medium increases, acoustic velocity:
- **a.** Increases
- **b.** Decreases

20. Rank the propagation velocities in the follow media from slowest to fastest:
- **a.** Fat, water, liver, bone
- **b.** Bone, liver, water, fat
- **c.** Blood, air, muscle, fat
- **d.** Liver, bone, water, air

21. The average value for sound speed in all types of human soft tissue is:
- **a.** 1,450 cm/sec
- **b.** 1.450 m/sec
- **c.** 1,540 m/sec
- **d.** 1,540 cm/sec

22. As the stiffness of a medium increases, acoustic velocity:
- **a.** Increases
- **b.** Decreases

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23. Compressibility is _____ stiffness.
- **a.** The same as
- **b.** The opposite of (converse)
- **c.** Always greater than
- **d.** Always less than

24. The number of acoustic waves passing a given point over a given period of time refers to:
- **a.** Period
- **b.** Phase
- **c.** Velocity
- **d.** Frequency

25. Which of the following units are used to measure frequency?
- **a.** Pascals
- **b.** Dynes
- **c.** Hertz
- **d.** Rayls

26. One megahertz equal _____ Hertz.
- **a.** 1,000
- **b.** 10,000
- **c.** 100,000
- **d.** 1,000,000

27. One kilohertz equal _____ Hertz.
- **a.** 1,000
- **b.** 10,000
- **c.** 100,000
- **d.** 1,000,000

28. Audible sound is defined as frequencies ranging from _____ to _____.
- **a.** 20 – 20,000 KHz
- **b.** 20 – 20,000 Hz
- **c.** 520 – 1,040 KHz
- **d.** 520 – 1,040 MHz

29. The spatial dimensions of an acoustic wave are referred to as:
- **a.** Frequency
- **b.** Period
- **c.** Wavelength
- **d.** Phase

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30. Units of measurement for acoustic wavelength are:
- **a.** sec, msec, sec
- **b.** cycles/sec
- **c.** watts, milliwatts
- **d.** cm, mm, µm

31. As the frequency of an acoustic wave increases, the wavelength:
- **a.** Increases
- **b.** Decreases

32. Acoustic waves with shorter wavelengths are associated with:
- **a.** Higher frequencies
- **b.** Lower frequencies
- **c.** Higher velocities
- **d.** Lower velocities

33. Wave phase refers to:
- **a.** The peak compressional point of a wave
- **b.** The peak rarefactional point of a wave
- **c.** The point of advancement of a wave from its origin
- **d.** Two points on any single wave

34. When two or more waves are travelling through a medium at the same time, the resulting waveform will be altered as a result of:
- **a.** Density of the medium
- **b.** Interference patterns
- **c.** Stiffness of the medium
- **d.** Frequency of the transducer

35. When two waves are travelling *in phase*, the amplitude of the resulting combined waveform will:
- **a.** Increase
- **b.** Decrease
- **c.** Remain the same

36. When two waves are travelling *out-of-phase*, the amplitude of the resulting combined waveform will:
- **a.** Increase
- **b.** Decrease
- **c.** Remain the same

37. The length of time required for completion of a single wave cycle is called:
- **a.** Phase
- **b.** Wavelength
- **c.** Frequency
- **d.** Period

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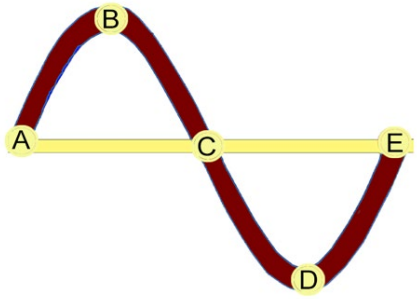
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38. Units of measurement for period are:

a. sec, msec, µsec
b. cycles/sec
c. watts, milliwatts
d. cm, mm, m

39. The strength of pressure in an acoustic wave is called:

a. Intensity
b. Power
c. Amplitude
d. Compression



40. In the accompanying illustration, which point represent maximum amplitude?

a. A
b. B
c. C
d. D

41. In the accompanying illustration, which point represent minimum amplitude?

a. A
b. B
c. C
d. D

42. Units of measurement for amplitude of an acoustic wave include all of the following except units of:

a. Time
b. Distance (mm, inches)
c. Density (grams/cm^3)
d. Pressure

43. The rate at which acoustic energy is transferred into a medium is the definition of:

a. Intensity
b. Amplitude
c. Power
d. Pressure

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44. Power is proportional to:
- **a.** Intensity^2
- **b.** Energy/area
- **c.** Amplitude^2
- **d.** Intensity x duty factor

45. All of the following are units of measurement for power except:
- **a.** Newtons
- **b.** Joules
- **c.** Watts
- **d.** Rayls

46. The amount of acoustic energy transferred into of a medium is the definition of:
- **a.** Intensity
- **b.** Amplitude
- **c.** Power
- **d.** Pressure

47. The units of measurement usually used in discussions of spatial intensity are:
- **a.** mW/cm^2
- **b.** mW/cm^3
- **c.** W/mm^2
- **d.** W/cm^3

48. The amount of acoustic energy delivered over a given area is called:
- **a.** Spatial intensity
- **b.** Temporal intensity
- **c.** Power
- **d.** Acoustic impedance

49. The amount of acoustic energy delivered over a given period of time is called:
- **a.** Spatial intensity
- **b.** Temporal intensity
- **c.** Power
- **d.** Acoustic impedance

50. The formal for determining spatial intensity is SI=_____.
- **a.** E * A
- **b.** A^2
- **c.** E^2
- **d.** E/A

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51. According to the formula for spatial intensity, as an area of insonation increases, spatial intensity:
- **a.** Increases
- **b.** Decreases
- **c.** Stays the same

52. According to the formula for spatial intensity, as the area of insonation decreases, spatial intensity:
- **a.** Increases
- **b.** Decreases
- **c.** Stays the same

53. In a single crystal, focused acoustic beam, where is spatial intensity is greatest?
- **a.** Near field
- **b.** Far field
- **c.** Focal zone
- **d.** Remains constant throughout acoustic field

54. In a single crystal, focused acoustic beam, the measurement of acoustic intensity at its narrowest point is called:
- **a.** Temporal average intensity
- **b.** Spatial average intensity
- **c.** Temporal peak intensity
- **d.** Spatial peak intensity

55. The SP/SA factor is also known as the:
- **a.** Beam profile ratio
- **b.** Beam uniformity ratio
- **c.** Duty factor
- **d.** Intensity coefficient

56. The point in time when acoustic intensity reaches its maximum value is called:
- **a.** Temporal peak intensity
- **b.** Temporal average intensity
- **c.** Time-of-flight intensity
- **d.** Spatial peak intensity

57. Intensity over the entire period of time an acoustic pulse occupies is called:
- **a.** Temporal peak intensity
- **b.** Temporal average intensity
- **c.** Time-of-flight intensity
- **d.** Spatial peak intensity

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58. Temporal average intensity is calculated as a function of _____ and_____.
- **a.** Temporal average intensity, duty factor
- **b.** Temporal average intensity, amplitude
- **c.** Temporal peak intensity, duty factor
- **d.** Temporal peak intensity, amplitude

59. Which of the following intensity measurements represents the overall highest exposure value?
- **a.** SATA
- **b.** SATP
- **c.** SPTA
- **d.** SPTP

60. Which of the following intensity measurements is most frequently referenced in discussion of acoustic bioeffects?
- **a.** SATA
- **b.** SATP
- **c.** SPTA
- **d.** SPTP

61. A measurement unit used widely in ultrasound imaging instrumentation that represents the logarithmic relationship between two variable is the:
- **a.** Decibel
- **b.** Rayl
- **c.** Pascal
- **d.** Hounsfeld unit

62. The ratio of a force acting on the surface of an object is called:
- **a.** Pressure
- **b.** Intensity
- **c.** Particle displacement
- **d.** Density

63. The formula that best describes pressure is:
- **a.** F/E
- **b.** F/A
- **c.** A^2
- **d.** E^2

64. The propensity of an object at rest to remain at rest and a body in motion to remain in motion is called:
- **a.** Acceleration
- **b.** Velocity
- **c.** Momentum
- **d.** Inertia

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65. Pressure is measured in units of:
- **a.** Paschals
- **b.** Rayls
- **c.** Newtons/m^2
- **d.** W/cm^2

66. The ability of a medium to return to its normal shape after being deformed by a force is called:
- **a.** Elasticity
- **b.** Compressibility
- **c.** Rarefaction
- **d.** Stretchability

67. The measure of relative volume change in a medium when acted upon by a pressure change or force is called:
- **a.** Elasticity
- **b.** Compressibility
- **c.** Rarefaction
- **d.** Stretchability

68. Density is defined as:
- **a.** Force/unit area
- **b.** Energy/unit area
- **c.** Mass/unit area
- **d.** Mass/unit volume

69. Which of the following unit of measurement best describes density?
- **a.** Kg/M^2
- **b.** g/M^2
- **c.** g/M^3
- **d.** Kg/cm

70. As the density of a medium increases, its compressibility:
- **a.** Increases
- **b.** Decreases
- **c.** Remains the same

71. As the density of a medium decreases, its compressibility:
- **a.** Increases
- **b.** Decreases
- **c.** Remains the same

72. The distance a that a body moves after being acted upon by a force is called:
- **a.** Rarefaction
- **b.** Inertia
- **c.** Propagation
- **d.** Particle displacement

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73. Units of measurement for particle displacement include all of the following except:
- **a.** millimeters
- **b.** seconds
- **c.** centimeters
- **d.** micrometers

74. The relative warmth or coolness of an object is its:
- **a.** Heat
- **b.** Energy
- **c.** Temperature
- **d.** Frigidity

75. The speed of sound varies slightly with a change in temperature of the medium.
- **a.** True
- **b.** False