MULTIPLE CHOICE

1. _____ is the amount of complete cycles per second.
   a. Wavelength
   b. Period
   c. Frequency
   d. Propagation speed

   ANS: C
   Frequency is defined as the number of complete cycles per second.

   REF: p. 15 OBJ: Explain what frequency is and why it is important in sonography.
   TOP: Basic ultrasound physics

2. Sound requires a _____ through which to travel.
   a. medium
   b. pressure
   c. vacuum
   d. wave

   ANS: A
   Sound travels (propagates) through a medium.

   REF: p. 14 OBJ: Define ultrasound and describe how it behaves.
   TOP: Basic ultrasound physics

3. The following are all ultrasound frequencies *except*:
   a. 30,000 Hz
   b. 250 kHz
   c. 15 kHz
   d. 0.3 MHz

   ANS: C
   Ultrasound frequencies range above 20,000 Hz (20 kHz).

   REF: p. 16 OBJ: Define ultrasound and describe how it behaves.
   TOP: Basic ultrasound physics

4. If frequency increases, each cycle (period) _____.
   a. increases
   b. decreases
   c. remains unchanged
   d. doubles

   ANS: B
   As more cycles are packed into one second (frequency), there is less time for each cycle (period).

REF: p. 16 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

5. Wavelength is the _____ over which one cycle occurs.
   a. time
   b. length
   c. area
   d. power

   ANS: B
   Wavelength is the length of space that one cycle takes up.

   REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
   TOP: Basic ultrasound physics

6. Propagation speed is the speed at which a wave _____ through a medium.
   a. cycles
   b. refracts
   c. travels
   d. reflects

   ANS: C
   Propagation speed is the speed at which a wave moves (travels) through a medium.

   REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
   TOP: Basic ultrasound physics

7. Stiffer media have _____ sound speeds.
   a. lower
   b. higher
   c. stiffness does not change the propagation speed
   d. sound cannot propagate through stiffer media

   ANS: B
   Stiffer media have higher sound speeds.

   REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
   TOP: Basic ultrasound physics

8. Frequency _____ wavelength.
   a. is directly proportional to
   b. is inversely proportional to
   c. is equal to
   d. has no bearing on

   ANS: B
   Frequency is inversely proportional to the wavelength. If frequency increases, wavelength decreases.

   REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
   TOP: Basic ultrasound physics

9. Propagation speed is primarily determined by the _____ of the medium.

a. density
b. thickness
c. stiffness
d. content

ANS: C
Propagation speed is determined by the medium, primarily its stiffness.

REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

10. Ultrasound pulses contain a range of frequencies called the _____.
a. fundamental frequencies
b. duty factor
c. pulse repetition frequencies
d. bandwidth

ANS: D
Ultrasound pulses contain a range of frequencies called the bandwidth.

REF: p. 22 OBJ: Compare continuous and pulsed ultrasound.
TOP: Pulse wave

11. Pulsed ultrasound consists of _____ separated by _____ of time.
a. frequencies; cycles
b. pulses; cycles
c. pulses; gaps
d. cycles; pulses

ANS: C
Pulsed ultrasound consists of pulses separated by gaps of time.

REF: p. 19 OBJ: Compare continuous and pulsed ultrasound.
TOP: Pulse wave

12. Pulse repetition frequency (PRF) refers to the _____ of pulses occurring in one second.
a. speed
b. number
c. type
d. cycle

ANS: B
PRF is defined as the number of pulses occurring in one second.

REF: p. 19 OBJ: Compare continuous and pulsed ultrasound.
TOP: Pulse wave

13. All of the following are acoustic variables *except* _____:
a. pressure
b. density
c. compression
d. particle vibration

ANS: C
Pressure, density, and particle vibration are called acoustic variables because they are quantities that vary in a sound wave.

REF: p. 14 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

14. Regions of lower pressure and density are called _____.
    a. compressions
    b. rarefactions
    c. longitudinal waves
    d. acoustic variables

ANS: B
Regions of lower pressure and density are called rarefactions. Regions of high pressure and density are called compressions.

REF: p. 14 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

15. Period is the _____ it takes for one _____ to occur.
    a. time; cycle
    b. time; wavelength
    c. frequency; cycle
    d. time; pulse

ANS: A
Period is the time that it takes for one cycle to occur.

REF: p. 16 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

16. _____ are the even and odd multiples of the fundamental frequency.
    a. Bandwidths
    b. Harmonics
    c. Mechanical waves
    d. Side lobes

ANS: B
The even and odd multiples of the fundamental wave are called even and odd harmonics, respectively.

REF: p. 19 OBJ: Discuss how harmonics are generated.
TOP: Harmonics

17. Propagation speed is higher in _____ than in soft tissue.
    a. lung
    b. bone
    c. water
    d. fat

ANS: B

Propagation speeds are highest in solids (bone) and lowest in gases (lung).

REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

18. Doppler ultrasound pulses are typically _____ cycles long.
    a. 2–3
    b. 12–30
    c. 5–20
    d. 5–30

    ANS: D
    Doppler pulses typically range from 5 to 30 cycles long, whereas sonographic pulses are typically 2 or 3 cycles long.

    REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
    TOP: Doppler ultrasound

19. The fraction of time that pulsed ultrasound is on is called _____.
    a. pulse repetition period
    b. duty factor (DF)
    c. period
    d. spatial pulse length

    ANS: B
    DF is the fraction of time that pulsed ultrasound is on.

    REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
    TOP: Pulse wave

20. The rate at which energy passes through a unit area is called _____.
    a. amplitude
    b. power
    c. attenuation
    d. intensity

    ANS: D
    Intensity is the rate at which energy (ability to do work) passes through a unit area.

    REF: p. 24 OBJ: Define ultrasound and describe how it behaves.
    TOP: Basic ultrasound physics

21. As sound travels, the reduction in amplitude and intensity of the wave is called _____.
    a. scattering
    b. attenuation
    c. absorption
    d. reflection

    ANS: B
    Attenuation is the weakening of sound (amplitude and intensity) as the wave propagates through soft tissue.

    REF: p. 24 OBJ: Describe the weakening of ultrasound as it travels through tissue.

TOP: Basic ultrasound physics

22. The wavelength of 3 MHz ultrasound in soft tissue is _____ mm.
    a. 510
    b. 5.1
    c. 0.51
    d. 4.6

    ANS: C
    Use formula:
    $$\text{Wavelength (mm)} = \frac{\text{Propagation speed (mm/μs)}}{\text{Frequency (MHz)}}$$

    REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
    TOP: Basic ultrasound physics

23. What would be the frequency for a 0.22 mm wavelength in soft tissue?
    a. 5.0 MHz
    b. 7.0 MHz
    c. 7.5 MHz
    d. 3.5 MHz

    ANS: B
    Use formula:
    $$\text{Frequency (MHz)} = \frac{\text{Propagation speed (mm/μs)}}{\text{Wavelength (mm)}}$$

    REF: p. 17 OBJ: Explain what frequency is and why it is important in sonography.
    TOP: Basic ultrasound physics

24. What is the period of a 5.0 MHz transducer in soft tissue?
    a. 0.2 μs
    b. 0.02 μs
    c. 3.1 μs
    d. 0.2 sec

    ANS: A
    Use formula:
    $$\text{Period (T)} = \frac{1}{\text{Frequency (MHz)}}$$

    REF: p. 16 OBJ: Define ultrasound and describe how it behaves.
    TOP: Basic ultrasound physics

25. What is the pulse duration of a four-cycle pulse in a period of 0.5 μs?
    a. 0.2 μs
    b. 2.0 μs
    c. 1.25 μs
    d. 0.125 μs

    ANS: B
    Use formula:

Pulse duration (μs) = numbers of cycles in a pulse × period (μs)

REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
TOP: Pulse wave

26. What is the spatial pulse length in soft tissue for a four-cycle pulse, using a frequency of 5.0 MHz?
    a. 0.6 mm
    b. 6.0 mm
    c. 0.9 mm
    d. 9.0 mm

    ANS: C
    Use formula:
    Spatial pulse length (mm) = wavelength (mm) × number of cycles in a pulse

    REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
    TOP: Pulse wave

27. If the wavelength is 0.5 mm, the spatial pulse length for a 4 cycle pulse is _____.
    a. 0.2 mm
    b. 8.0 mm
    c. 0.8 mm
    d. 2.0 mm

    ANS: D
    Use formula:
    Spatial pulse length (mm) = wavelength (mm) × number of cycles in a pulse

    REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
    TOP: Pulse wave

28. The average propagation speed in human soft tissue is _____.
    a. 1.54 cm/μs
    b. 1.54 mm/μs
    c. 1.54 m/sec
    d. none of the above

    ANS: B
    The average propagation speed in human soft tissue is 1540 m/s, or 1.54 mm/μs.

    REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
    TOP: Basic ultrasound physics

29. The velocity of sound in human soft tissue is assumed to be a constant. If you employ a 7.5 MHz transducer, what is the wavelength of the sound?
    a. 0.11 mm
    b. 0.20 mm
    c. 0.025 mm
    d. 1.1 mm

    ANS: B

Use formula:
Wavelength (mm) = $\frac{\text{Propagation speed (mm/μs)}}{\text{Frequency (MHz)}}$

REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

30. If you switch to a lower frequency for penetration, the wavelength of the transducer _____.
    a. remains unchanged
    b. decreases
    c. increases
    d. doubles

    ANS: C
    Frequency and wavelength are inversely proportional; if frequency decreases, wavelength increases.

    REF: p. 17 OBJ: Explain what frequency is and why it is important in sonography.
    TOP: Basic ultrasound physics

31. 20 kHz is equal to _____ Hz.
    a. 200
    b. 2000
    c. 20,000
    d. 200,000

    ANS: C
    1 kHz = 1,000 Hz
    20 kHz = 1,000 × 20
    20 kHz is equal to 20,000 Hz.

    REF: p. 15 OBJ: Explain what frequency is and why it is important in sonography.
    TOP: Basic ultrasound physics

32. 1000 Hz is equal to _____ kHz.
    a. 1
    b. 10
    c. 1000
    d. 0.1

    ANS: A
    1000 Hz is equal to 1 kHz.

    REF: p. 15 OBJ: Explain what frequency is and why it is important in sonography.
    TOP: Basic ultrasound physics

33. What is the attenuation coefficient for a 5.0 MHz transducer in soft tissue?
    a. 0.25 dB/cm
    b. 0.1 dB/cm
    c. 2.5 dB/cm
    d. 10 dB/cm

ANS: C
Use formula: Attenuation coefficient (dB/cm) = ½ [frequency (MHz)]

REF: p. 26 OBJ: Describe the weakening of ultrasound as it travels through tissue.
TOP: Attenuation

34. At what depth does a 3.0 MHz transducer have an attenuation of 9 dB?
a. 6.0 mm
b. 0.6 cm
c. 6.0 cm
d. 0.6 mm

ANS: B
Use formula:
Distance (mm) = ½ [propagation speed (mm/μs) × round-trip time (μs)]

REF: p. 34 OBJ: Describe the weakening of ultrasound as it travels through tissue.
TOP: Attenuation

35. The attenuation of a 5.0 MHz transducer at a depth of 4 cm is _____ dB.
a. 1.6
b. 10
c. 16
d. 20

ANS: B
Use formula:
Attenuation (dB) = ½ [frequency (MHz) × path length (cm)]

REF: p. 26 OBJ: Describe the weakening of ultrasound as it travels through tissue.
TOP: Attenuation

36. What is the attenuation of a 7.5 MHz transducer at a depth of 20 mm?
a. 7.5 dB
b. 5.0 dB
c. 0.53 dB
d. 75 dB

ANS: A
Use formula:
Attenuation (dB) = ½ [frequency (MHz) × path length (cm)]

REF: p. 26 OBJ: Describe the weakening of ultrasound as it travels through tissue.
TOP: Attenuation

37. If beam power increases, intensity _____.
a. increases
b. decreases
c. doubles
d. remains unchanged

ANS: A
Increasing the power increases the intensity.

REF: p. 24 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

38. If the beam area decreases, the intensity _____.
    a. decreases
    b. remains unchanged
    c. increases
    d. quadruples

ANS: C
Decreasing the area (focusing) increases the intensity because the power is more concentrated.

REF: p. 24 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

39. Attenuation increases with increasing _____.
    a. wavelength
    b. frequency
    c. power
    d. pressure

ANS: B
Attenuation increases with increasing frequency and imaging depth.

REF: pp. 26-27 OBJ: Describe the weakening of ultrasound as it travels through tissue.
TOP: Attenuation

40. For perpendicular incidence, the incidence angle is _____.
    a. 50
    b. 10
    c. 90
    d. 0

ANS: D
For perpendicular incidence, the incidence angle is zero.

REF: p. 29 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

41. The pulse repetition frequency is the number of pulses that occur in a single _____.
    a. microsecond
    b. second
    c. millisecond
    d. pulse

ANS: B
The pulse repetition frequency is the number of pulses that occur in a single second.

REF: p. 19 OBJ: Compare continuous and pulsed ultrasound.
TOP: Pulse wave

42. Calculate the pulse duration for a 3.0 MHz transducer in soft tissue with a four-cycle pulse.
    a. 1.2 µs
    b. 1.3 µs
    c. 12 µs
    d. 13 µs

    ANS: B
    Use formula:
    Pulse duration (µs) = numbers of cycles in a pulse × period (µs)

    REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
    TOP: Pulse wave

43. If the number of cycles in a pulse is reduced, the pulse duration _____.
    a. is increased
    b. is decreased
    c. remains unchanged
    d. is not possible

    ANS: B
    If the number of cycles in a pulse is reduced, the pulse duration is decreased.

    REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
    TOP: Pulse wave

44. Continuous wave (CW) Doppler has a duty factor of _____ %.
    a. 1.0
    b. 0.10
    c. 100
    d. 10

    ANS: C
    CW is on 100% of the time.

    REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
    TOP: Continuous wave

45. Amplitude and intensity are indicators of the sound wave's _____.
    a. strength
    b. bandwidth
    c. wavelength
    d. duty factor

    ANS: A
    Amplitude and intensity are indicators of the strength of the sound wave.

    REF: p. 23 OBJ: Define ultrasound and describe how it behaves.
    TOP: Basic ultrasound physics

46. What is the spatial pulse length of a four-cycle pulse with a wavelength of 0.1 mm?
    a. 4.0 mm

b. 0.4 cm
c. 0.4 mm
d. 40 mm

ANS: C
Use formula:
Spatial pulse length (mm) = wavelength (mm) × number of cycles in a pulse

REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
TOP: Pulse wave

47. Duty factors for sonography are typically in the range of _____%.
a. 0.1–1.0
b. 0.5–2.0
c. 25–50
d. 90–100

ANS: A
Typically duty factors for sonography are in the range of 0.1–1.0%

REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
TOP: Pulse wave

48. The attenuation coefficient for soft tissue using a 10 MHz transducer is _____.
a. 5 dB/cm
b. 5 dB/mm
c. 10 dB/cm
d. 10 dB/mm

ANS: A
Use formula:
Attenuation coefficient (dB/cm) = $\frac{1}{2}$ [frequency (MHz)]

REF: p. 26 OBJ: Describe the weakening of ultrasound as it travels through tissue.
TOP: Echo interaction | Attenuation

49. Impedance is equal to density multiplied by _____.
a. propagation speed
b. wavelength
c. path length
d. stiffness

ANS: A
Impedance is equal to density multiplied by its propagation speed.

REF: p. 28 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

50. The unit for impedance is _____.
a. W/cm^2
b. dB/cm
c. watt

d. rayl

ANS: D
The unit for impedance is the rayl.

REF: p. 28 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

51. The even harmonics of 2 MHz are _____ MHz.
a. 2, 4, 6
b. 4, 8, 12
c. 2, 4, 8
d. 4, 6, 8

ANS: D
A fundamental frequency of 2 MHz would reveal even harmonic frequencies of 4, 6, and 8.

REF: p. 19 OBJ: Discuss how harmonics are generated.
TOP: Harmonics

52. If the impedances are equal between two media in perpendicular incidence, there is no _____.
a. reflection
b. transmission
c. angle of incidence
d. angle of transmission

ANS: A
For perpendicular incidence and equal impedances, there is no reflection and the transmitted intensity equals the incident intensity.

REF: p. 29 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

53. In perpendicular incidence, what is the intensity reflection coefficient for impedances of 45 and 55 rayls?
a. 0.001
b. –0.01
c. 0.01
d. –0.001

ANS: C
Use formula:

$$\text{Intensity Reflection Coefficient} = \left[\frac{\text{Impedance 2} - \text{Impedance 1}}{\text{Impedance 2} + \text{Impedance 1}} \right]^2$$

REF: p. 28 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

54. If the propagation speed through the second medium is greater than through the first medium, the transmission angle is _____.

a. less than the incidence angle
b. equal to the incidence angle
c. greater than the incidence angle
d. unrelated to the incidence angle

ANS: C
If the propagation speed through the second medium is greater than through the first medium, the transmission angle is greater than the incidence angle.

REF: p. 30 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

55. The distance to the reflector (D) in soft tissue with a round-trip time of 39 μs is _____.
a. 3 mm
b. 3 cm
c. 13 mm
d. 13 cm

ANS: B
Use formula:
Distance (cm) = $\frac{\text{Round trip time (s)}}{13\mu s}$

REF: pp. 34-35
OBJ: Define ultrasound and describe how it behaves. | Discuss the generation of echoes in tissue.
TOP: Pulse wave

56. What does 3 dB of attenuation mean?
a. One half the original intensity.
b. One third the original intensity.
c. Three decibels more than the original intensity.
d. Increasing amplitude.

ANS: A
3 dB corresponds to an intensity ratio of one half and intensity reduction of 50%.

REF: p. 25 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

57. The attenuation of a 5 MHz transducer in soft tissue would be _____ dB at 2 cm of depth.
a. 20
b. 5
c. 10
d. 1.25

ANS: B
Use formula:
Attenuation (dB) = Attenuation coefficient (dB/cm) × path length (cm).

REF: p. 26 OBJ: Describe the weakening of ultrasound as it travels through tissue.
TOP: Attenuation

58. Which of the following is *not* a term used to describe continuous wave ultrasound?
    a. Pulse duration.
    b. Frequency.
    c. Wavelength.
    d. Propagation speed.

    ANS: A
    Pulse duration is a term used in pulsed ultrasound.

    REF: p. 21 OBJ: Define ultrasound and describe how it behaves.
    TOP: Basic ultrasound physics

59. Lateral position errors occur on an image due to sound _____.
    a. reflection
    b. attenuation
    c. refraction
    d. transmission

    ANS: C
    Refraction is important because, when it occurs, lateral position errors (refraction artifacts) occur on the image.

    REF: p. 30 OBJ: Discuss the generation of echoes in tissue.
    TOP: Echo interaction

60. The proportion of intensity to amplitude is _____.
    a. tripled
    b. halved
    c. squared
    d. quadrupled

    ANS: C
    Intensity is proportional to amplitude squared; if amplitude is doubled, intensity is quadrupled; if amplitude is halved, intensity is quartered.

    REF: p. 24 OBJ: Define ultrasound and describe how it behaves.
    TOP: Basic ultrasound physics

61. Attenuation encompasses _____.
    a. absorption
    b. scattering
    c. reflection
    d. all of the above

    ANS: D
    Attenuation encompasses the absorption of sound as it travels and the reflection and scattering of the sound (echoes) as it encounters tissue interfaces and heterogeneous tissues.

    REF: p. 24 OBJ: Describe the weakening of ultrasound as it travels through tissue.
    TOP: Attenuation

62. What units are used to quantify attenuation?

a. Unitless.
b. dB/cm.
c. dB.
d. Rayls.

ANS: C
Decibel is the unit of attenuation.

REF: p. 24 OBJ: Describe the weakening of ultrasound as it travels through tissue.
TOP: Attenuation

63. If intensity reflection coefficient increases, intensity transmission coefficient _____.
a. decreases
b. increases
c. remains unchanged
d. is equal to the intensity reflection coefficient

ANS: A
If intensity reflection coefficient increases, intensity transmission coefficient decreases.

REF: p. 29 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

64. For perpendicular incidence and equal impedances between media, there is no _____ and the _____ intensity equals the incident intensity.
a. transmission; reflected
b. reflection; transmitted
c. transmission; transmitted
d. reflection; reflected

ANS: B
For perpendicular incidence and equal impedances between media, there is no reflection and the transmitted intensity equals the incident intensity.

REF: p. 29 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

65. The distance to a reflector in soft tissue is 15 cm. What is the round-trip time to this depth?
a. 19.5 μs
b. 195 μs
c. 1.15 μs
d. 11.5 μs

ANS: B
Use formula:
$$\text{Distance (cm)} = \frac{\text{Round trip time } (\mu s)}{13\ \mu s}$$

REF: pp. 34-35 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

66. If the pulse duration is 3 μs and the pulse repetition period is 350 μs, the duty factor would be _____ %.
    a. 0.8
    b. 8.0
    c. 0.08
    d. 1.16

    ANS: A
    Use formula:
    Duty factor = $\frac{\text{Pulse duration}}{\text{Pulse repetition frequency}}$

    REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
    TOP: Pulse wave

67. In oblique incidence, the _____ and _____ angles are always equal.
    a. transmitted; reflected
    b. normal; transmitted
    c. incidence; reflection
    d. incidence; transmitted

    ANS: C
    In oblique incidence, the incidence angle always equals the reflection angle.

    REF: pp. 29-30 OBJ: Discuss the generation of echoes in tissue.
    TOP: Echo interaction

68. The liquid suspensions that have been developed can be injected into the circulation intravenously to increase _____.
    a. wavelength
    b. propagation speed
    c. impedance
    d. echogenicity

    ANS: D
    The liquid suspensions that have been developed can be injected into the circulation intravenously to increase echogenicity of the tissues. These materials are called ultrasound contrast agents.

    REF: p. 32 OBJ: Discuss the generation of echoes in tissue.
    TOP: Echo interaction

69. If an echo returns 104 μs after a pulse was emitted by a transducer, at what depth is the structure that produced the echo located?
    a. 0.8 mm
    b. 80 cm
    c. 8.0 mm
    d. 8.0 cm

    ANS: D
    Use formula:
    Distance (cm) = $\frac{\text{Round trip time (μs)}}{}$

13 µs

REF: pp. 34-35 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

70. In oblique incidence, when the propagation speeds on either side of the boundary are different, which incidence is most likely to occur?
a. Transmitted.
b. Refracted.
c. Reflected.
d. Attenuated.

ANS: B
For refraction to occur there are two requirements: oblique incidence and different propagation speed on either side of the boundary.

REF: p. 30 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

71. Optison and Imagent are names of ultrasound _____.
a. machines
b. transducers
c. coupling mediums
d. contrast agents

ANS: D
Optison, Imagent, and Definity are contrast agents currently approved for clinical cardiac use in the United States.

REF: p. 32 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

72. Intensity is equal to the power of a wave divided by the _____ over which the power is spread.
a. diameter
b. radius
c. area
d. width

ANS: C
Intensity is equal to the power of a wave divided by the area over which the power is spread.

REF: p. 24 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

73. Amplitude is the maximum variation that occurs in an acoustic _____.
a. frequency
b. medium
c. variable
d. propagation speed

ANS: C

Amplitude is the maximum variation that occurs in an acoustic wave.

REF: p. 23 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

74. The propagation speed for a round-trip time of 39 μs would be _____ mm.
a. 1540
b. 15.4
c. 1.45
d. none of the above

ANS: D
Use formula:
Distance (mm) = ½ [propagation speed (mm/μs) × pulse round-trip time (μs)]

REF: p. 34 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

75. The best way to describe the role of ultrasound reflection and scattering in diagnostic imaging is it _____.
a. is responsible for enhancement
b. provides clear detail
c. allows us to see the tissue interfaces
d. increases the patient's exposure

ANS: C
Ultrasound is useful as an imaging tool because of the reflection and scattering of sound waves at organ and tissue interfaces and scattering within heterogeneous tissues.

REF: p. 28 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

76. _____ is the dominant factor contributing to attenuation of ultrasound in soft tissue.
a. Absorption
b. Backscattering
c. Reflection
d. Range

ANS: A
Absorption is the dominant factor contributing to attenuation of ultrasound in soft tissue.

REF: p. 24 OBJ: Describe the weakening of ultrasound as it travels through tissue.
TOP: Attenuation

77. Almost all ultrasound contrast agents contain _____.
a. iodine
b. barium
c. epinephrine
d. gas microbubbles

ANS: D

Almost all contrast agents contain microbubbles of gas that are stabilized by a protein, lipid, or polymer shell.

REF: p. 32 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

78. For each centimeter of distance, the pulse round-trip travel time is equal to _____.
    a. 3 µs
    b. 13 µs
    c. 15 µs
    d. 26 µs

    ANS: B
    The 13 µs/cm rule: The pulse round-trip travel time is equal to 13 µs for each centimeter of distance from source to reflector.

    REF: p. 34 OBJ: Discuss the generation of echoes in tissue.
    TOP: Echo interaction

79. Ultrasound systems use propagation speed to determine
    a. intensity of the sound wave
    b. amplitude of the sound wave
    c. echo location of the display
    d. attenuation of the sound wave

    ANS: C
    Ultrasound systems use propagation speed to determine echo location of the display.

    REF: p. 18 OBJ: Discuss the generation of echoes in tissue.
    TOP: Basic ultrasound physics

80. Which of the following determines how fast images are generated?
    a. Pulse duration.
    b. Duty factor.
    c. Pulse repetition frequency.
    d. Pulse repetition period.

    ANS: C
    Pulse repetition frequency determines how fast images are generated.

    REF: p. 20 OBJ: Define ultrasound and describe how it behaves.
    TOP: Pulse wave

TRUE/FALSE

1. Interfaces that scatter ultrasound energy are usually considered those that are equal to or smaller than the wavelength.

    ANS: T
    If the reflection object is comparable in size or smaller than the wavelength, the incident sound will be scattered.

REF: p. 30 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

2. The ultrasound machine directly measures distance.

ANS: F
The ultrasound machine cannot measure distance directly; rather, it measures travel time and determines distance from it.

REF: p. 34 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

3. Amplitude and intensity describe the strength of sound.

ANS: T
Amplitude and intensity describe the strength of sound.

REF: p. 23 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

4. Propagation speed is determined by the fundamental frequency.

ANS: F
The medium determines the propagation speed.

REF: p. 17 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

5. Cycle, period, and frequency are examples of acoustic variables.

ANS: F
Acoustic variables include pressure, density, and particle vibration.

REF: p. 14 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

6. Sound is a mechanical longitudinal wave.

ANS: T
Sound is a mechanical compression wave in which back-and-forth motion is parallel to the direction of the wave (longitudinal).

REF: pp. 14-15 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

7. Stiffer media have higher sound speeds.

ANS: T
Stiffer media have higher sound speeds.

REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

8. The average propagation speed in soft tissue is 1.54 mm/μs.

   ANS: T
   Propagation speed in soft tissue ranges from 1.44 to 1.64 mm/μs, with an average propagation speed of 1.54 mm/μs.

   REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
   TOP: Basic ultrasound physics

9. Imaging depth increases with increasing frequency.

   ANS: F
   Imaging depth decreases with increasing frequency.

   REF: p. 27 OBJ: Compare continuous and pulsed ultrasound.
   TOP: Pulse wave

10. Duty factor is unitless.

    ANS: T
    Duty factor has no units because it is a fraction of time in both the numerator and denominator. It is expressed simply as a decimal or percentage.

    REF: p. 21 OBJ: Define ultrasound and describe how it behaves.
    TOP: Basic ultrasound physics

11. Attenuation increases with an increase in wavelength.

    ANS: F
    Attenuation increases with increasing frequency.

    REF: p. 26 OBJ: Describe the weakening of ultrasound as it travels through tissue.
    TOP: Attenuation

12. The direction of travel in oblique incidence with respect to the boundary is given by the incidence angle.

    ANS: T
    The direction of travel in oblique incidence with respect to the boundary is given by the incidence angle.

    REF: p. 29 OBJ: Discuss the generation of echoes in tissue.
    TOP: Echo interaction

13. Harmonic frequencies are generated as sound travels through tissue.

    ANS: T
    Harmonic frequencies are generated as sound travels through tissue.

    REF: pp. 18-19 OBJ: Discuss how harmonics are generated.
    TOP: Harmonics

14. When frequency increases, the period decreases.

    ANS: T
    Frequency and period are inversely proportional; when frequency increases, the period decreases.

    REF: p. 16 OBJ: Explain what frequency is and why it is important in sonography.
    TOP: Basic ultrasound physics

15. The average propagation speed in soft tissue is 1.54 m/s.

    ANS: F
    Propagation speed in soft tissue is equal to 1540 m/s or 1.54 mm/μs.

    REF: p. 17 OBJ: Define ultrasound and describe how it behaves.
    TOP: Basic ultrasound physics

16. A cycle is one complete variation in pressure.

    ANS: T
    A cycle is one complete variation in pressure or other acoustic variable.

    REF: p. 15 OBJ: Define ultrasound and describe how it behaves.
    TOP: Basic ultrasound physics

17. Spatial pulse length is determined by the length of the pulse (wavelength) and the propagation speed.

    ANS: F
    Spatial pulse length is determined by the length of the pulse (wavelength) and the number of cycles in a pulse.

    REF: p. 21 OBJ: Define ultrasound and describe how it behaves.
    TOP: Basic ultrasound physics

18. The impedances of the media determine how much of the incident sound wave is reflected and transmitted into the second medium.

    ANS: T
    The impedances of the media determine how much of the incident sound wave is reflected and transmitted into the second media.

    REF: p. 28 OBJ: Discuss the generation of echoes in tissue.
    TOP: Echo interaction

19. Contrast agents produce echoes because the impedance of the suspended particles is similar to the suspending medium.

    ANS: F
    Contrast agents produce echoes because of the impedance mismatch between the suspended particles and the suspending medium (for example, blood).

REF: p. 32 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

20. The average attenuation coefficient for soft tissue is 1.0 dB/cm for each megahertz of frequency.

ANS: F
The average attenuation coefficient for soft tissue is 0.5 dB/cm for each megahertz of frequency.

REF: p. 26 OBJ: Describe the weakening of ultrasound as it travels through tissue.
TOP: Attenuation

21. Attenuation limits imaging depth.

ANS: T
Attenuation is the weakening of sound as it propagates, which limits imaging depth.

REF: p. 27 OBJ: Describe the weakening of ultrasound as it travels through tissue.
TOP: Doppler ultrasound

22. Acoustic speckle is a form of acoustic information in sonographic imaging.

ANS: F
Speckle is a form of acoustic noise in the sonographic image.

REF: p. 32 OBJ: Discuss the generation of echoes in tissue.
TOP: Echo interaction

23. A range of duty factors is encountered in diagnostic sonography because of various conditions chosen by the instrument and the operator.

ANS: T
A range of duty factors is encountered in diagnostic sonography because of various conditions chosen by the instrument and the operator.

REF: p. 21 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

24. The shorter the pulse, the broader the bandwidth.

ANS: T
The shorter the pulse (fewer number of cycles) is, the more frequencies are present in it (broader bandwidth).

REF: p. 22 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

25. A continuous wave (CW) sinusoidal wave is characterized by multiple frequencies.

ANS: F

A CW sinusoidal wave is characterized by a single frequency.

REF: p. 19 OBJ: Discuss how harmonics are generated.
TOP: Harmonics

26. Sound having a frequency of 10,000 Hz or higher is called *ultrasound*.

ANS: F
Sound with a frequency of 20,000 Hz or higher is called *ultrasound*.

REF: p. 16 OBJ: Define ultrasound and describe how it behaves.
TOP: Basic ultrasound physics

27. With Doppler techniques, the operator controls the pulse repetition frequency.

ANS: T
With Doppler techniques, the operator controls the pulse repetition frequency with the scale control.

REF: p. 20 OBJ: Define ultrasound and describe how it behaves.
TOP: Doppler ultrasound

28. Pulse duration is the time from the beginning of one pulse to the beginning of the next pulse.

ANS: F
Pulse duration is the time from the beginning of one pulse to the beginning of the next pulse.

REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
TOP: Pulse wave

29. Shorter pulses improve the quality of sonographic images.

ANS: T
Shorter pulses improve the quality of sonographic images

REF: p. 21 OBJ: Compare continuous and pulsed ultrasound.
TOP: Pulse wave

30. The actual number of cycles occurring in a second for pulsed ultrasound depends on duty factor.

ANS: T REF: p. 22 OBJ: Compare continuous and pulsed ultrasound.
TOP: Pulse wave