

Ultrasound Physics Vocabulary Quiz

Part 1: Foundations of Sound, Pulsed Ultrasound & Transducers

Chapters 1–10 | Edelman, *Understanding Ultrasound Physics*, 4th Ed.

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Student Name: _____

Date: _____

Instructions: Read each definition or description carefully. Select the **one best answer** (A, B, C, or D) that matches the term described. Write your answer in the space provided after each question.

Chapters 1–2: Introduction to Sound & Wave Parameters

1. The number of complete cycles of a wave that occur in one second, measured in Hertz (Hz). In clinical imaging, this parameter ranges from 2 to 15 MHz.

- A. Period
- B. Wavelength
- C. Frequency
- D. Amplitude

Answer: _____

2. The distance that one complete cycle of a wave occupies in space, measured in millimeters. Higher frequency results in a shorter value for this parameter.

- A. Amplitude
- B. Wavelength
- C. Period
- D. Frequency

Answer: _____

3. The maximum variation of an acoustic variable from its undisturbed (resting) value. It relates to the strength or loudness of the wave.

- A. Intensity
- B. Power
- C. Amplitude
- D. Peak-to-Peak Amplitude

Answer: _____

4. The concentration of power (energy) over a given area, measured in W/cm^2 . Calculated by dividing power by the beam cross-sectional area.

- A. Amplitude
- B. Power
- C. Decibel
- D. Intensity

Answer: _____

5. A wave in which the particle motion is along the same direction as the propagation of wave energy, like the motion of a compressed Slinky.

- A. Compression
- B. Sound Wave
- C. Longitudinal Wave
- D. Rarefaction

Answer: _____

6. When a pair of in-phase waves combine to form a single wave with greater amplitude than either individual wave.

- A. Destructive Interference
- B. Compression
- C. Rarefaction
- D. Constructive Interference

Answer: _____

Chapter 3: Propagation of Sound Through Tissue

7. The speed at which a sound wave travels through a medium. It is determined by the density and stiffness of the medium, not by the sound source. Approximately 1,540 m/s in soft tissue.

- A. Acoustic Impedance
- B. Frequency
- C. Propagation Speed
- D. Attenuation

Answer: _____

8. The resistance of a tissue to the passage of sound, equal to the product of tissue density multiplied by propagation speed. Measured in Rayls.

- A. Stiffness
- B. Attenuation
- C. Acoustic Impedance
- D. Propagation Speed

Answer: _____

9. The ability of a material to resist compression. It is the dominant factor affecting the speed of sound through a medium, and stiffer materials have higher propagation speeds.

- A. Density
- B. Acoustic Impedance
- C. Viscosity
- D. Stiffness

Answer: _____

Chapter 4: Pulsed Ultrasound

10. The number of pulses emitted by the transducer per second, measured in Hz or kHz. Shallow imaging allows a higher value for this parameter.

- A. Pulse Duration
- B. Duty Factor
- C. Pulse Repetition Frequency
- D. Pulse Repetition Period

Answer: _____

11. The physical length of a pulse in space, equal to the number of cycles in the pulse multiplied by the wavelength. This parameter determines axial resolution.

- A. Wavelength
- B. Spatial Pulse Length
- C. Pulse Duration
- D. Bandwidth

Answer: _____

12. The fraction (percentage) of time that the transducer is actively transmitting sound. In diagnostic imaging, this value is very low, typically 0.1–1%.

- A. Pulse Repetition Frequency
- B. Quality Factor
- C. Pulse Duration
- D. Duty Factor

Answer: _____

13. An ultrasound mode that is produced without interruption, requiring two separate crystals: one that continuously transmits and one that continuously receives.

- A. Pulsed Wave
- B. B-Mode
- C. Continuous Wave
- D. M-Mode

Answer: _____

Chapter 5: Interactions of Ultrasound with Tissue

14. The progressive weakening of a sound wave as it travels through tissue, caused by absorption, reflection, and scattering. Measured in decibels (dB).

- A. Absorption
- B. Scattering
- C. Attenuation
- D. Reflection

Answer: _____

15. The change in direction (bending) of a sound wave as it passes from one medium to another at an oblique angle, caused by a change in propagation speed.

- A. Reflection
- B. Scattering
- C. Refraction
- D. Normal Incidence

Answer: _____

16. Reflection from a large, smooth surface (relative to wavelength) that produces a strong, organized echo in one direction. The diaphragm and pericardium are clinical examples.

- A. Scattering
- B. Normal Incidence
- C. Specular Reflection
- D. Refraction

Answer: _____

17. The thickness of tissue required to reduce the intensity of the ultrasound beam to half its original value.
- A. Decibel
 - B. Absorption
 - C. Attenuation
 - D. Half-Value Layer

Answer: _____

Chapters 6–7: Transducers & Beam Characteristics

18. The property of certain crystals (such as PZT) to generate an electrical voltage when mechanically deformed, and to vibrate when an electrical signal is applied.

- A. Acoustic Impedance
- B. Bandwidth
- C. Piezoelectric Effect
- D. Matching Layer

Answer: _____

19. The ability to distinguish two structures lying along the beam's path (one in front of the other). It is determined by the spatial pulse length, with shorter pulses yielding better performance.

- A. Lateral Resolution
- B. Slice Thickness
- C. Axial Resolution
- D. Focal Point

Answer: _____

20. The ability to distinguish two structures lying side by side, perpendicular to the beam. It is determined by beam width, with a narrower beam yielding better performance.

- A. Axial Resolution
- B. Lateral Resolution
- C. Temporal Resolution
- D. Slice Thickness

Answer: _____

21. A layer of material placed on the face of the transducer to reduce the acoustic impedance mismatch between the crystal and the skin, improving sound transmission into the body.

- A. Backing Material
- B. Acoustic Insulator
- C. Piezoelectric Effect
- D. Matching Layer

Answer: _____

Chapter 8: Range Equation & Image Display

22. The formula stating: distance to reflector = (propagation speed $\times$ time) $\div$ 2. The division by 2 accounts for the round-trip travel of the pulse.

- A. Doppler Equation
- B. 13-Microsecond Rule
- C. Continuity Equation
- D. Range Equation

Answer: _____

23. A display method in which returning echo amplitudes are represented as varying shades of gray, from black (no echo) to white (strongest echo). This is the basis for all gray-scale imaging.

- A. A-Mode
- B. M-Mode
- C. Color Doppler
- D. B-Mode

Answer: _____

Chapters 9–10: Arrays & Sound Beams

24. A transducer with many small elements that use electronic time delays to both steer and focus the sound beam, producing a sector-shaped (pie-shaped) image from a small footprint with no moving parts.

- A. Linear Sequential Array
- B. Convex Array
- C. Annular Phased Array
- D. Linear Phased Array

Answer: _____

25. The accuracy of imaging in time, defined as the ability to correctly locate moving structures at any particular instant. It is determined entirely by frame rate.

- A. Axial Resolution
- B. Lateral Resolution
- C. Temporal Resolution
- D. Spatial Resolution

Answer: _____

Score:

/ 25

Percentage:

%

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