



Course title: Basic Physics of Ultrasonographic Imaging

Chapter 1: THE NATURE OF ULTRASOUND

1. Sound is a _____ form of energy.
 - A. mechanical
 - B. chemical
 - C. ionizing
 - D. nuclear

2. _____ is a unit that expresses frequency.
 - A. speed
 - B. kilometer
 - C. hertz
 - D. mile

3. _____ sounds are those which can be perceived by the human ear.
 - A. Infra
 - B. Audible
 - C. Ultra
 - D. Magnetic

4. In most humans, the audible frequency range is approximately _____.
 - A. 20 Hz – 20,000 Hz
 - B. 40 Hz – 40,000 Hz
 - C. 50 Hz – 50,000 Hz
 - D. 60 Hz – 60,000 Hz

5. Ultrasound may be defined as sound energy of frequency higher than _____.
 - A. 20 Hz – 20,000 Hz
 - B. 40 Hz – 40,000 Hz
 - C. 50 Hz – 50,000 Hz
 - D. 20 kilohertz (20 kHz)

6. The sine waveform is characterized by which of the following wave parameters?
 - A. amplitude
 - B. wavelength
 - C. miles
 - D. both A and B

7. The _____ also represents the number of times the wave is repeated per unit time.
 - A. energy
 - B. frequency
 - C. power
 - D. length

8. Ultrasound for medical imaging employs frequencies in the _____ range.
 - A. meter
 - B. kilometer
 - C. megahertz (MHz)
 - D. mile

9. The velocities of ultrasound in the various soft tissues are quite identical.
 - A. TRUE
 - B. FALSE

Chapter 2: GENERATION AND DETECTION OF ULTRASOUND

10. Production of ultrasound relies on the reverse piezoelectric effect, while detection is based on the piezoelectric effect.

- A. TRUE
- B. FALSE

11. In ultrasound which of the following devices convert one form of energy into another?

- A. target
- B. magnetic coil
- C. x-ray tube
- D. transducers

12. The _____ element is the **most** key component of the transducer.

- A. tungsten
- B. lead
- C. crystal
- D. magnetic

13. The crystal _____ controls the frequency of vibrations in ultrasound.

- A. brightness
- B. type
- C. thickness
- D. price

14. The back electrode of the crystal in transducer serves as the live connection, while the front electrode is earthed to protect the patient from _____.

- A. electrical shock
- B. radiation
- C. heat
- D. none of the above

15. The purpose of the backing block is to absorb ultrasonic energy transmitted back into the _____, and hence to quickly damp the oscillations of the crystal following a pulsation.

- A. transducer
- B. x-ray tube
- C. magnetic coil
- D. cathode

16. _____ prevents vibrations originating from the crystal from being transmitted into the transducer housing.

- A. The tube housing
- B. The protective cover
- C. The acoustic insulator
- D. Lead apron

Chapter 3: INTERACTION OF ULTRASOUND WITH MATTER

17. In order to use ultrasound for either diagnostic or therapeutic purposes, a beam of ultrasound must be directed into the _____ of the subject over a selected area of interest.

- A. air
- B. nucleus
- C. protons
- D. tissues

18. The **most** important single interaction process for purposes of generating an ultrasound image is _____.

- A. ionization
- B. reflection
- C. vibration
- D. electronization

19. _____ is a change of beam direction at a boundary between two media in which ultrasound travels at different velocities.

- A. Magnification
- B. Minification

- C. Crystallization
- D. Refraction

20. The medium absorption of energy from the beam is affected by which of the following variables?

- A. the viscosity of the medium
- B. the relaxation time of the medium
- C. the beam frequency
- D. All of the above

21. In soft tissues, absorption of ultrasound increases in direct proportion to the beam frequency.

- A. TRUE
- B. FALSE

22. The _____ of a beam of ultrasound in a specified medium is the distance within that medium which reduces the intensity of the beam to one half of its original value.

- A. ionization
- B. half value thickness (HVT)
- C. vibration
- D. electrification

23. Compartments which allow ultrasound to pass readily through them are referred to as _____.

- A. half value thickness (HVT)
- B. aluminum filters
- C. acoustic windows
- D. step-wedge filters

24. Attenuation of ultrasound increases rapidly with increasing beam _____.

- A. ionization
- B. frequency
- C. vibration
- D. electrification

Chapter 4: INTENSITY OF ULTRASOUND

25. The _____ in a beam of ultrasound is the total energy passing over the whole cross-sectional area of the beam per unit time.

- A. power
- B. magnetism
- C. chemical
- D. x-ray

26. On the relative scale, the intensity at a point of interest is compared to that at some defined reference point and expressed in units called _____.

- A. half value thickness (HVT)
- B. target anode
- C. decibels (dB)
- D. acoustic windows

Chapter 5: ULTRASOUND BEAM SHAPE

27. The ultrasound beam spreads out, or undergoes _____, as it moves away from the transducer.

- A. ionization
- B. divergence
- C. vibration
- D. electrification

28. The shape of the ultrasound beam is affected by which of the following?

- A. the size and shape of the ultrasound source
- B. the beam frequency
- C. beam focusing
- D. All of the above

29. The size of the ultrasound source affects which of the following?
- A. the beam width
 - B. the length of the Fresnel zone
 - C. the angle of divergence beyond the near field
 - D. All of the above

Chapter 6: THE ULTRASOUND IMAGE: GENERATION AND DISPLAY

30. Which of the following basic diagnostic parameters can be determined in ultrasonic imaging?
- A. the size of an echo
 - B. the distance of echo origin from the transducer
 - C. ionization of the tissue
 - D. both A and B
31. Echo ranging is possible only when ultrasound is used in the _____ mode, in which the transducer operation is made to alternate between transmission and reception.
- A. magnetic
 - B. radiation
 - C. pulsed
 - D. intensified
32. The Doppler shift can be measured and used to do which of the following?
- A. detect motion
 - B. determine the direction of motion
 - C. determine the velocity of a moving structure
 - D. All of the above
33. The greater the Doppler shift, the higher the velocity of the moving structure, and a higher detected frequency implies relative motion towards the transducer, while a lower detected frequency implies a receding reflector.
- A. TRUE
 - B. FALSE

Chapter 7: TRANSDUCERS FOR REAL-TIME IMAGING

34. Transducers for real-time imaging may be classified broadly into which of the following categories?
- A. mechanical transducers
 - B. electronic transducers
 - C. ionizing transducers
 - D. both A and B
35. Mechanical transducers are made using either a single _____ or a small group of crystals.
- A. tungsten tile
 - B. lead pile
 - C. piezoelectric crystal
 - D. magnetic strip
36. The crystals in _____ are arranged in a suitable geometrical configuration, or an array, to provide the desired field of view.
- A. mechanical transducers
 - B. electronic transducers
 - C. ionizing transducers
 - D. x-ray tube

Chapter 8: IMAGE CHARACTERISTICS IN CLINICAL ULTRASOUND

37. _____ describes the ability to distinguish between objects located at various positions in space.
- A. Quantum mottle
 - B. Image blurriness
 - C. Spatial resolution
 - D. Intensification
38. _____ resolution is the ability to distinguish between two reflectors situated side by side in a direction perpendicular to that of the ultrasound beam.
- A. Oblique
 - B. Anterior

- C. Lateral
- D. Posterior

39. The longer the spatial pulse length, the better the axial resolution.
A. TRUE
B. FALSE

40. Whereas axial resolution is limited by the length of the ultrasound pulse, the lateral resolution is limited by the _____ of the pulse.
A. width
B. shape
C. pattern
D. color

41. Multiple reflections across tissue boundaries, or between the transducer and tissue boundaries, are known as _____.
A. detective quantum efficiency (DQE)
B. window width
C. pulse repetition frequency (PRF)
D. reverberations

Chapter 9: SAFETY OF DIAGNOSTIC ULTRASOUND

42. The mechanical energy of ultrasound can be transformed into _____ through absorption in tissue, resulting in the elevation of tissue temperature.

- A. gas
- B. radiation
- C. heat
- D. none of the above

43. The World Federation for Ultrasound in Medicine and Biology (WFUMB) recommends that diagnostic exposures that produce a maximum temperature rise of 1.50 C above the normal physiological level of 37°C may be used without reservation.

- A. TRUE
- B. FALSE