



## Professional Ultrasound Services

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### Final Examination No.1

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1. Which of the following quantitative measurements cannot be made using an arterial Doppler spectral waveform?
  - a. Peak systolic velocity
  - b. Resistive Index
  - c. End diastolic velocity
  - d. Distance from surface
2. The electronic device that breaks down a Doppler signal into its basic frequency components is a:
  - a. Spectrum analyzer (FFT)
  - b. Analog waveform generator
  - c. Continuous wave Doppler transducer
  - d. System receiver
3. The reduction in intensity and amplitude of a sound beam as it passes through a medium is called:
  - a. Absorption
  - b. Attenuation
  - c. Refraction
  - d. Resistance
4. Which of the following hemodynamic parameters are not directly observable using Doppler technology?
  - a. Presence of flow
  - b. Flow velocity
  - c. Flow volume
  - d. Flow direction
5. The units used to measure ultrasound intensity are:
  - a. joules
  - b. rayles
  - c. dynes/cm<sup>2</sup>
  - d. mWatts/cm<sup>2</sup>
6. All of the following characteristics of blood affect its flow except:
  - a. Viscosity
  - b. Oxygenation levels
  - c. Volume
  - d. Red blood cell content
7. Which of the following Doppler techniques must be used to obtain quantitative information of blood flow velocity?
  - a. Pulse Doppler
  - b. Continuous wave Doppler
  - c. Color Flow Imaging
  - d. Color Flow Mapping

8. The Doppler shift is defined as the:
  - a. Product of transmitted frequency and received frequency
  - b. Sum of all frequencies received by the transducer
  - c. Difference between transmitted frequency and the received frequency
  - d. Difference between received frequency and the average frequency
9. As frequency increases in a sound wave; wavelength:
  - a. Increase
  - b. Decreases
  - c. Remains the same
10. Acoustic impedance is defined as:
  - a. Product of velocity and density
  - b. Sum of velocity and density
  - c. Difference in density and stiffness
  - d. Sum of velocity and stiffness
11. Which of the following factors will not affect the **intensity** of the Doppler shift?
  - a. Velocity of scatterers
  - b. Quantity of scatterers present in fluid
  - c. Frequency of transmitted sound
  - d. Difference in acoustic impedance
12. The Doppler effect is best characterized as a change in:
  - a. Frequency
  - b. Velocity
  - c. Speed
  - d. Direction
13. An ultrasound transducer receives an echo whose frequency is 0.25MHz greater than the frequency emitted. The imaging system will display this information:
  - a. Below the baseline on a frequency spectrum
  - b. Above the baseline on a frequency spectrum
  - c. As the hue on the bottom of the color bar
  - d. As an area of increased saturation in a color Doppler map
14. On a Doppler spectral display, which parameter is displayed on the X (horizontal) axis?
  - a. Depth
  - b. Velocity
  - c. Amplitude
  - d. Time
15. The characteristics of a medium that determine propagation speed of ultrasound through it are:
  - a. Density, compressibility
  - b. Stiffness; mass
  - c. Density; weight
  - d. Volume; acoustic impedance
16. The number of wavelengths passing a given point in a single second is called:
  - a. Velocity
  - b. Frequency
  - c. Acoustic impedance
  - d. Period

17. A structure that has a varied echo-texture throughout may be described sonographically as:
- Hypoechoic
  - Homogenous
  - Hyperechoic
  - Heterogenous
18. The tendency of a body to stay at rest unless acted upon by a force is the definition of:
- Friction
  - Pressure
  - Viscosity
  - Inertia
19. In a spectral waveform displaying arterial flow, the horizontal (x) axis represents:
- Respiratory phasicity
  - The cardiac cycle
  - Velocity of flow
  - Amplitude of flow
20. A very light, lowly saturated color displayed in the center portion of an artery using color Doppler imaging represents:
- Relatively high velocity flow
  - Relatively low velocity flow
  - Flow reversal
  - Turbulence
21. The ability to discern two point reflectors perpendicular to the long axis of a sound beam is called:
- Axial resolution
  - Temporal resolution
  - Lateral resolution
  - Focal resolution
22. Arterial flow, as displayed on a Doppler spectral waveform, that demonstrates a brief flow reversal in early diastole suggests that the distal vascular bed is:
- Metabolically very active
  - Metabolically not very active
  - Ischemic
  - Inadequately perfused
23. The formula for Doppler shift is:
- $F_D = F_r + F_o$
  - $F_D = F_r \times F_o$
  - $F_D = F_o - F_r$
  - $F_D = F_r - F_o$
24. Which of the following CW audio parameters is not consistent with venous flow?
- Phasicity
  - Pulsatility
  - Subtle changes in frequency over time
  - Changes in flow with changes in respiration
25. Blood flow varies \_\_\_\_\_ with viscosity of the blood.
- Inversely
  - Directly
  - Not at all

26. The inherent ability of a material to convert one form of energy into another is called:
- Scan conversion
  - Pressure gradient
  - Isotropy
  - Piezoelectricity
27. Which of the following expresses the correct mathematical relationship between wavelength, frequency and velocity?
- $w = f/v$
  - $w = fv$
  - $f = vw$
  - $v = fw$
28. In ultrasound physics and instrumentation studies, intensity is defined as:
- Energy/unit volume
  - Amplitude<sup>2</sup>
  - Power<sup>4</sup>
  - Mass/unit volume
29. If an ultrasound beam is emitted with a resonant frequency of 5.0MHz and the transducer receives a frequency returning from the body at 4.5MHz, what is the Doppler shift?
- 0.5 MHz
  - +0.5 MHz
  - 5.5 MHz
  - +5.5MHz
30. The primary source of scattering in the human body that produces nearly all the Doppler information processed in diagnostic medical sonography is:
- Leukocytes
  - Erythrocytes
  - Plasma protein
  - Platelets
31. On a Doppler spectral display, flow toward the transducer is displayed as:
- A brighter shade of gray on the waveform
  - A darker shade of gray on the waveform
  - Information displayed above the baseline
  - Information displayed below the baseline
32. The primary source of energy that induces the flow of blood in the human circulatory system is:
- Gravity
  - Cardiac contractions
  - Thoracic pump mechanism
  - Inertia
33. Continuous forward flow throughout the cardiac cycle in an artery as demonstrated on Doppler spectral display suggests that:
- There may be right-sided heart failure
  - The artery is too large
  - The distal vascular bed requires constant perfusion
  - The distal vascular bed is metabolically inactive

34. Which of the following is not an advantage of real-time sonography over static imaging methods?
- Demonstration of organ excursion
  - Measurement of pathologic masses
  - Optimization of imaging windows
  - Reduced overall scan time
35. The bending of a horizontally traveling sound wave away from incident direction is called:
- Reflection
  - Divergence
  - Dissonance
  - Refraction
36. In color Doppler imaging physics, saturation is best defined as:
- The strength or purity of a color
  - The brightness of reflected light waves
  - The color reflected or transmitted from an object
  - The technique of plotting relative velocity of flow
37. An ultrasound transducer receives an echo whose frequency is 0.66MHz less than the frequency emitted. The imaging system will display this information:
- As the hue on the top of the color bar
  - Above the baseline on a frequency spectrum
  - Below the baseline on a frequency spectrum
  - As an area of decreased saturation in a color Doppler map
38. A continuous wave Doppler ultrasound transducer contains:
- One crystal; alternating between transmitting and receiving
  - Two crystals; one transmitting, one receiving
  - An array of crystals with varying pulsed-echo sequences
  - Two crystals; both continuously transmitting
39. Spectral waveforms display blood flow:
- Change in velocity with depth in tissue
  - Change in velocity over time
  - Relative velocities and direction of flow
  - Flow volume over time
40. The law that relates vascular wall tension to fluid pressure within a blood vessel was postulated by:
- Laplace
  - Curie
  - Poiseuille
  - Bernoulli
41. The amplitude of a sound beam is best described in terms of its:
- Period
  - Strength
  - Frequency
  - Phase
42. Streamlining of blood flow with higher velocities in the center of the vessel and slower velocities along the walls is called \_\_\_\_\_ flow.
- Plug
  - Turbulent
  - Laminar
  - Reynold's

43. Increased saturation in a color Doppler image represents:
- Higher velocity flow
  - Lower velocity flow
  - Flow toward the transducer
  - Flow away from the transducer
44. The engineering principle that allows selective acquisition of Doppler data from operator determined depths within a blood vessel is called:
- Sensitivity zoning
  - Spectral analysis
  - Fast Fourier Transform (FFT)
  - Gating
45. The type of sonographic display modality in which the brightness of a pixel displayed on the screen is proportional to the amplitude of the returning echo is called:
- Real-time
  - B-mode
  - A-mode
  - Spectral display
46. The type of real-time imaging probe that produces a triangular shaped image by altering the firing sequence of multiple transducer crystals aligned along the face of the probe is a:
- Mechanical sector
  - Phased linear array
  - Phased sector
  - Sequential linear array
47. Heat sterilizing an ultrasound transducer:
- Is the method of choice with biopsy transducers
  - Will eliminate its piezoelectric properties
  - Can melt the epoxy backing material
  - Can be done if Cidex solution is not available for disinfecting endovaginal transducers
48. Which of the following modalities does not provide Doppler information?
- Continuous wave
  - M-mode
  - Pulse echo
  - Color flow
49. The primary function of the circulatory system is:
- Transportation
  - Oxygenation
  - Physiologic exchange
  - Blood flow
50. On a Doppler spectral display, which parameter is displayed on the Y (vertical) axis?
- Depth
  - Velocity
  - Amplitude
  - Time

51. Which of the following is a simple, yet accurate, definition of the use of a Fast Fourier Transform in Doppler ultrasound applications?
- A technique for determining depth, or range, of a given Doppler signal
  - A device that separates transmit and received frequencies, allowing calculation of the Doppler shift
  - A method of analyzing all the component frequencies in a single Doppler signal
  - A method of transforming Doppler data into imaging data
52. Approximately 80% of energy loss as ultrasound travels through soft tissue is due to:
- Reflection
  - Refraction
  - Absorption
  - Divergence
53. In real-time sonography, at least 25 single "static" images must be displayed in one second to achieve the illusion of motion. This is called:
- Frame time
  - PRF
  - Flicker fusion rate
  - Frame rate
54. The material that is most commonly used in constructing ultrasound transducer elements is:
- Lead zirconate titanate
  - Beryllium
  - Rochelle salt
  - Epoxy
55. For an ultrasonic reflection to occur, which of the following conditions is essential?
- A flat interface
  - A change in wavelength as the beam travels through a medium
  - Cystic and solid tissue in the same structure
  - A difference in acoustic impedance between two media
56. What two condition must be met for specular reflection to occur?
- Difference in acoustic impedance; oblique incidence
  - Change in velocity; a curved reflecting surface
  - Difference in acoustic impedance; normal incidence
  - Change in frequency; moving red blood cells
57. Which of the following formulae accurately expresses the relationship between variables found in the clinical Doppler formula:

a.  $F_d = \frac{2 F_o V}{C} \cos \theta$

c.  $F_d = \frac{F_o V}{C} \cos \theta$

b.  $F_d = \frac{2 F_o C}{V} \cos \theta$

d.  $F_d = \frac{2 F_r V}{C} \cos \theta$

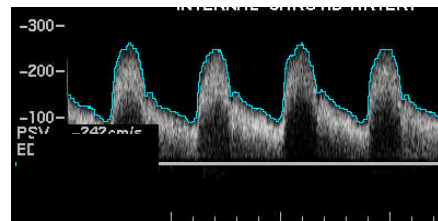
58. Direction of flow on a color Doppler flow map is plotted using:
- Saturation of color
  - Hue
  - Variance in hue
  - Luminance

59. If an ultrasound beam is emitted with a resonant frequency of 5.0MHz and the transducer receives a frequency returning from the body at 6.5MHz, what is the Doppler shift?
- 1.5 MHz
  - +1.5 MHz
  - 11.5 MHz
  - +11.5MHz
60. Arterial circulation carries all of the following human tissue except:
- Oxygen
  - Heat
  - Nutrients
  - Metabolic waste products
61. As the diameter of an artery increase; blood flow volume:
- Increases
  - Decreases
  - Does not change
62. The average propagation speed of ultrasound in human soft tissue is approximately:
- 1540 cm/sec
  - 1.54 m/sec
  - 1540 m/sec
  - 6.5  $\mu$ s/cm
63. A simple cyst will demonstrate all of the following sonographic characteristics except:
- Posterior acoustic shadowing
  - Good through transmission
  - Posterior acoustic enhancement
  - Anechoic lumen
64. A common unit of measuring arterial flow velocity is:
- dynes / cm
  - dynes / cm<sup>2</sup>
  - cm<sup>3</sup> / second
  - meters / second
65. Which of the following hemodynamic parameters are not displayed on an arterial Doppler spectral waveform?
- Depth of vessel being interrogated
  - Velocity
  - Cardiac cycle
  - Time
66. Hemodynamics is a field of study that relates to:
- Arterial and venous circulation
  - Capillary exchange of dynamic flow
  - Forces and motion of blood flow
  - Dynamic oxygenation of tissue
67. The region which is common to both the transmitted ultrasonic field and the listening area of the receiving crystal in a CW Doppler probe is called the:
- Crossover area
  - Transmit focal zone
  - Focal zone
  - Sensitivity zone

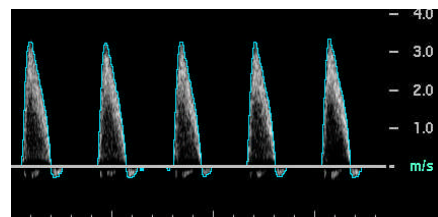
68. Which of the following formulae demonstrate the “range equation”?
- $d = 2vt$
  - $d = vt$
  - $t = dv$
  - $v = td$
69. Spatial pulse length is a product of:
- Velocity; pulse repetition period
  - Frequency; period
  - Wavelength; cycles per pulse
  - Wavelength; velocity
70. The relationship between two waves relative to their occurrence in time is called:
- Period
  - Frequency
  - Phase
  - Amplitude
71. The typical rate of attenuation of ultrasound in human soft tissue is approximately:
- 1.54 dB/cm/sec
  - 0.6 dB/rayle
  - 1 dB/cm/KHz
  - 1 dB/cm/MHz
72. The technique used to adjust the amplitude of returning echoes so that signals received from deep reflectors in the body will appear on an ultrasound image with the same level of brightness as those received from close reflectors is:
- Gain compensation
  - Overall gain
  - Pre-processing
  - Baseline
73. Constructive interference has the effect of \_\_\_\_\_ the amplitude of a sound wave.
- Increasing
  - Decreasing
  - Not changing
74. A positive value Doppler shift indicates flow is:
- Toward the sound source
  - Away from the sound source
  - Faster
  - Slower
75. Duty factor is a measure of:
- Beam quality
  - Beam intensity
  - Beam geometry
  - Beam divergence
76. The sonographic imaging system component that controls the timing of pulse generation, receive time between pulses, and all other timing of firing and receiving functions is the:
- Master generator
  - Clock
  - Master synchronizer
  - Pulser

77. Which of the following is not a function of the ultrasound system receiver?
- Demodulation
  - Compression
  - Post-processing gray scale assignment
  - Amplification
78. The only component of attenuation that actually removes energy from a sound beam is:
- Reflection
  - Refraction
  - Absorption
  - Divergence
79. On a color Doppler image, the hue at the top of the color bar indicates:
- High velocity flow
  - Low velocity flow
  - Flow away from the transducer
  - Flow toward the transducer
80. The primary reason that Rayleigh scattering occurs in human blood is that:
- Blood has an acoustic impedance slightly less than surrounding soft tissue
  - Particulate matter in blood causes micro-refraction
  - Red blood cells are smaller than ultrasound wavelengths
  - Plasma moves at a velocity less than 1540 m/sec
81. The electronic process by which low-level signals are selectively eliminated from further signal processing is called:
- Rejection
  - Repression
  - Depth gain compensation
  - Modulation
82. The law that predicts volume of flow in a straight was postulated by:
- Laplace
  - Curie
  - Poiseuille
  - Bernoulli
83. In a digital scan converter, how many memory pixels are typically available for storage?
- 1,540,000
  - 262, 144 (512 x 512)
  - 1,000,000 (1,000 x 1,000)
  - an infinite number
84. Which of the following clinical evaluations cannot be made using continuous wave Doppler devices?
- Identifying the fetal heart beat
  - Grading an arterial stenosis
  - Estimating arterial flow velocity
  - Detecting arterial flow presence after surgery
85. The imaging system component that stores electronic signals provided by the receiver is the:
- Scan converter
  - Demodulator
  - Transducer
  - Oscilloscope

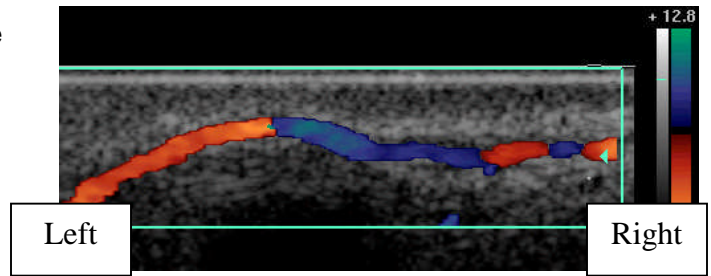
86. The value (positive, negative) of a Doppler signal is determined by:
- Operator controls
  - Receiver sensitivity
  - Transmitted frequency
  - Direction of reflector movement
87. As the frequency of the incident sound beam increases, the Doppler shift intensity:
- Increases
  - Decreases
  - Remains the same
88. The scanner component that sends bursts of electricity to the transducer is the:
- Insulation coil
  - Dielectrical backing
  - Pulser
  - Scan converter
89. The ultrasound application that permits selective acquisition of hemodynamic information from a specific depth within the human body is called:
- Continuous wave Doppler
  - Color blood flow mapping
  - Pulsed Doppler
  - Doppler analog waveform analysis
90. The breakdown of normal, parabolic blood flow patterns in an artery is called \_\_\_\_\_ flow.
- Turbulent
  - Chaotic
  - Plug
  - Phasic
91. Choose the statement that best describes the hemodynamic activity displayed in the following spectral waveform.
- Flow toward the transducer during systole; away from the transducer during diastole
  - Flow toward the transducer throughout the cardiac cycle
  - Flow velocities remain the same, no change in direction throughout the cardiac cycle
  - Flow away from the transducer throughout the cardiac cycle.



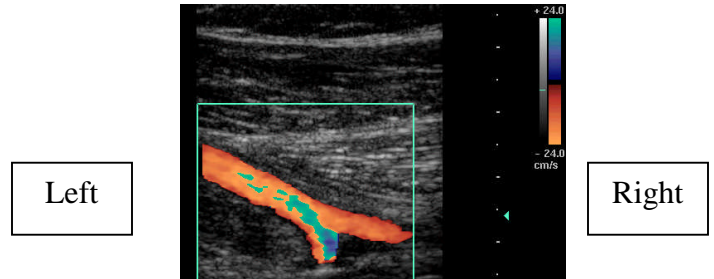
92. In the above velocity spectrum, what is the approximate Peak Systolic Velocity?
- 100 cm/s
  - 200 cm/s
  - 250 cm/s
  - 300 cm/s
93. The spectral waveform on the right represents blood flow that is:
- High velocity; high resistance
  - High velocity, low resistance
  - Low velocity, low resistance
  - Low velocity, high resistance



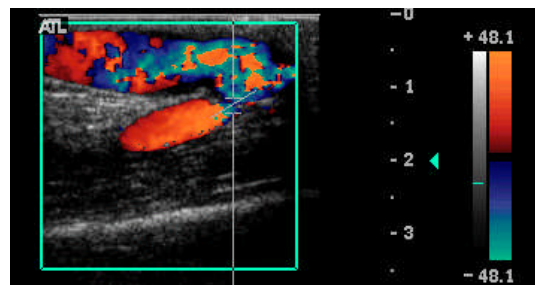
94. Blood flow in the color Doppler image to the right is:
- To the right
  - To the left
  - Alternating, right to left
  - Alternating, left to right



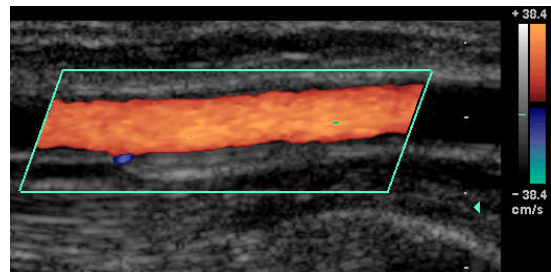
95. Blood flow in this color Doppler image is:
- To the right
  - To the left
  - Alternating, right to left
  - Alternating, left to right



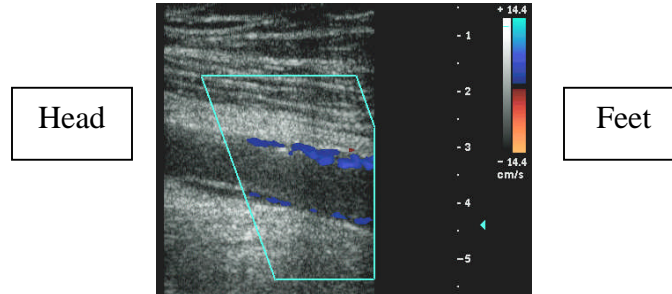
96. The color flow pattern displayed in the adjacent image represents:
- Laminar flow
  - Phasic flow
  - Turbulent flow
  - Triphasic flow



97. The color flow pattern displayed in the adjacent image represents:
- Laminar flow
  - Phasic flow
  - Turbulent flow
  - Triphasic flow



98. Which of the following statements best interprets the image below?
- Homogenous, echogenic filling of a vessel lumen with some residual flow toward the patient's head.
  - Homogenous, echogenic filling of the vessel with complete occlusion of the vessel.
  - Turbulent, low velocity flow in a vessel with flow toward the head.
  - Laminar, low velocity flow in an occluded vessel with flow toward the feet.



99. A papilla is best described as:
- Solid polyp
  - A solid irregularity of the inner surface of a cystic mass
  - A nipple-like protuberance into the lumen of a structure
  - A complex wall irregularity
100. The highest speed of sound would be recorded through which body structure?
- Lung
  - Bone
  - Muscle
  - Blood