COMPREHENSIVE MOCK EXAM 2

Supplemental to: Ultrasound Physics Board Review 2026-2027

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ARDMS SPI (Sonography Principles and Instrumentation) Exam — 110 questions, single-best-answer multiple choice, domain-weighted per the official V24.1 blueprint (23% Perform Ultrasound Examinations / 7% Manage Transducers / 26% Optimize Sonographic Images / 34% Apply Doppler Concepts / 10% Clinical Safety & QA)

Board-Review Questions

1. A sonographer needs to calculate transmitted frequency from a system readout showing a period value of 0.4 microseconds per cycle. What is the resulting frequency?

A. 0.4 MHz

B. 1 MHz

C. 1.5 MHz

D. 2.5 MHz

2. Which of the following best describes wavelength?

A. The distance one complete cycle occupies in space

B. The number of cycles occurring per second

C. The time required for one complete cycle

D. The maximum variation of an acoustic variable from its average value

3. As frequency increases, wavelength in a given medium behaves in which of the following ways?

A. Increases proportionally with frequency

B. Remains entirely unchanged regardless of frequency

C. Decreases proportionally as frequency increases

D. Varies unpredictably with no genuine mathematical relationship

4. Diagnostic ultrasound systems assume every returning echo traveled at a single, fixed propagation speed through soft tissue. If the true tissue speed genuinely differs from this assumed value, what is the direct consequence?

A. The system automatically recalculates and corrects the assumed value

B. A genuine distance-measurement error results, since depth is calculated from this assumption

C. Axial resolution improves proportionally to the actual speed difference

D. No genuine consequence occurs, since distance calculation ignores propagation speed

5. Propagation speed through a medium is primarily determined by which of the following properties?

A. The frequency of the transmitted ultrasound pulse

B. The stiffness and density of the medium itself

C. The amplitude of the transmitted pulse

D. The pulse repetition frequency selected by the operator

6. Compared to propagation speed in soft tissue, propagation speed in bone is which of the following?

A. Faster, due to bone's genuinely greater stiffness

B. Slower, due to bone's greater density alone

C. Identical, since speed is frequency-independent

D. Immeasurable using any standard clinical technique

7. A beam is observed to genuinely weaken progressively as it travels deeper into tissue, from a combination of absorption, reflection, and scattering. This progressive weakening is best described as which of the following?

A. The frequency shift observed from a genuinely moving reflector

B. The conversion of returning echoes into a displayed image

C. The rate at which pulses are transmitted each second

D. Attenuation, the progressive weakening of the beam with depth

8. The primary mechanism responsible for attenuation in soft tissue is which of the following?

A. Reflection occurring at every tissue interface encountered

B. Absorption, converting acoustic energy into heat

C. Scattering from red blood cells exclusively

D. Refraction occurring at oblique tissue boundaries

9. A sonographer needs to estimate total attenuation and selects the soft-tissue attenuation coefficient for the calculation. Which of the following values is the standard approximation used?

A. 1.0 decibels per centimeter, independent of frequency

B. 1.54 decibels per centimeter, independent of frequency

C. 0.3 decibels per centimeter per megahertz

D. 0.5 decibels per centimeter per megahertz

10. Using the standard soft-tissue attenuation coefficient, what is the approximate total round-trip attenuation for a 5 MHz beam traveling to a depth of 4 cm and returning?

A. 5 decibels of total attenuation

B. 10 decibels of total attenuation

C. 15 decibels of total attenuation

D. 20 decibels of total attenuation

11. A sonographer wants to know the specific depth at which beam intensity has fallen to exactly half of its original transmitted value. Which concept directly describes this depth?

A. The depth at which spatial pulse length is genuinely halved

B. The frequency at which a transducer's bandwidth is centered

C. The half-value layer, a direct measure of depth-dependent attenuation

D. The point at which duty factor equals exactly 50 percent

12. Higher-frequency transducers genuinely experience attenuation that is which of the following, all else held equal?

A. Greater, resulting in shallower effective penetration depth

B. Lesser, resulting in deeper effective penetration depth

C. Identical to lower-frequency transducers at every depth

D. Entirely unrelated to the transducer's operating frequency

13. A sonographer needs to predict how strongly two tissue types will reflect sound at their shared boundary and must first determine each tissue's acoustic impedance. Acoustic impedance itself is calculated as which of the following?

A. Tissue density multiplied by propagation speed

B. Frequency multiplied by wavelength

C. Amplitude divided by period

D. Intensity multiplied by the attenuation coefficient

14. A sonographer images a large, smooth diaphragm interface and observes a strong, predictable, mirror-like echo. Which type of reflection is genuinely responsible for this appearance?

A. Non-specular, diffuse reflection, unrelated to interface size

B. Rayleigh scattering, unrelated to true reflection at all

C. Specular reflection, predictable and mirror-like in character

D. Refraction only, with no genuine reflection present

15. Non-specular, diffuse reflection occurs at interfaces that are genuinely which of the following?

A. Perfectly smooth and large relative to the wavelength

B. Irregular in shape, or small relative to the wavelength

C. Oriented perpendicular to the beam exclusively

D. Composed entirely of cortical bone tissue

16. Rayleigh scattering describes sound redirected in many directions from structures that are genuinely which of the following?

A. Much larger than the ultrasound wavelength itself

B. Exactly equal in size to the ultrasound wavelength

C. Much smaller than the ultrasound wavelength itself

D. Located exclusively at major organ boundaries

17. Refraction, the genuine bending of the ultrasound beam, occurs when a beam crosses an oblique boundary between two media with which of the following?

A. A genuine propagation speed difference between the two media

B. Identical acoustic impedance values in both media

C. Identical attenuation coefficients in both media

D. No density difference whatsoever between the two media

18. Snell's Law describes the mathematical relationship governing which of the following?

A. Attenuation as a function of increasing depth

B. The Doppler frequency shift from moving blood

C. The angle of refraction at an oblique tissue boundary

D. Axial resolution as a function of spatial pulse length

19. Pulse repetition period (PRP) refers to which of the following?

A. The time from the start of one pulse to the start of the next

B. The number of pulses genuinely transmitted each second

C. The time the system is actively transmitting a pulse

D. The physical length occupied by a single pulse

20. Pulse repetition frequency (PRF) is genuinely inversely related to which of the following?

A. Duty factor, a separate but related parameter

B. Pulse repetition period, its direct mathematical inverse

C. The number of cycles genuinely present in each pulse

D. Propagation speed through the specific medium scanned

21. A system is actively transmitting sound for only a small fraction of each pulse repetition period, spending the remainder of the time listening for returning echoes. This fraction of active transmission time is genuinely known as which of the following?

A. Duty factor, the fraction of time spent actively transmitting

B. The total number of cycles present in a single pulse

C. The specific operating frequency of the transducer itself

D. The speed of sound through the specific medium scanned

22. For standard pulsed ultrasound imaging, typical duty factor values are approximately which of the following?

A. Approximately 50 to 75 percent of total time

B. Genuinely less than 1 percent of total time

C. Exactly 100 percent of total time, continuously

D. Approximately 25 percent of total time

23. A transducer emits a pulse containing 3 cycles at a wavelength of 0.4 mm. What is the resulting spatial pulse length?

A. 1.2 millimeters, the product of cycle count and wavelength

B. 0.4 millimeters, equal to the wavelength alone

C. 3 millimeters, equal to the cycle count alone

D. 0.13 millimeters, the wavelength divided by cycle count

24. Decreasing the number of cycles per pulse, thereby shortening spatial pulse length, genuinely improves which of the following?

A. Lateral resolution exclusively, with no other genuine effect

B. Axial resolution, the along-the-beam resolving capability

C. Temporal resolution exclusively, with no other genuine effect

D. Contrast resolution exclusively, with no other genuine effect

25. Which of the following is an appropriate ergonomic practice to genuinely reduce a sonographer's musculoskeletal injury risk during scanning?

A. Maintaining a neutral wrist position and adjusting equipment height

B. Gripping the transducer as tightly as possible for maximum control

C. Scanning exclusively with the arm fully extended from the body

D. Avoiding any use of adjustable equipment to keep technique consistent

26. A transducer element produces a measurable voltage in direct response to being mechanically compressed by a returning echo. This behavior is a direct demonstration of which of the following?

A. Electronic beam steering, achieved through timed element firing

B. The piezoelectric effect, the transducer's foundational mechanism

C. Scan conversion, translating echo data into a display format

D. The matching layer's function in reducing impedance mismatch

27. The matching layer in a transducer assembly serves which of the following purposes?

A. Reduces impedance mismatch between the element and the skin

B. Increases the element's fundamental resonant frequency value

C. Provides electrical insulation between adjacent elements

D. Physically focuses the beam at a single fixed depth

28. A transducer element continues to vibrate briefly after its initial excitation unless something behind it actively dampens this ringing. Which component genuinely performs this dampening function?

A. The matching layer, positioned at the transducer face

B. The acoustic lens, focusing the beam in the elevational plane

C. Backing material, positioned directly behind the element

D. The transducer housing, providing structural support only

29. A curvilinear (curved) array transducer is genuinely best suited for which of the following applications?

A. Superficial, high-resolution imaging exclusively, such as thyroid

B. Cardiac imaging exclusively, through a narrow intercostal window

C. Abdominal imaging, providing a genuinely wide field of view at depth

D. Endocavitary imaging exclusively, through a small physical footprint

30. A phased array transducer needs to steer and focus its beam toward a specific location without any physical movement of the array itself. Which mechanism makes this genuinely possible?

A. A fixed acoustic lens permanently bonded to the transducer face

B. Precisely timed firing delays applied across the element sequence

C. Selecting a genuinely higher transmitted frequency for that scan line

D. Physically rotating the entire transducer housing during acquisition

31. Grating lobes are genuinely a consequence of which of the following?

A. The array's individual element spacing relative to wavelength

B. An excessively low transmitted frequency for the current application

C. An improperly matched acoustic backing material behind the array

D. A transducer face that has become physically damaged or cracked

32. An unfocused transducer's beam is observed to genuinely narrow with increasing depth, up to a certain point, rather than immediately diverging. This behavior is characteristic of which region of the beam?

A. The far field (Fraunhofer zone), beyond the natural focus

B. A region where genuine acoustic energy is entirely absent

C. The near field (Fresnel zone), before the natural focus

D. A region unaffected by the transducer's physical diameter

33. A matrix array transducer differs from a standard one-dimensional array in which of the following ways?

A. It contains only a single piezoelectric element overall

B. It cannot perform any genuine electronic beam steering

C. It is used exclusively for continuous-wave Doppler applications

D. It contains a true two-dimensional grid enabling steering in two planes

34. The pulser's primary function in the pulse-echo instrumentation chain is which of the following?

A. Generating the electrical voltage that excites the transducer element

B. Amplifying the weak returning echo signal for display purposes

C. Converting the returning echo into a displayed gray-scale value

D. Storing the completed final image for later clinical review

35. Which of the following is a genuine function of the receiver in the pulse-echo instrumentation chain?

A. Amplifying, compensating, compressing, and demodulating the returning signal

B. Generating the initial voltage pulse exciting the transducer element

C. Physically steering the beam electronically across the field of view

D. Converting the analog signal directly into a permanent printed copy

36. Dynamic range refers to which of the following?

A. The physical distance from the transducer face to the deepest point

B. The total number of pixels genuinely displayed across the image

C. The number of pulses transmitted by the system each second

D. The ratio between the largest and smallest signal amplitudes processed

37. Compression, applied by the receiver, serves which of the following purposes?

A. Increases the total number of gray shades displayed without limit

B. Physically shortens the transmitted pulse for better resolution

C. Eliminates weak echo signals from the display entirely

D. Reduces the dynamic range to fit the display's genuine capability

38. Time gain compensation (TGC) serves which of the following purposes?

A. Compensates for depth-dependent attenuation, equalizing brightness at depth

B. Increases the transmitted frequency for structures at greater depth

C. Physically steers the beam toward deeper structures preferentially

D. Eliminates the need for any further receiver processing at all

39. If time gain compensation is set inappropriately with excessive near-field gain, the resulting image will genuinely show which of the following?

A. A uniformly dark image throughout the entire field of view

B. An abnormally bright near field relative to equivalent deeper tissue

C. A complete absence of any near-field signal whatsoever

D. An image entirely unaffected by the TGC adjustment made

40. Overall gain, as a receiver control, affects which of the following?

A. Only the near-field portion of the displayed image itself

B. Only the far-field portion of the displayed image itself

C. The transmitted frequency selected for the current exam

D. The amplification applied uniformly across the entire receiver signal

41. Excessive overall gain, applied without a corresponding clinical need, most directly risks which of the following?

A. Introducing noise into the displayed image without adding information

B. Physically damaging the transducer element through genuine overuse

C. Permanently altering the assumed propagation speed constant used

D. Eliminating all genuine anatomic detail from the display entirely

42. Brightness (grayscale value) assigned to a given pixel is directly determined by which of the following?

A. The amplitude of the returning echo at that specific location

B. The total element count within the transducer array in use

C. The current pulse repetition frequency setting selected

D. The specific frequency of the transducer used for that exam

43. Scan conversion refers to which of the following processes?

A. Converting analog transmitted pulses into a digital output signal

B. Converting the transducer's element count into a resolution value

C. Converting acquired echo data into proper format for screen display

D. Converting the assumed propagation speed into a corrected value

44. Frame rate refers to which of the following?

A. The number of complete images genuinely displayed per second

B. The number of individual scan lines within a single image

C. The number of focal zones selected for the current exam

D. The specific frequency of the transducer currently in use

45. Increasing imaging depth, all else held equal, has which of the following effects on frame rate?

A. Decreases frame rate, since each pulse requires more return time

B. Increases frame rate, since genuinely fewer scan lines are needed

C. Has no genuine effect on frame rate under any circumstance

D. Only affects frame rate when color Doppler is also active

46. Increasing the number of focal zones selected, all else held equal, has which of the following effects on frame rate?

A. Increases frame rate, since each zone requires less processing time

B. Decreases frame rate, since additional pulses are required per line

C. Has no genuine effect on frame rate under any circumstance

D. Only affects frame rate when persistence is also increased

47. Two structures sit at different depths, one directly behind the other along the beam's own path. The minimum distance between them required to display them as genuinely separate structures is which of the following?

A. The minimum side-by-side distance perpendicular to the beam

B. The ability to distinguish genuinely different tissue types

C. The number of complete images displayed on-screen per second

D. Axial resolution, measured directly along the beam's own axis

48. Two structures sit side-by-side, perpendicular to the beam's axis, at the same depth. The minimum distance between them required to display them as genuinely separate structures is which of the following?

A. Axial resolution, measured along the beam's own axis

B. Lateral resolution, measured perpendicular to the beam itself

C. The system's ability to distinguish different tissue echogenicities

D. The number of complete images displayed on-screen per second

49. Lateral resolution is genuinely best at which of the following locations along the beam?

A. Immediately at the transducer face itself, in the very near field

B. At the greatest depth the system can genuinely image at all

C. At the focal zone, where the beam is genuinely narrowest

D. Lateral resolution does not genuinely vary with depth at all

50. A sonographer needs to distinguish two adjacent tissue regions that differ only subtly in their genuine echogenicity, not in their physical location. Which capability governs this specific distinction?

A. The minimum distance between two structures along the beam's axis

B. The number of complete images displayed on-screen per second

C. Contrast resolution, distinguishing subtle echogenicity differences

D. The minimum side-by-side distance between two structures

51. Increasing the number of gray shades a system can display genuinely improves which of the following?

A. Axial resolution exclusively, with no other genuine effect

B. Lateral resolution exclusively, with no other genuine effect

C. Temporal resolution exclusively, with no other genuine effect

D. Contrast resolution, distinguishing subtle echogenicity differences

52. Preprocessing, applied by the system, refers to which of the following?

A. Manipulation of image data before it is genuinely stored in memory

B. Manipulation of image data only after it has already been frozen

C. Manipulation applied exclusively to a genuine hard-copy printout

D. Manipulation that permanently alters the raw acquired echo data

53. Postprocessing, applied by the system, refers to which of the following?

A. Manipulation of image data before it is genuinely stored in memory

B. Manipulation applied exclusively during initial pulse-echo acquisition

C. Manipulation that requires re-scanning the patient to take effect

D. Manipulation of already-acquired, stored image data for display

54. Persistence, as an image-processing control, serves which of the following purposes?

A. Permanently alters the transmitted frequency for the current exam

B. Increases the true frame rate beyond the system's genuine capability

C. Averages sequential frames, reducing noise but possibly blurring motion

D. Eliminates the need for any further gain adjustment whatsoever

55. Excessive persistence applied during an exam involving genuine motion risks which of the following?

A. Eliminating all genuine noise from the displayed image entirely

B. Blurring genuinely moving structures across sequential frames

C. Permanently improving axial resolution beyond system capability

D. Eliminating the need for any TGC adjustment whatsoever

56. Electronic zoom ("pan zoom"), applied after image acquisition, genuinely provides which of the following?

A. Genuinely improved resolution through additional acquired scan lines

B. A magnified view of already-acquired data, with no new resolution

C. A completely new acquisition using different transducer elements

D. Improved penetration depth beyond what was originally acquired

57. Write zoom, applied during image acquisition itself, genuinely provides which of the following advantage over zoom applied afterward?

A. No genuine advantage exists between the two zoom types at all

B. Write zoom genuinely increases the transducer's total element count

C. Write zoom genuinely acquires additional scan lines, improving resolution

D. Write zoom eliminates the need for any further gain adjustment

58. A sonographer notes that an image appears too dark overall, with structures that should be genuinely visible appearing black. Which control adjustment is most directly appropriate?

A. Decrease overall gain further still, regardless of current setting

B. Decrease persistence, since persistence controls overall brightness

C. Decrease dynamic range, since a narrower range increases brightness

D. Increase overall gain, appropriately amplifying the receiver signal

59. A sonographer notes that structures at depth appear genuinely dimmer than equivalent, closer structures despite appropriate overall gain. Which control adjustment is most directly appropriate?

A. Decrease the transmitted frequency, since higher frequency causes this

B. Increase persistence, since persistence compensates for depth dimming

C. Decrease dynamic range, narrowing the genuine displayed range shown

D. Increase TGC at the corresponding depth, compensating for attenuation

60. Which of the following knobology adjustments would most appropriately improve axial resolution for a superficial structure?

A. Decrease overall gain to reduce genuine image noise present

B. Increase persistence to average multiple sequential frames together

C. Select a higher-frequency transducer, shortening spatial pulse length

D. Increase dynamic range to display additional genuine gray shades

61. Which of the following knobology adjustments would most appropriately improve genuine penetration depth for a technically difficult, deep structure?

A. Increase the transmitted frequency for improved axial resolution

B. Decrease overall gain to reduce genuine image noise present

C. Increase persistence to average multiple sequential frames together

D. Select a lower-frequency transducer, reducing attenuation with depth

62. A sonographer is imaging a structure at a fixed, known depth and wants to maximize lateral resolution specifically there, without altering transducer frequency. Which adjustment is most directly appropriate?

A. Increase overall gain, amplifying the receiver signal uniformly

B. Increase persistence, averaging sequential frames together

C. Increase dynamic range, displaying additional genuine gray shades

D. Position the focal zone at that specific depth, narrowing the beam

63. The Doppler equation directly relates the observed Doppler shift to which of the following variables?

A. Transmitted frequency, reflector velocity, the Doppler angle, and propagation speed

B. Transducer element count, frame rate, and the current imaging depth setting

C. Dynamic range, persistence, and the current overall gain setting selected

D. Spatial pulse length, duty factor, and the current pulse repetition frequency

64. As the Doppler angle increases toward 90 degrees, all else held equal, the magnitude of the observed Doppler shift genuinely does which of the following?

A. Increases steadily, becoming maximal exactly at 90 degrees

B. Remains entirely constant regardless of the Doppler angle used

C. Decreases, approaching zero as the angle approaches 90 degrees

D. Becomes genuinely unpredictable once the angle exceeds 60 degrees

65. Angle correction becomes genuinely unreliable as the Doppler angle approaches which of the following values?

A. 90 degrees, where small angle errors produce large velocity errors

B. 0 degrees, where the cosine value is at its most stable point

C. 45 degrees, the angle at which cosine changes most slowly

D. Angle correction is equally reliable at every possible angle value

66. A Doppler mode transmits and receives continuously and simultaneously, using two separate crystal elements, and cannot distinguish returning signal by depth. Which mode does this describe?

A. Pulsed-wave (PW) Doppler, using range gating

B. Continuous-wave (CW) Doppler

C. Color Doppler, using a two-dimensional flow map

D. Power Doppler, mapping signal amplitude only

67. Pulsed-wave (PW) Doppler achieves range resolution, unlike CW Doppler, through which of the following mechanisms?

A. Using two entirely separate, physically distinct transducer crystals

B. Transmitting continuously while receiving on a separate element

C. Selecting a genuinely higher transmitted frequency than CW uses

D. Range gating, timing the received signal to a specific sample volume

68. Comparing duty factor between CW and PW Doppler, which of the following is genuinely accurate?

A. PW Doppler genuinely has a higher duty factor than CW Doppler

B. CW and PW Doppler genuinely share an identical duty factor value

C. CW Doppler's duty factor is near 100 percent; PW's is much lower

D. Duty factor is entirely inapplicable to any genuine Doppler mode

69. Color Doppler assigns a displayed color to each pixel based most directly on which of the following?

A. The grayscale brightness value already present at that same pixel

B. The mean Doppler shift (velocity) detected within that sample

C. The current overall gain setting applied to the grayscale image

D. The specific frequency of the transducer currently selected

70. A sonographer is evaluating a vessel with genuinely very low, difficult-to-detect flow and needs maximal sensitivity, accepting that directional information is not required for this specific clinical question. Which Doppler mode is most appropriate?

A. Continuous-wave Doppler, for its unlimited velocity range

B. Conventional color Doppler, for its directional information

C. Power Doppler, for its superior low-flow sensitivity

D. Pulsed-wave spectral Doppler, for its quantitative velocity output

71. A sonographer selects power Doppler specifically for its superior low-flow sensitivity, but later needs to determine the actual direction and speed of flow at that same site. Which limitation of power Doppler is now relevant?

A. Power Doppler cannot genuinely detect any flow signal at all

B. Power Doppler is genuinely far less sensitive to low-flow states

C. Power Doppler requires a genuinely different transducer entirely

D. Power Doppler does not display direction or velocity information

72. The Nyquist limit, the maximum unambiguously detectable Doppler shift, is genuinely calculated as which of the following?

A. The current transmitted frequency divided by the propagation speed

B. The current pulse repetition frequency (PRF) divided by two

C. The Doppler angle divided by the current pulse repetition frequency

D. The current overall gain multiplied by the current dynamic range

73. Aliasing occurs when the true Doppler shift genuinely does which of the following?

A. Falls below the current wall filter's genuine cutoff setting

B. Falls below the minimum detectable threshold for the current gain

C. Exceeds the maximum value the Doppler angle can genuinely produce

D. Exceeds the Nyquist limit established by the current PRF setting

74. A sonographer moves the sample volume progressively deeper during a single exam and notices the achievable scale (PRF) setting genuinely decreasing at each successive depth. This directly reflects which of the following?

A. The Nyquist limit genuinely increases as sample volume depth increases

B. Depth has no genuine effect on achievable PRF under any circumstance

C. The achievable Nyquist limit becomes unpredictable beyond a fixed depth

D. The achievable PRF, and therefore Nyquist limit, decreases with depth

75. A vessel shows a peak systolic velocity of 80 cm/s and an end-diastolic velocity of 20 cm/s. What is the resistive index at this site?

A. 0.75, calculated as (PSV minus EDV) divided by PSV

B. 0.25, calculated as EDV divided by PSV

C. 4.0, calculated as PSV divided by EDV

D. 1.0, calculated as PSV divided by the sum of PSV and EDV

76. The pulsatility index (PI) is genuinely calculated using which of the following formula?

A. End-diastolic velocity divided by peak systolic velocity value alone

B. Peak systolic velocity minus end-diastolic velocity, divided by mean velocity

C. Mean velocity divided by peak systolic velocity value alone

D. Peak systolic velocity divided by end-diastolic velocity alone

77. A spectral waveform shows a sharp systolic peak with minimal or absent forward flow during diastole. This pattern is most consistent with which of the following?

A. Continuous, substantial forward flow throughout the entire cycle

B. A completely flat waveform lacking any genuine systolic peak

C. Equal peak systolic and end-diastolic velocity values recorded

D. A high-resistance waveform pattern, reflecting elevated resistance

78. A spectral waveform shows continuous, substantial forward flow maintained throughout diastole, not just at systole. This pattern is most consistent with which of the following?

A. A sharp systolic peak with minimal or absent diastolic flow

B. A low-resistance waveform pattern, reflecting reduced resistance

C. Reversal of flow direction throughout the entire cardiac cycle

D. A completely flat waveform lacking any genuine systolic peak

79. A genuinely elevated resistive index at a given vascular site most directly suggests which of the following?

A. Genuinely decreased downstream vascular resistance at that site

B. A technical error in Doppler angle correction, not a true finding

C. Genuinely increased downstream vascular resistance at that site

D. An artifact requiring no further genuine clinical consideration

80. Mean velocity, as calculated by the system, genuinely differs from peak systolic velocity in which of the following ways?

A. Mean velocity is genuinely always higher than peak systolic velocity

B. Mean velocity averages the full spectrum, not just the single peak

C. Mean and peak systolic velocity are genuinely identical values always

D. Mean velocity is calculated exclusively using CW Doppler technique

81. An excessively large sample volume, encompassing more than the vessel lumen itself, most directly risks which of the following?

A. Genuinely eliminating the Doppler shift signal entirely from view

B. Automatically correcting the Doppler angle to zero degrees exactly

C. Permanently altering the vessel's genuine true propagation speed

D. Spectral broadening from adjacent structures and wall motion noise

82. The wall filter, as a Doppler console control, serves which of the following purposes?

A. Increases the transmitted frequency for improved genuine penetration

B. Physically steers the beam away from the vessel wall itself

C. Removes low-frequency, high-amplitude signal from vessel wall motion

D. Increases the current pulse repetition frequency setting selected

83. Setting the wall filter excessively high most directly risks which of the following?

A. Losing genuine low-velocity flow signal along with wall motion noise

B. Permanently damaging the transducer element through genuine overuse

C. Introducing genuine aliasing that was not previously present at all

D. Automatically increasing the current color box size selected

84. A sonographer observes aliasing on a spectral Doppler trace at a moderate depth. Which adjustment is most directly appropriate as a first step?

A. Decrease overall gain to reduce genuine image noise present

B. Decrease the wall filter setting to its genuine minimum value

C. Increase scale (PRF), if genuinely achievable at the current depth

D. Increase persistence to average multiple sequential frames

85. Shifting the baseline is genuinely most appropriate when flow at a given site is which of the following?

A. Genuinely bidirectional, with substantial flow in both directions

B. Entirely absent, with no genuine detectable Doppler shift at all

C. Occurring exclusively during continuous-wave Doppler acquisition

D. Predominantly unidirectional, allowing more display room that way

86. Correct angle correction requires the angle-correction cursor to be genuinely aligned with which of the following?

A. The actual direction of genuine blood flow within the vessel

B. The transducer face's genuine orientation relative to the patient

C. The current color box's genuine border, regardless of flow direction

D. The vessel wall's genuine physical orientation on the display

87. For genuinely accurate velocity measurement, the Doppler angle should generally be kept below approximately which of the following values?

A. 90 degrees, where the Doppler shift is genuinely at its maximum

B. 60 degrees, where cosine remains relatively stable and reliable

C. Doppler angle genuinely has no meaningful effect on accuracy

D. Angle only matters when using genuine continuous-wave Doppler

88. Excessive color Doppler gain most directly risks which of the following?

A. Genuinely eliminating all color signal from the display entirely

B. Automatically correcting the Doppler angle to zero degrees exactly

C. Color noise and color bleeding beyond the genuine vessel lumen

D. Permanently increasing the system's true achievable frame rate

89. Increasing the size of the color box, all else held equal, has which of the following effects on frame rate?

A. Increases frame rate, since fewer grayscale pulses are needed

B. Has no genuine effect on frame rate under any circumstance

C. Decreases frame rate, since additional color pulses are required

D. Only affects frame rate when spectral Doppler is also active

90. Comparing duty factor across ultrasound modes, spectral (particularly CW) Doppler genuinely has which of the following relationship to standard B-mode imaging?

A. Spectral Doppler's duty factor is genuinely lower than B-mode's

B. Spectral Doppler and B-mode genuinely share an identical duty factor

C. Duty factor is entirely inapplicable to spectral Doppler as a mode

D. Spectral Doppler's duty factor is substantially higher than B-mode's

91. Mirror image artifact arises from which of the following underlying mechanisms?

A. Sound reflecting off a strong reflector, duplicating genuine signal

B. The true Doppler shift genuinely exceeding the current Nyquist limit

C. An excessively high wall filter setting removing genuine flow signal

D. A second pulse transmitted before the first pulse's echo returns

92. A sonographer, using an unusually high PRF at significant depth, notices a Doppler signal appearing to originate from an implausible depth inconsistent with known anatomy. This finding is most consistent with which artifact?

A. Aliasing, a frequency-domain artifact tied to the Nyquist limit

B. Mirror image artifact, from reflection off a strong reflector

C. Range ambiguity, a depth-domain artifact distinct from aliasing

D. An excessively high wall filter setting removing genuine signal

93. Aliasing can genuinely be distinguished from range ambiguity by recognizing which of the following?

A. The two artifacts are genuinely identical, differing only in name

B. Aliasing is a frequency-domain artifact; range ambiguity is depth-domain

C. Aliasing occurs only in B-mode; range ambiguity only in Doppler

D. Range ambiguity can genuinely be corrected only by switching to CW

94. A sonographer observes aliasing on a spectral trace despite the scale already being set near its achievable maximum for the current depth. Which of the following is the most appropriate next step?

A. Decrease the wall filter setting to its genuine minimum value

B. Decrease persistence to its genuine minimum available value

C. Switch to continuous-wave Doppler for this specific measurement

D. Decrease the current color box size selected on the display

95. A sonographer observes an apparent second vessel with flow signal immediately beyond a known strong reflector, at a location with no expected anatomic vessel. What is the most appropriate next step?

A. Immediately document a genuine second vessel without further check

B. Increase Doppler gain to confirm the second vessel's signal strength

C. Reposition the transducer and correlate carefully with grayscale anatomy

D. Assume the finding is artifactual without any further correlation

96. When a sonographer encounters an unclear or unexpected Doppler finding, the most appropriate systematic first step is which of the following?

A. Immediately conclude the finding is artifactual without further check

B. Increase every console setting simultaneously until it resolves

C. Switch to an entirely different imaging modality without further review

D. Identify the likely mechanism, then apply the corresponding targeted fix

97. Turbulent flow, on a spectral Doppler trace, is genuinely characterized by which of the following?

A. A completely smooth, narrow spectral trace with no genuine variation

B. Spectral broadening, with genuine filling-in of the spectral window

C. An entirely flat waveform with no genuine systolic peak present

D. Continuous forward flow with no genuine variation across the cycle

98. A vessel is insonated at a 60-degree Doppler angle with a 5 MHz transducer; the measured Doppler shift is 2 kHz, and propagation speed is assumed at 1540 m/s. Which of the following calculation approaches correctly solves for genuine blood flow velocity?

A. Divide the Doppler shift by twice the transmitted frequency alone

B. Multiply the Doppler shift by the assumed propagation speed alone

C. Rearrange the Doppler equation, solving for velocity using cosine of 60

D. The Doppler angle is genuinely irrelevant to this specific calculation

99. When both a genuine grayscale signal and a genuine color Doppler signal are present at the same pixel within the color box, which of the following is generally true of standard display priority?

A. Grayscale signal is genuinely always displayed, overriding color entirely

B. Color signal is generally given display priority within the color box

C. Neither signal is genuinely displayed if both are present simultaneously

D. Display priority is genuinely random and cannot be meaningfully set

100. A sonographer notices the console's Thermal Index value rising as overall output power is increased during a routine exam. Which underlying mechanism does the Thermal Index actually reflect?

A. Tissue absorbing acoustic energy and converting it into heat

B. Reflection of acoustic energy at genuine tissue interfaces present

C. Refraction of the beam at a genuinely oblique tissue boundary

D. Scattering of sound from structures smaller than the wavelength

101. A microbubble contrast agent circulating in a patient's vasculature is exposed to diagnostic ultrasound pressure fluctuations, causing the bubble to oscillate and, under certain conditions, collapse. This bioeffect category is best described as which of the following?

A. Gradual tissue heating from genuinely absorbed acoustic energy

B. Mechanical bioeffects, arising from cavitation

C. Beam bending occurring at a genuinely oblique tissue boundary

D. Gradual weakening of beam intensity with increasing depth

102. A sonographer performing an exam where fetal bone is genuinely positioned at the beam's focus should expect thermal bioeffects risk at that location to be affected in which of the following ways?

A. Genuinely decreased, since bone reflects sound entirely away

B. Unaffected, since bone absorbs sound identically to soft tissue

C. Only affected if contrast agents are simultaneously present

D. Genuinely increased, since bone absorbs energy efficiently

103. For a given peak rarefactional pressure, how does the Mechanical Index (MI) genuinely change as transducer frequency increases?

A. MI genuinely increases proportionally as frequency increases

B. MI remains entirely unaffected by the transducer's frequency

C. MI genuinely decreases, since frequency sits in the denominator

D. MI increases only once frequency exceeds a fixed universal value

104. A sonographer weighs the diagnostic benefit of a longer exam against the potential bioeffects risk of extended exposure, and chooses the shortest exam time and lowest output genuinely sufficient to answer the clinical question. This decision-making approach is best described as an application of which of the following?

A. A fixed numeric output threshold that must never genuinely be exceeded

B. A requirement to use maximum available diagnostic output for every exam

C. A one-time setting applied at the start, requiring no further attention

D. The ALARA principle, weighing benefit against genuine exposure risk

105. A sonographer wants to actively monitor bioeffects potential throughout an exam without relying on memory or assumption about current output settings. Which standard specifically enables this?

A. A standard requiring automatic output reduction at a fixed TI value

B. A standard mandating the lowest available frequency for every exam

C. The AIUM/NEMA Output Display Standard, requiring real-time display

D. A standard requiring permanent recording of every TI and MI value

106. A QA technologist wants to assess axial resolution, distance accuracy, and sensitivity all within a single testing session, using one tool. Which of the following genuinely makes this possible?

A. A dedicated axial-resolution-only test object, used three separate times

B. Three entirely separate, purpose-built phantoms used in sequence

C. A manufacturer's printed specification sheet, reviewed without testing

D. A tissue-equivalent phantom, containing target groups for each parameter

107. A facility schedules ultrasound equipment testing at regular intervals regardless of whether any specific problem has been noticed. This practice is most accurately characterized as which of the following?

A. Proactive, systematic quality assurance testing

B. Reactive troubleshooting performed in response to a suspected issue

C. An informal practice with no established tools or procedures

D. A one-time verification, relevant only at initial installation

108. The dead zone in ultrasound QA testing refers to which of the following?

A. The maximum depth at which a genuine, low-level signal can be detected

B. The specific frequency range at which a transducer produces no output

C. The minimum depth near the transducer face where structures can first be resolved

D. The region where color Doppler cannot genuinely be applied at all

109. Shear wave elastography, as distinct from strain elastography, genuinely provides which of the following?

A. An absolute, quantitative stiffness value based on wave propagation speed

B. Only a relative, qualitative color-coded map of tissue deformation

C. No genuine stiffness information whatsoever, only vascular signal

D. Information exclusively about vascular flow, not tissue stiffness

110. Contrast-enhanced ultrasound (CEUS) genuinely requires a deliberately low Mechanical Index setting primarily to accomplish which of the following?

A. Preserve microbubble integrity while still allowing detectable signal

B. Increase the transmitted frequency for improved axial resolution

C. Ensure microbubbles remain confined within the transducer's near field

D. Eliminate the need for angle correction during subsequent Doppler use

Answers

1. D. Frequency equals 1 divided by period: 1 / 0.0000004 s = 2,500,000 Hz = 2.5 MHz. Options A, B, and C each misapply the frequency-period relationship.

2. A. Wavelength is the distance one complete cycle occupies in space, a fixed spatial measure of a single cycle. Option B describes frequency, option C describes period, and option D describes amplitude.

3. C. Wavelength equals propagation speed divided by frequency; for a fixed propagation speed, wavelength genuinely decreases as frequency increases. Options A, B, and D each misstate this inverse relationship.

4. B. Because distance is calculated directly from the assumed 1540 m/s propagation speed and echo return time, any genuine difference between assumed and true tissue speed produces a real distance-measurement error. Options A, C, and D each misstate this actual consequence.

5. B. Propagation speed through a medium is primarily determined by that medium's stiffness and density, not by the transmitted pulse's own frequency, amplitude, or PRF. Options A, C, and D each misattribute this determination.

6. A. Bone's genuinely greater stiffness relative to soft tissue produces a correspondingly faster propagation speed through it. Options B, C, and D each misstate this relationship.

7. D. Attenuation is the progressive weakening of an ultrasound beam's intensity as it travels through tissue, from absorption, reflection, and scattering combined. Options A, B, and C describe unrelated phenomena.

8. B. Absorption, converting acoustic energy into heat, is the dominant attenuation mechanism in soft tissue. Options A, C, and D describe contributing but non-dominant or unrelated mechanisms.

9. D. The soft-tissue attenuation coefficient is standardly approximated as 0.5 dB/cm/MHz, the basis for depth-dependent attenuation calculations used in practice. Options A, B, and C are not this standard approximation.

10. D. Total attenuation (dB) = attenuation coefficient x frequency (MHz) x total path length (cm): 0.5 x 5 x 8 (4 cm there, 4 cm back) = 20 dB. Options A, B, and C each miscalculate this round-trip total.

11. C. The half-value layer is, by definition, the specific depth at which beam intensity has been reduced to exactly half its original value. Options A, B, and D describe unrelated concepts.

12. A. Higher-frequency transducers are attenuated more per centimeter than lower-frequency transducers, directly reducing effective penetration depth. Options B, C, and D each misstate this genuine frequency-dependent relationship.

13. A. Acoustic impedance equals tissue density multiplied by propagation speed (Z = density x speed), the property that determines reflection strength at a tissue interface. Options B, C, and D describe unrelated calculations.

14. C. A large, smooth interface relative to wavelength produces specular reflection, a predictable, mirror-like reflection governed by the angle of incidence, consistent with this diaphragm appearance. Options A, B, and D describe unrelated or contradictory phenomena.

15. B. Non-specular, diffuse reflection occurs at interfaces that are irregular in shape or small relative to the ultrasound wavelength, scattering the beam unpredictably. Options A, C, and D each misstate this actual condition.

16. C. Rayleigh scattering redirects sound in many directions specifically from structures much smaller than the ultrasound wavelength, such as red blood cells. Options A, B, and D each misstate this actual size relationship.

17. A. Refraction occurs when a beam crosses an oblique boundary between two media with a genuine propagation speed difference, causing the beam to bend. Options B, C, and D each describe a condition that does not produce refraction.

18. C. Snell's Law mathematically governs the angle of refraction at an oblique tissue boundary, based on the relative propagation speeds of the two media. Options A, B, and D describe unrelated physics concepts.

19. A. Pulse repetition period is the time interval from the start of one pulse to the start of the next, encompassing both pulse duration and the silent listening interval. Option B describes PRF, option C describes pulse duration, and option D describes spatial pulse length.

20. B. PRF is the direct mathematical inverse of pulse repetition period (PRF = 1/PRP); as PRP increases, PRF genuinely decreases. Options A, C, and D describe unrelated or indirectly related parameters.

21. A. Duty factor is genuinely the fraction of the total pulse repetition period during which the system is actively transmitting sound. Options B, C, and D describe unrelated parameters.

22. B. Standard pulsed imaging duty factor is genuinely quite low, typically under 1 percent, since the system spends the vast majority of each cycle listening for returning echoes rather than transmitting. Options A, C, and D each substantially overstate this actual value.

23. A. Spatial pulse length equals the number of cycles multiplied by wavelength: 3 x 0.4 mm = 1.2 mm. Options B, C, and D each apply an incorrect calculation.

24. B. Shortening spatial pulse length, by decreasing the number of cycles per pulse, directly improves axial resolution, the along-the-beam resolving capability established elsewhere. Options A, C, and D each misattribute this improvement to an unrelated resolution type.

25. A. Maintaining a neutral wrist position and adjusting equipment height appropriately are genuine, evidence-based ergonomic practices that reduce a sonographer's cumulative musculoskeletal injury risk. Options B, C, and D each describe a practice that would genuinely increase, not reduce, injury risk.

26. B. A crystal producing a voltage when mechanically deformed, and conversely deforming when a voltage is applied, is the piezoelectric effect, the foundational mechanism of transducer operation. Options A, C, and D describe unrelated mechanisms or components.

27. A. The matching layer reduces the genuine acoustic impedance mismatch between the piezoelectric element and skin, improving sound transmission into the patient. Options B, C, and D describe functions the matching layer does not actually perform.

28. C. Backing material dampens the element's ringing after excitation, shortening pulse duration and thereby improving axial resolution. Options A, B, and D describe components that do not perform this specific dampening function.

29. C. A curvilinear array's curved footprint provides a genuinely wide field of view at depth, well suited to abdominal imaging where a broad view of deeper structures is needed. Options A, B, and D describe applications better suited to other array types.

30. B. Phased array electronic focusing and steering is achieved by applying precisely timed firing delays across the element sequence, allowing the beam to be directed without any physical movement. Options A, C, and D describe mechanisms the array does not actually use for this purpose.

31. A. Grating lobes arise from the array's individual element spacing relative to the wavelength in use, producing unwanted off-axis beams under certain spacing-to-wavelength ratios. Options B, C, and D describe unrelated causes.

32. C. The near field (Fresnel zone) of an unfocused transducer is characterized by a beam that is genuinely converging with increasing depth, up to the natural focus, distinct from far-field divergence beyond it. Options A, B, and D each misstate this actual near-field beam behavior.

33. D. A matrix array contains a true two-dimensional grid of elements, enabling electronic beam steering and focusing in both the azimuthal and elevational directions simultaneously, unlike a standard 1D array. Options A, B, and C each misstate this actual distinction.

34. A. The pulser generates the electrical voltage that excites the transducer element, initiating the transmitted pulse, the first stage of the pulse-echo instrumentation chain. Options B, C, and D describe functions of other components entirely.

35. A. The receiver performs amplification, compensation (TGC), compression, and demodulation on the returning echo signal, processing it for display. Options B, C, and D describe functions of other components entirely.

36. D. Dynamic range is the ratio between the largest and smallest signal amplitudes the system can genuinely process, a key receiver processing parameter. Options A, B, and C describe unrelated measurements.

37. D. Compression reduces the acquired dynamic range to fit within the display's genuine capability, a necessary receiver processing step. Options A, B, and C describe functions compression does not actually perform.

38. A. TGC compensates for depth-dependent attenuation, applying increasing amplification with depth to equalize brightness across the image. Options B, C, and D describe functions TGC does not actually perform.

39. B. Excessive near-field TGC gain produces an abnormally bright near field relative to genuinely equivalent deeper tissue, a classic TGC miscalibration artifact. Options A, C, and D each misstate this actual visual consequence.

40. D. Overall gain applies amplification uniformly across the entire receiver signal, regardless of depth, distinct from TGC's depth-specific compensation. Options A, B, and C each misstate gain's actual uniform application.

41. A. Excessive overall gain amplifies both genuine signal and background noise together, introducing visible noise without adding genuine diagnostic information. Options B, C, and D describe consequences gain does not actually produce.

42. A. Pixel brightness is directly determined by the amplitude of the returning echo at that specific spatial location, the fundamental basis of grayscale image formation. Options B, C, and D describe unrelated determining factors.

43. C. Scan conversion converts acquired echo data into the proper format for display on a screen, translating acquisition geometry into a viewable image. Options A, B, and D describe unrelated processes.

44. A. Frame rate is the number of complete images genuinely displayed per second, a key measure of temporal resolution. Options B, C, and D describe unrelated parameters.

45. A. Increasing imaging depth requires each pulse more time to travel and return, directly decreasing the number of pulses (and thus frames) possible per second. Options B, C, and D each misstate this actual depth-frame rate relationship.

46. B. Additional focal zones require additional pulses per scan line, directly decreasing frame rate since more total pulses are needed to complete each frame. Options A, C, and D each misstate this actual relationship.

47. D. Axial resolution is the minimum distance between two structures along the beam's own axis (front-to-back) required to distinguish them as genuinely separate. Options A, B, and C describe unrelated resolution types or capabilities.

48. B. Lateral resolution is the minimum side-by-side distance, perpendicular to the beam, required to distinguish two structures as genuinely separate. Options A, C, and D describe unrelated resolution types or capabilities.

49. C. Lateral resolution is genuinely best at the focal zone, where the beam achieves its narrowest width, directly established by beam-forming physics. Options A, B, and D each misstate this actual depth-dependent relationship.

50. C. Contrast resolution is the system's ability to distinguish subtly different tissue echogenicities from one another on the display, the specific capability this scenario describes. Options A, B, and D describe unrelated resolution types or capabilities.

51. D. More available gray shades allow finer distinctions between subtly different echo amplitudes, directly improving contrast resolution specifically. Options A, B, and C each misattribute this improvement to an unrelated resolution type.

52. A. Preprocessing manipulates image data before it is genuinely stored in memory, applied during initial acquisition. Options B, C, and D each misstate this actual timing and scope.

53. D. Postprocessing manipulates already-acquired, stored image data for display purposes, applied after acquisition without requiring re-scanning. Options A, B, and C each misstate this actual timing and scope.

54. C. Persistence averages sequential frames together, reducing random noise but potentially blurring genuinely moving structures across those averaged frames. Options A, B, and D each misstate persistence's actual function.

55. B. Excessive persistence, by averaging sequential frames, genuinely blurs structures that are moving between those frames, a direct visual consequence. Options A, C, and D each misstate this actual consequence.

56. B. Electronic (pan) zoom magnifies already-acquired data for display, without acquiring new scan lines and therefore without genuinely improving resolution. Options A, C, and D each misstate this actual limitation.

57. C. Write zoom, applied during acquisition itself, genuinely acquires additional scan lines within the magnified region, providing a true resolution improvement unlike zoom applied afterward. Options A, B, and D each misstate this actual advantage.

58. D. Increasing overall gain appropriately amplifies the receiver signal, directly addressing an image that is genuinely too dark overall. Options A, B, and C each describe an adjustment that would not address, or would worsen, the described problem.

59. D. Increasing TGC at the corresponding depth directly compensates for depth-dependent attenuation, addressing dimming that persists despite appropriate overall gain. Options A, B, and C each describe an adjustment that does not address this specific depth-related problem.

60. C. Selecting a higher-frequency transducer shortens spatial pulse length, directly improving axial resolution, well suited to a superficial structure where penetration is not the limiting concern. Options A, B, and D each describe an adjustment that does not improve axial resolution.

61. D. Selecting a lower-frequency transducer reduces attenuation with depth, directly improving genuine penetration for a technically difficult, deep structure. Options A, B, and C each describe an adjustment that does not improve penetration depth.

62. D. Positioning the focal zone at the structure's specific depth narrows the beam precisely there, directly maximizing lateral resolution at that location without requiring a frequency change. Options A, B, and C each describe an adjustment that does not affect lateral resolution at that depth.

63. A. The Doppler equation directly relates the observed Doppler shift to transmitted frequency, reflector velocity, the Doppler angle (via cosine), and the assumed propagation speed. Options B, C, and D list parameters unrelated to the Doppler equation itself.

64. C. As the Doppler angle increases toward 90 degrees, cosine of that angle approaches zero, so the calculated Doppler shift genuinely decreases toward zero. Options A, B, and D each misstate this actual angle-shift relationship.

65. A. Near 90 degrees, cosine changes very rapidly per degree of angle error, so small angle-estimation errors produce disproportionately large velocity errors, making angle correction genuinely unreliable there. Options B, C, and D each misstate this actual reliability pattern.

66. B. This description matches continuous-wave (CW) Doppler, which transmits and receives continuously via separate crystal elements, providing no genuine range resolution. Options A, C, and D describe modes with a genuinely different acquisition mechanism.

67. D. PW Doppler achieves range resolution through range gating, timing the received signal window to correspond to a specific, selected sample volume depth. Options A, B, and C describe mechanisms PW Doppler does not actually use.

68. C. CW Doppler's duty factor is near 100 percent, since it transmits and receives continuously, while PW Doppler's duty factor remains very low, similar to standard pulsed imaging. Options A, B, and D each misstate this actual comparison.

69. B. Color Doppler assigns displayed color based on the mean Doppler shift (velocity) detected within each sample along the scan line, distinct from the underlying grayscale brightness. Options A, C, and D describe unrelated determining factors.

70. C. Power Doppler is genuinely more sensitive to low-velocity, low-flow states than conventional color Doppler, since it maps signal amplitude rather than a directional velocity value, making it well suited when maximal sensitivity is the priority. Options A, B, and D describe modes less suited to this specific low-flow priority.

71. D. Power Doppler maps signal amplitude rather than the Doppler shift itself, so it does not genuinely display direction or velocity information, a direct trade-off for its improved sensitivity, relevant once directional data is needed. Options A, B, and C each misstate this actual limitation.

72. B. The Nyquist limit is calculated as the current pulse repetition frequency (PRF) divided by two, the maximum Doppler shift that can be unambiguously detected without aliasing. Options A, C, and D describe unrelated or incorrect calculations.

73. D. Aliasing occurs when the true Doppler shift genuinely exceeds the Nyquist limit established by the current PRF setting, producing wraparound on the display. Options A, B, and C describe unrelated or incorrect mechanisms.

74. D. As sample volume depth increases, each pulse requires more time to return, directly decreasing the maximum achievable PRF and therefore the achievable Nyquist limit at that depth. Options A, B, and C each misstate this actual depth relationship.

75. A. Resistive index equals (peak systolic velocity minus end-diastolic velocity) divided by peak systolic velocity: (80-20)/80 = 0.75. Options B, C, and D each apply an incorrect formula.

76. B. Pulsatility index is calculated as peak systolic velocity minus end-diastolic velocity, divided by the mean velocity across the cardiac cycle, distinct from the resistive index's denominator. Options A, C, and D describe incorrect formula arrangements.

77. D. A sharp systolic peak with minimal or absent diastolic flow is the characteristic pattern of a high-resistance waveform, reflecting substantial downstream resistance. Options A, B, and C describe patterns inconsistent with genuine high resistance.

78. B. Continuous, substantial forward flow maintained throughout diastole is the characteristic pattern of a low-resistance waveform, reflecting low downstream resistance. Options A, C, and D describe patterns inconsistent with genuine low resistance.

79. C. An elevated resistive index reflects genuinely increased downstream vascular resistance at that specific site, a clinically meaningful hemodynamic finding rather than a technical artifact by default. Options A, B, and D each misattribute or dismiss this genuine finding.

80. B. Mean velocity averages the full velocity spectrum present at each point in time, rather than reflecting only the single highest (peak systolic) value recorded. Options A, C, and D each misstate this actual distinction.

81. D. An excessively large sample volume, extending beyond the vessel lumen itself, risks capturing signal from adjacent structures and vessel wall motion, producing spectral broadening and noise. Options A, B, and C each misstate this actual consequence.

82. C. The wall filter removes low-frequency, high-amplitude signal characteristic of vessel wall motion, isolating genuine blood flow signal from this contaminating source. Options A, B, and D describe functions the wall filter does not actually perform.

83. A. An excessively high wall filter setting risks removing genuine low-velocity flow signal along with the intended wall motion noise, since both can occupy a similar low-frequency range. Options B, C, and D each misstate this actual risk.

84. C. Increasing scale (PRF), where achievable at the current depth, directly raises the Nyquist limit, the appropriate first-step correction for aliasing. Options A, B, and D each describe an adjustment that does not address aliasing's actual mechanism.

85. D. Shifting the baseline is most appropriate when flow is predominantly unidirectional, reallocating the display's vertical range to better accommodate that single direction. Options A, B, and C each describe a scenario where baseline shifting is not the appropriate response.

86. A. The angle-correction cursor must be aligned with the actual direction of genuine blood flow within the vessel, not with the vessel wall or an unrelated reference, for the calculated velocity to be accurate. Options B, C, and D each describe an incorrect alignment reference.

87. B. Keeping the Doppler angle below approximately 60 degrees keeps cosine in a range where it changes more gradually, producing more reliable, reproducible velocity measurements. Options A, C, and D each misstate this actual accuracy consideration.

88. C. Excessive color Doppler gain produces color noise and color bleeding beyond the genuine vessel lumen, obscuring the true anatomic boundary of flow. Options A, B, and D each misstate this actual visual consequence.

89. C. A larger color box requires additional color-specific pulses per scan line to cover the expanded area, directly decreasing achievable frame rate. Options A, B, and D each misstate this actual relationship.

90. D. Spectral, and particularly CW, Doppler's duty factor is substantially higher than standard B-mode imaging's very low duty factor, since Doppler acquisition involves much more continuous or near-continuous transmission. Options A, B, and C each misstate this actual comparison.

91. A. Mirror image artifact arises from sound reflecting off a strong specular reflector, causing genuine signal to appear falsely duplicated on the far side of that reflector. Options B, C, and D describe mechanisms of unrelated artifacts.

92. C. A signal appearing to originate from an implausible depth, particularly at unusually high PRF, is consistent with range ambiguity, a depth-domain artifact distinct from aliasing's frequency-domain mechanism. Options A, B, and D describe mechanisms of unrelated artifacts.

93. B. Aliasing is fundamentally a frequency-domain artifact tied to the Nyquist limit, while range ambiguity is fundamentally a depth-domain artifact tied to pulse timing, a key distinguishing concept. Options A, C, and D each misstate this actual distinction.

94. C. When scale is already near its achievable maximum and aliasing persists, switching to continuous-wave Doppler avoids the Nyquist limitation entirely, an appropriate next step for velocities genuinely exceeding the achievable PW limit. Options A, B, and D each describe an adjustment that does not address aliasing at this specific stage.

95. C. Repositioning the transducer relative to the reflector and correlating carefully with grayscale anatomy is the appropriate way to confirm suspected mirror image artifact rather than a genuine second vessel. Options A, B, and D each skip this genuinely necessary verification step.

96. D. The appropriate systematic first step is identifying the likely underlying mechanism for the finding, then applying the corresponding targeted correction or verification approach. Options A, B, and C each describe an inappropriate, non-systematic response.

97. B. Turbulent flow produces spectral broadening, with genuine filling-in of the normally clear spectral window beneath the waveform, reflecting the wide range of simultaneous velocities and directions present. Options A, C, and D each describe a pattern inconsistent with genuine turbulence.

98. C. Solving the Doppler equation for velocity requires rearranging it algebraically and substituting the measured shift, transmitted frequency, propagation speed, and cosine of the actual 60-degree angle used. Options A, B, and D each describe an approach that omits a genuinely necessary variable or misapplies the equation.

99. B. Standard display convention generally gives color Doppler signal display priority within the color box when both grayscale and color signal are genuinely present at the same pixel. Options A, C, and D each misstate this actual standard display convention.

100. A. The Thermal Index reflects thermal bioeffects potential, which arises from tissue absorbing acoustic energy and converting it into heat. Options B, C, and D describe unrelated acoustic phenomena that do not directly produce tissue heating.

101. B. Bubble oscillation and collapse under pressure fluctuations is cavitation, the basis of mechanical bioeffects, distinct from thermal heating. Options A, C, and D describe unrelated mechanisms or a thermal, not mechanical, bioeffect.

102. D. Bone absorbs ultrasound energy considerably more efficiently than soft tissue, so bone genuinely positioned at the beam's focus increases thermal bioeffects risk at that specific location. Options A, B, and C each misstate this actual relationship.

103. C. Mechanical Index is calculated as peak rarefactional pressure divided by the square root of frequency, so for a fixed peak pressure, MI genuinely decreases as frequency increases. Options A, B, and D each misstate this actual mathematical relationship.

104. D. Weighing diagnostic benefit against exposure risk, and choosing the lowest output and shortest time genuinely sufficient for the clinical question, is a direct application of the ALARA principle. Options A, B, and C each mischaracterize ALARA as a fixed threshold or one-time setting.

105. C. The AIUM/NEMA Output Display Standard requires real-time display of TI and MI values on the console, enabling exactly this kind of active, ongoing bioeffects monitoring throughout an exam. Options A, B, and D describe requirements no actual standard imposes.

106. D. A single tissue-equivalent phantom, containing target groups specifically designed for each parameter, allows simultaneous assessment of multiple performance measures within one testing session. Options A, B, and C describe an approach that does not genuinely achieve this single-session capability.

107. A. Testing performed at regular scheduled intervals, regardless of whether a specific problem has been noticed, is the defining characteristic of proactive, systematic QA, genuinely distinct from reactive troubleshooting. Options B, C, and D each mischaracterize this actual practice.

108. C. The dead zone is the minimum depth near the transducer face at which the system can first genuinely resolve two closely spaced structures, a near-field limitation related to pulse ring-down. Options A, B, and D describe unrelated or fabricated concepts.

109. A. Shear wave elastography provides an absolute, quantitative stiffness value based on measured shear wave propagation speed, unlike strain elastography's relative, qualitative output. Options B, C, and D each misstate or dismiss shear wave elastography's actual capability.

110. A. CEUS requires a deliberately low, non-zero Mechanical Index specifically to preserve microbubble integrity, avoiding inertial cavitation, while still allowing genuine detectable signal. Options B, C, and D describe reasons unrelated to MI's actual purpose in this specific context.