

# COMPREHENSIVE MOCK EXAM 8

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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

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1. A pulse has a period of 0.25 microseconds. What is its genuine frequency?
  - A. 0.25 MHz
  - B. 4 MHz
  - C. 2.5 MHz
  - D. 40 MHz
  
2. Which of the following genuinely describes amplitude?
  - A. The distance one complete cycle occupies in space
  - B. The maximum variation of an acoustic variable from its average value
  - C. The number of cycles occurring each second
  - D. The time required for one complete cycle
  
3. A sound wave's frequency remains fixed at 5 MHz as it passes from soft tissue into a genuinely different medium with a different propagation speed. Which of the following also changes as a direct result?
  - A. Wavelength, since wavelength genuinely depends on propagation speed
  - B. Frequency itself, recalculated for the new medium encountered
  - C. Amplitude, proportional to the genuine propagation speed change
  - D. Period, recalculated independent of the transducer's frequency
  
4. A sonographer compares two hypothetical media: one genuinely stiffer but less dense, one genuinely less stiff but more dense. Propagation speed through each medium is ultimately governed by which combined relationship?
  - A. The medium's stiffness and density together, not either property alone
  - B. Frequency and wavelength of the transmitted pulse, not medium properties
  - C. Amplitude and intensity of the transmitted pulse, not medium properties

**D.** Pulse repetition frequency and duty factor, not genuine medium properties

**5.** Compared to fat, propagation speed through muscle tissue is genuinely which of the following?

**A.** Slower, since muscle is genuinely less stiff overall

**B.** Faster, since muscle is genuinely stiffer than fat

**C.** Identical, since tissue type does not affect propagation speed

**D.** Immeasurable using any standard clinical technique available

**6.** Which of the following is the correct approximate propagation speed value assumed by ultrasound systems for average soft tissue?

**A.** 1540 meters per second

**B.** 1450 meters per second

**C.** 3300 meters per second

**D.** 331 meters per second

**7.** The total attenuation experienced by a beam traveling through tissue is genuinely a combination of which of the following mechanisms?

**A.** Reflection alone, with no other genuine contributor present

**B.** Refraction alone, with no other genuine contributor present

**C.** Absorption, reflection, and scattering combined together

**D.** Amplitude alone, with no other genuine contributor present

**8.** A sonographer needs to calculate the round-trip attenuation for a 3 MHz beam reaching a depth of 6 cm. Using the standard soft-tissue coefficient, what is the approximate total attenuation?

**A.** 6 decibels of total round-trip attenuation

**B.** 9 decibels of total round-trip attenuation

**C.** 12 decibels of total round-trip attenuation

**D. 18 decibels of total round-trip attenuation**

**9. The half-value layer is genuinely useful clinically because it directly indicates which of the following?**

- A. The exact frequency at which resolution is genuinely optimized**
- B. The specific PRF genuinely required to avoid aliasing entirely**
- C. The approximate depth at which beam intensity is genuinely halved**
- D. The exact duty factor genuinely required for a given exam type**

**10. As transmitted frequency increases, all else held equal, genuine tissue penetration depth does which of the following?**

- A. Decreases, due to genuinely greater attenuation at higher frequency**
- B. Increases, due to genuinely lesser attenuation at higher frequency**
- C. Remains entirely unaffected by any genuine frequency changes**
- D. Only changes when TGC is genuinely adjusted simultaneously**

**11. Acoustic impedance mismatch between two tissue types directly determines which of the following?**

- A. The genuine propagation speed through each individual tissue type**
- B. The proportion of sound genuinely reflected versus transmitted**
- C. The transmitted frequency genuinely selected for that specific exam**
- D. The current pulse repetition frequency setting genuinely selected**

**12. A boundary between two tissues with a genuinely large acoustic impedance mismatch (such as soft tissue and bone) produces which of the following?**

- A. Minimal reflection, with nearly all sound genuinely transmitted through**
- B. Complete transmission, with no genuine reflection whatsoever occurring**
- C. Strong reflection, with limited sound genuinely transmitted beyond it**

**D.** No echo at all, since impedance mismatch genuinely blocks all sound

**13.** Which of the following interfaces would most likely produce specular, rather than diffuse, reflection?

- A.** A collection of red blood cells within a genuine vessel lumen
- B.** A large, smooth organ capsule surface encountered during scanning
- C.** The irregular surface of a genuinely heterogeneous solid mass
- D.** Fine parenchymal tissue texture genuinely present within an organ

**14.** Rayleigh scattering is genuinely most responsible for which of the following?

- A.** The strong specular echo returned from a genuinely large, smooth interface
- B.** The bending of the beam at a genuinely oblique tissue boundary
- C.** The faint background echo texture from genuine tissue parenchyma
- D.** The complete absence of signal beyond a strongly reflective boundary

**15.** Refraction becomes clinically relevant primarily because it can genuinely cause which of the following?

- A.** Increased genuine attenuation specifically at the refracting boundary
- B.** A completely accurate depiction of a structure's true genuine position
- C.** Improved genuine lateral resolution at the refracting boundary itself
- D.** Beam bending, potentially misplacing a structure on the genuine display

**16.** A system's pulse repetition frequency is doubled during an exam. What genuinely happens to the corresponding pulse repetition period as a direct mathematical consequence?

- A.** PRP genuinely doubles as well, moving in the identical direction
- B.** PRP genuinely halves, since PRF and PRP are mathematical inverses
- C.** PRP remains entirely unchanged, since the two are unrelated values

**D. PRP becomes genuinely unpredictable without additional information**

**17. As imaging depth increases, all else held equal, PRP and PRF genuinely respond in which of the following ways?**

**A. PRP genuinely decreases and PRF genuinely increases, together**

**B. PRP genuinely increases and PRF genuinely decreases, together**

**C. Both PRP and PRF genuinely increase together simultaneously**

**D. Neither PRP nor PRF is genuinely affected by imaging depth**

**18. Duty factor for standard grayscale pulsed imaging is genuinely best approximated as which of the following?**

**A. Genuinely less than 1 percent of the total cycle time**

**B. Approximately 50 percent of the total cycle time available**

**C. Exactly 100 percent of the total cycle time available**

**D. Approximately 25 percent of the total cycle time available**

**19. A pulse contains 6 cycles at a wavelength of 0.2 mm. What is the resulting spatial pulse length?**

**A. 0.2 millimeters, equal to the wavelength value alone**

**B. 3 millimeters, an unrelated intermediate calculation entirely**

**C. 6 millimeters, equal to the cycle count value alone**

**D. 1.2 millimeters, the product of cycle count and wavelength**

**20. Decreasing spatial pulse length, all else held equal, most directly improves which of the following?**

**A. Lateral resolution, the genuine side-by-side resolving capability**

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

**C. Temporal resolution, the genuine frame-to-frame update rate**

**D.** Contrast resolution, the genuine tissue-differentiation capability

**21.** Which of the following genuinely reduces spatial pulse length, thereby improving axial resolution?

**A.** A shorter damping backing material producing fewer cycles per pulse

**B.** A longer transmitted pulse with genuinely more cycles present

**C.** A lower transmitted frequency, genuinely increasing wavelength

**D.** Increasing the current pulse repetition frequency setting selected

**22.** Which of the following is a genuine, evidence-based ergonomic recommendation for sonographers?

**A.** Scanning with the transducer gripped as tightly as physically possible

**B.** Maintaining a consistently twisted torso position throughout each exam

**C.** Alternating the scanning hand and adjusting table height to reduce strain

**D.** Avoiding any break between consecutive patient exams throughout a shift

**23.** Standard infection control practice between sequential patient exams genuinely requires which of the following?

**A.** Using the identical transducer gel applicator without genuine replacement

**B.** Skipping disinfection when the prior patient appeared clinically well

**C.** Appropriate transducer disinfection consistent with its genuine use category

**D.** Relying exclusively on the patient's own hand sanitizer instead

**24.** Frame averaging (persistence), applied during real-time scanning, genuinely provides which of the following trade-off?

**A.** Improved genuine axial resolution at the cost of increased noise

**B.** Reduced genuine random noise at the cost of potential motion blur

**C.** Improved genuine lateral resolution at the cost of reduced depth

**D. Increased genuine frame rate at the cost of reduced gray shades**

**25.** A sonographer scanning a rapidly moving structure, such as a fetal heart, should generally do which of the following regarding persistence?

- A. Use a genuinely lower persistence setting to preserve temporal detail**
- B. Use a genuinely higher persistence setting to maximize smoothing**
- C. Persistence setting is genuinely irrelevant to rapidly moving structures**
- D. Disable frame averaging entirely, which is not a genuine option**

**26.** A transducer element is cut to a specific thickness that directly determines its natural resonant frequency. This thickness-frequency relationship is genuinely which of the following?

- A. Directly proportional; a genuinely thicker element resonates higher**
- B. Entirely unrelated; element thickness does not affect resonant frequency**
- C. Only relevant for genuinely curved array transducer designs specifically**
- D. Inversely proportional; a genuinely thinner element resonates higher**

**27.** A sonographer selects a linear array transducer specifically for its genuine field-of-view characteristic. Which of the following best describes this characteristic?

- A. A genuinely rectangular field of view, with constant width at all depths**
- B. A genuinely triangular field of view, narrow near the transducer face**
- C. A genuinely circular field of view, expanding equally in all directions**
- D. A field of view that genuinely narrows progressively with depth**

**28.** A phased array transducer's genuinely small physical footprint makes it particularly well suited for which of the following applications?

- A. Superficial imaging exclusively, such as genuine thyroid evaluation**
- B. Wide abdominal fields of view exclusively at genuinely increased depth**

- C. Endocavitary imaging exclusively, through a genuinely narrow orifice
- D. Cardiac imaging, through a genuinely narrow intercostal acoustic window

**29.** Electronic steering, without any genuine physical movement of the transducer, is genuinely achieved in a phased array through which of the following mechanisms?

- A. A fixed mechanical motor rotating the crystal element assembly
- B. Precisely timed firing delays applied sequentially across the elements
- C. A genuinely fixed acoustic lens permanently bonded to the array face
- D. Physically repositioning the entire transducer housing between pulses

**30.** A curvilinear array transducer's curved footprint genuinely produces which of the following field-of-view characteristic?

- A. A field of view that genuinely widens progressively with increasing depth
- B. A genuinely rectangular field of view, constant in width at all depths
- C. A field of view that genuinely narrows progressively with increasing depth
- D. A genuinely fixed, unchanging field-of-view width regardless of depth

**31.** Grating lobes, an unwanted consequence of array element spacing, most directly risk which of the following on the display?

- A. A genuine, physically permanent reduction in transducer bandwidth
- B. A complete, genuine loss of all signal from the intended scan line
- C. An automatic, genuine correction applied by the system's own software
- D. Placement of a genuine reflector's echo at an incorrect apparent position

**32.** A matrix array transducer's true two-dimensional element grid genuinely enables which of the following, distinct from a standard one-dimensional array?

- A. Electronic beam steering and focusing in two genuine planes at once

- B.** Genuinely eliminating the need for any matching layer whatsoever
- C.** Exclusive, genuine use for continuous-wave Doppler applications only
- D.** A genuinely fixed, single, unchangeable focal depth for every exam

**33.** The acoustic lens, when present on a transducer's face, genuinely serves which of the following purpose?

- A.** Electronically steers the beam in the genuine azimuthal plane only
- B.** Physically focuses the beam in the genuine elevational plane
- C.** Reduces the genuine acoustic impedance mismatch at the skin surface
- D.** Dampens genuine element ringing after the initial excitation pulse

**34.** Increasing the voltage applied to the pulser, all else held equal, most directly produces which of the following effects on the transmitted pulse?

- A.** A genuinely higher transmitted frequency for that specific pulse
- B.** A genuinely longer pulse duration for that specific pulse
- C.** A genuinely greater transmitted amplitude for that specific pulse
- D.** A genuinely different propagation speed assumption for that pulse

**35.** Within the receiver's genuine signal-processing sequence, amplification and time gain compensation are genuinely applied in which general relationship to compression and demodulation?

- A.** Amplification and compensation genuinely occur before compression
- B.** Compression genuinely occurs before any amplification takes place
- C.** Demodulation genuinely occurs before any amplification takes place
- D.** All four processes genuinely occur in a single, simultaneous step

**36.** A system's overall genuine image quality reflects the combined contribution of which of the following?

- A.** Axial resolution alone, independent of any other genuine factor
- B.** Frame rate alone, independent of any other genuine factor
- C.** Multiple resolution types (axial, lateral, contrast, temporal) together
- D.** Dynamic range alone, independent of any other genuine factor

**37.** The digital scan converter's genuine primary function is which of the following?

- A.** Storing and manipulating acquired data for proper display on a monitor
- B.** Generating the genuine initial voltage pulse exciting the transducer
- C.** Physically steering the beam electronically across the field of view
- D.** Converting the assumed propagation speed into a genuinely measured value

**38.** A pixel, the smallest genuine unit of a digital ultrasound image, directly stores which of the following?

- A.** The genuine total element count of the transducer array in use
- B.** The current pulse repetition frequency setting genuinely selected
- C.** The specific frequency of the transducer genuinely used for that exam
- D.** A genuine brightness (grayscale) value for that specific location

**39.** Increasing the display matrix size (pixel density), all else held equal, genuinely affects displayed image detail in which of the following ways?

- A.** Genuinely improves displayed detail, since more pixels represent the data
- B.** Genuinely worsens displayed detail, since more pixels compete for space
- C.** Has no genuine effect on displayed detail under any circumstance
- D.** Only affects displayed detail when persistence is also genuinely increased

**40.** For a fixed imaging depth, increasing the number of scan lines per frame (line density), all else held equal, genuinely affects frame rate in which of the following ways?

- A.** Genuinely increases frame rate, since each line requires less processing
- B.** Has no genuine effect on frame rate under any circumstance at all
- C.** Genuinely decreases frame rate, since more total pulses are required
- D.** Only affects frame rate when genuine color Doppler is also active

**41.** A sonographer must balance genuine image detail (line density) against genuine frame rate when configuring a real-time exam. This trade-off exists primarily because of which of the following?

- A.** Line density and frame rate are entirely unrelated system parameters
- B.** Higher line density genuinely requires fewer total pulses per frame
- C.** Frame rate is genuinely fixed and cannot be affected by line density
- D.** Both parameters genuinely compete for the same limited pulse-time budget

**42.** Temporal resolution, the system's ability to genuinely and accurately depict motion over time, is most directly tied to which of the following?

- A.** Axial resolution, the along-the-beam genuine resolving capability
- B.** Frame rate, the number of complete images genuinely displayed per second
- C.** Contrast resolution, the genuine tissue-differentiation capability
- D.** Dynamic range, the genuine ratio of largest to smallest signal amplitude

**43.** A sonographer needs to genuinely improve temporal resolution for an exam involving rapid motion. Which of the following adjustments would most directly accomplish this?

- A.** Decrease imaging depth, line density, or the number of focal zones used
- B.** Increase imaging depth, line density, and the number of focal zones used
- C.** Increase persistence substantially, averaging additional sequential frames
- D.** Increase dynamic range substantially, displaying additional gray shades

**44.** Tissue harmonic imaging generates its image primarily from which of the following signal sources?

- A.** The exact fundamental transmitted frequency, unmodified by tissue itself
- B.** A genuinely separate, second transducer element dedicated to harmonics
- C.** Signal reflected exclusively from genuine microbubble contrast agents
- D.** Harmonic frequencies genuinely generated as sound propagates through tissue

**45.** Tissue harmonic imaging genuinely provides which of the following clinical benefit compared to fundamental frequency imaging alone?

- A.** Genuinely improved penetration depth beyond fundamental frequency imaging
- B.** A genuinely higher achievable frame rate than fundamental imaging allows
- C.** Elimination of the genuine need for any TGC adjustment whatsoever
- D.** Reduced near-field artifact and genuinely improved border definition

**46.** Spatial compounding, combining images acquired from multiple genuine beam angles, primarily achieves which of the following?

- A.** Reduced speckle noise and genuinely improved border definition
- B.** A genuinely higher achievable frame rate than single-angle acquisition
- C.** Elimination of the genuine need for any persistence adjustment
- D.** Genuinely improved penetration depth beyond single-angle acquisition

**47.** Spatial compounding's genuine image-quality benefit comes with which of the following direct trade-off?

- A.** Genuinely reduced axial resolution compared to single-angle acquisition
- B.** Genuinely reduced lateral resolution compared to single-angle acquisition
- C.** Genuinely increased susceptibility to genuine aliasing artifact
- D.** Genuinely reduced frame rate, since multiple angles must be acquired

**48.** A sonographer scanning a patient with a genuinely thick body habitus notices structures beyond a certain depth appear dimmer despite an already-appropriate overall gain setting for shallower structures. Which specific control most directly addresses this depth-specific dimming?

- A.** Overall gain, applied uniformly regardless of the genuine depth involved
- B.** Time gain compensation (TGC), adjusted specifically at that depth
- C.** Persistence, averaging sequential frames to compensate for dimming
- D.** Dynamic range, narrowing the genuinely displayed range of values shown

**49.** A sonographer wants to eliminate low-level background noise from the display without affecting the amplification applied to genuine, stronger echo signals. Which specific receiver control accomplishes this?

- A.** Increases the genuine transmitted frequency for improved resolution
- B.** Physically steers the beam away from a genuine noise source present
- C.** Increases the current pulse repetition frequency setting genuinely selected
- D.** The reject control, eliminating signal below a selected threshold

**50.** A sonographer sets reject to an unnecessarily aggressive level in an attempt to eliminate all background noise entirely. What is the most likely unintended consequence of this specific choice?

- A.** Introducing genuine aliasing that was not previously present at all
- B.** Losing genuine weak but real signal along with the intended noise
- C.** Permanently damaging the transducer element through genuine overuse
- D.** Automatically increasing the current color box size genuinely selected

**51.** A system's dynamic range and its available gray-scale bit depth are genuinely related in which of the following ways?

- A.** Greater bit depth allows more gray shades across the genuine dynamic range
- B.** Bit depth and dynamic range are entirely unrelated system parameters
- C.** Greater bit depth genuinely reduces the achievable dynamic range value

**D. Dynamic range is genuinely fixed regardless of the system's bit depth**

**52. A sonographer wants genuine tissue boundaries to appear more sharply defined on the display, without changing the underlying acquired data itself. Which postprocessing function accomplishes this?**

- A. Edge enhancement, sharpening genuine boundaries between tissue regions**
- B. Smoothing, softening genuine boundaries between tissue regions instead**
- C. Increasing the genuine transmitted frequency for that specific exam**
- D. Physically re-acquiring additional genuine scan lines for the image**

**53. Smoothing, a postprocessing function genuinely opposite in effect to edge enhancement, accomplishes which of the following?**

- A. Sharpens genuine boundaries between adjacent, differing tissue regions**
- B. Softens transitions between adjacent regions, reducing apparent noise**
- C. Increases the genuine transmitted frequency for that specific exam**
- D. Physically re-acquires additional genuine scan lines for the image**

**54. The orientation marker (indicator) on both the transducer and the display genuinely serves which of the following purpose?**

- A. Adjusts the genuine overall gain applied uniformly to the display**
- B. Selects the genuine imaging depth appropriate for the current exam**
- C. Establishes consistent, genuinely correct image orientation for the reader**
- D. Controls the genuine persistence setting applied to sequential frames**

**55. A sonographer notices the displayed image orientation does not genuinely match the expected anatomic convention for the current exam type. Which of the following is most likely responsible?**

- A. An excessively high overall gain setting applied to the current image**
- B. An inappropriately narrow dynamic range setting currently selected**

- C. An excessively high persistence setting applied to sequential frames
- D. Transducer marker orientation not genuinely matching the intended convention

56. Selecting additional focal zones for a single exam, all else held equal, genuinely trades improved focal-zone resolution for which of the following?

- A. A genuinely higher achievable frame rate than fewer zones allow
- B. Genuinely improved penetration depth beyond what fewer zones allow
- C. A genuinely lower achievable frame rate, since more pulses are needed
- D. Elimination of the genuine need for any TGC adjustment whatsoever

57. For optimal lateral resolution at a structure of specific, known interest, focal zone placement should genuinely follow which of the following practice?

- A. Placed at the shallowest depth available, regardless of structure location
- B. Positioned at or near the specific depth of the structure of interest
- C. Placed at the deepest depth available, regardless of structure location
- D. Focal zone placement genuinely has no effect on lateral resolution

58. A sonographer notices the current image appears genuinely grainy and noisy despite adequate penetration to the structure of interest. Which of the following adjustments is most directly appropriate?

- A. Increase overall gain further still, regardless of the current setting
- B. Decrease overall gain, or increase persistence, to reduce apparent noise
- C. Decrease the current imaging depth to a genuinely shallower setting
- D. Increase the current transmitted frequency for improved axial detail

59. A sonographer notices two adjacent tissue regions with a genuinely subtle echogenicity difference are difficult to distinguish on the display. Which of the following adjustments is most directly appropriate?

- A. Adjust dynamic range or the gray map to enhance genuine contrast resolution

- B.** Increase overall gain uniformly across the entire displayed image
- C.** Decrease the current pulse repetition frequency setting genuinely selected
- D.** Increase the current color box size genuinely selected on the display

**60.** A sonographer notices a structure of clinical interest is genuinely positioned at the very edge of the display, partially cut off from view. Which of the following adjustments is most directly appropriate?

- A.** Increase overall gain to genuinely improve visibility of the structure
- B.** Increase dynamic range to display additional genuine gray shades
- C.** Increase persistence to genuinely average additional sequential frames
- D.** Reposition the transducer or adjust the field of view to recenter it

**61.** A sonographer wants to magnify a specific region of interest while genuinely acquiring additional scan lines within that region, improving true resolution rather than merely enlarging the existing display. Which technique accomplishes this?

- A.** Write zoom, applied during the genuine image acquisition itself
- B.** Increasing overall gain within the genuine region of interest specifically
- C.** Increasing persistence within the genuine region of interest specifically
- D.** Electronic (pan) zoom, applied after the image has already been acquired

**62.** A sonographer applies write zoom to a specific region before acquisition, then also applies electronic (pan) zoom to that same already-acquired, magnified image. The pan zoom step genuinely provides which of the following?

- A.** Genuinely additional true resolution beyond what write zoom already provided
- B.** Further magnification of the already-acquired data, with no new resolution
- C.** Improved genuine penetration depth beyond what was originally acquired
- D.** A genuinely new acquisition using different genuine transducer elements

**63.** The Doppler shift is genuinely defined as which of the following?

- A. The transmitted frequency alone, unmodified by any moving reflector
- B. The received frequency alone, unmodified by the transmitted value
- C. The propagation speed divided by the current Doppler angle used
- D. The difference between transmitted and received frequency values

**64.** A reflector is genuinely moving toward the transducer during insonation. The resulting Doppler shift is genuinely which of the following?

- A. Negative, since received frequency is genuinely lower than transmitted
- B. Zero, since motion toward the transducer produces no genuine shift
- C. Unpredictable, since direction alone cannot genuinely determine sign
- D. Positive, since received frequency is genuinely higher than transmitted

**65.** A sonographer places the angle-correction cursor parallel to the vessel wall, assuming flow direction matches wall orientation. In a vessel with genuine turbulent, non-parallel flow, this assumption most directly risks which of the following?

- A. A genuinely inaccurate velocity measurement from a mismatched angle
- B. A genuinely improved measurement accuracy from this alignment choice
- C. No genuine effect, since wall orientation always matches flow direction
- D. Automatic system correction for any genuine wall-flow mismatch present

**66.** A sonographer needs to measure a genuinely very high-velocity jet, such as severe valvular stenosis, where the true velocity would exceed the achievable Nyquist limit for any genuinely achievable PW scale setting. Which mode is most appropriate?

- A. Pulsed-wave (PW) Doppler, at the genuinely highest achievable scale
- B. Color Doppler alone, without any spectral Doppler component used
- C. Power Doppler alone, since it provides genuinely unlimited velocity range
- D. Continuous-wave (CW) Doppler, since it has no genuine Nyquist limit

**67.** A sonographer needs to measure velocity at one genuinely specific, known depth within a vessel, without genuine signal contamination from adjacent structures at other depths. Which mode is most appropriate?

- A.** Continuous-wave (CW) Doppler, providing genuine range resolution
- B.** Pulsed-wave (PW) Doppler, using a range-gated sample volume
- C.** Power Doppler alone, without any spectral component whatsoever
- D.** M-mode alone, without any genuine Doppler component whatsoever

**68.** Selecting a genuinely smaller sample volume gate size, all else held equal, produces which of the following trade-off?

- A.** Genuinely improved sensitivity at the cost of reduced range specificity
- B.** Genuinely improved range specificity at the cost of reduced sensitivity
- C.** No genuine trade-off exists between sensitivity and range specificity
- D.** Gate size genuinely affects only the displayed color, not spectral output

**69.** A sonographer enlarges the color box to cover a genuinely wider anatomic area during a single exam. This adjustment, all else held equal, genuinely produces which of the following consequence?

- A.** A genuinely higher achievable frame rate than a smaller color box allows
- B.** No genuine effect on achievable frame rate under any circumstance
- C.** A genuinely lower achievable frame rate, since more pulses are required
- D.** Automatic, genuine improvement in color sensitivity at every depth

**70.** A sonographer evaluating suspected testicular torsion needs maximal sensitivity to detect genuinely reduced or absent perfusion, without requiring directional flow information for this specific clinical question. Which mode is most appropriate?

- A.** Continuous-wave Doppler, for its genuinely unlimited velocity range
- B.** Conventional color Doppler, for its genuine directional information
- C.** Power Doppler, for its superior sensitivity to low-flow states

**D. M-mode Doppler, for its genuinely high temporal resolution alone**

**71. Power Doppler is genuinely more susceptible than conventional color Doppler to which of the following artifacts?**

- A. Aliasing, the frequency-domain wraparound artifact specifically**
- B. Range ambiguity, the depth-domain artifact specifically**
- C. Mirror image artifact, from reflection off a strong reflector**
- D. Flash artifact, from genuine patient or transducer motion**

**72. A system's current PRF setting is 5000 Hz. What is the genuine Nyquist limit for this specific setting?**

- A. 5000 Hz, equal to the current PRF setting itself**
- B. 2500 Hz, half of the current PRF setting**
- C. 10000 Hz, double the current PRF setting itself**
- D. 1250 Hz, one quarter of the current PRF setting**

**73. A sonographer reviewing a spectral trace notices the waveform's peak is genuinely missing from the top of the display and instead reappears at the bottom, as though it had wrapped around. This visual pattern is most consistent with which of the following?**

- A. A genuinely normal waveform requiring no further clinical consideration**
- B. Spectral broadening, with genuine filling-in of the spectral window**
- C. A completely flat, genuinely featureless waveform throughout the cycle**
- D. Aliasing, a frequency-domain artifact tied to the Nyquist limit**

**74. A sonographer increases sample volume depth substantially during a single exam. The maximum achievable PRF for that new depth, all else held equal, genuinely does which of the following?**

- A. Decreases, since each pulse now requires more time to genuinely return**
- B. Increases, since deeper structures require genuinely less processing**

- C. Remains entirely unchanged regardless of sample volume depth used
- D. Becomes genuinely unpredictable once depth exceeds a fixed value

75. A vessel shows a peak systolic velocity of 90 cm/s and an end-diastolic velocity of 30 cm/s. What is the resistive index at this site?

- A. 0.33, calculated as EDV divided by PSV directly
- B. 3.0, calculated as PSV divided by EDV directly
- C. 0.67, calculated as (PSV minus EDV) divided by PSV
- D. 1.0, calculated as PSV divided by the sum of PSV and EDV

76. A vessel shows a peak systolic velocity of 90 cm/s, an end-diastolic velocity of 30 cm/s, and a mean velocity of 45 cm/s. What is the pulsatility index at this site?

- A. 0.67, calculated as (PSV minus EDV) divided by PSV directly
- B. 1.33, calculated as (PSV minus EDV) divided by mean velocity
- C. 3.0, calculated as PSV divided by EDV directly
- D. 2.0, calculated as PSV divided by mean velocity directly

77. A peripheral arterial waveform shows a sharp systolic peak, a brief period of genuine early diastolic flow reversal, and a small amount of genuine late diastolic forward flow. This triphasic pattern is genuinely most consistent with which of the following?

- A. A genuinely occluded vessel with no true distal flow present at all
- B. A low-resistance waveform pattern, inconsistent with this description
- C. A normal, healthy peripheral arterial waveform pattern
- D. An artifact requiring no further genuine clinical consideration

78. A waveform from a specific vascular bed shows continuous forward diastolic flow with a genuinely low resistive index, consistent with an organ requiring constant perfusion. This pattern is genuinely most consistent with which of the following vascular beds?

- A.** A low-resistance bed, such as the internal carotid or a normal kidney
- B.** A high-resistance peripheral arterial bed under resting conditions
- C.** A completely occluded vessel with no genuine distal flow present
- D.** An artifact requiring no further genuine clinical consideration

**79.** A follow-up exam shows a genuinely decreased resistive index at a vascular site compared to a prior exam, with no other technical change identified. This most directly suggests which of the following?

- A.** Genuinely decreased downstream vascular resistance at that specific site
- B.** Genuinely increased downstream vascular resistance at that specific site
- C.** A technical error in Doppler angle correction, not a genuine true finding
- D.** An artifact requiring no further genuine clinical consideration at all

**80.** Volume flow rate calculations genuinely require which velocity measure, rather than peak systolic velocity alone?

- A.** End-diastolic velocity alone, without any other genuine velocity value
- B.** Peak systolic velocity alone, without any other genuine velocity value
- C.** Mean velocity, averaging the full spectrum across the cardiac cycle
- D.** The resistive index alone, without any genuine velocity value at all

**81.** A sonographer needs to estimate the actual volume of blood passing a specific point per unit time, not simply a velocity value alone. Which specific combination of measurements genuinely accomplishes this?

- A.** Mean velocity combined with the vessel's genuine cross-sectional area
- B.** Peak systolic velocity combined with the current Doppler angle alone
- C.** Resistive index combined with the vessel's genuine cross-sectional area
- D.** Mean velocity alone, without any genuine cross-sectional measurement

**82.** A sonographer evaluating genuinely low-velocity venous flow should generally select which of the following wall filter settings, compared to a typical arterial exam?

- A.** A genuinely lower wall filter setting, to preserve low-velocity signal
- B.** A genuinely higher wall filter setting, matching typical arterial values
- C.** Wall filter setting genuinely has no relevance to venous flow at all
- D.** The genuine highest available wall filter setting, for cleanest signal

**83.** A sonographer evaluating venous flow notices the expected venous signal is genuinely absent from the spectral display, despite confirmed vessel patency on grayscale imaging. Which setting should be checked first?

- A.** The current transmitted frequency selected for this specific exam
- B.** The wall filter setting, potentially set too high for low venous velocities
- C.** The current dynamic range setting selected for this specific exam
- D.** The current persistence setting selected for this specific exam

**84.** A sonographer observes aliasing at a moderate sample volume depth and has genuine room remaining to increase the current scale setting. Which adjustment is most directly appropriate as a first step?

- A.** Switch immediately to continuous-wave Doppler without further adjustment
- B.** Decrease the wall filter setting to its genuine minimum available value
- C.** Increase scale (PRF), since genuine room remains to do so at this depth
- D.** Decrease overall gain to reduce genuine image noise present

**85.** A sonographer evaluating predominantly unidirectional venous flow notices the waveform is genuinely compressed near one edge of the display, wasting available display range. Which adjustment is most directly appropriate?

- A.** Shift the baseline to reallocate display range toward that flow direction
- B.** Increase overall gain uniformly across the entire spectral display

- C. Decrease persistence to its genuine minimum available value
- D. Increase the current color box size genuinely selected on the display

**86.** A sonographer aligns the angle-correction cursor with the vessel wall rather than the genuine direction of blood flow within it. This misalignment most directly risks which of the following?

- A. A genuinely improved velocity measurement from this specific alignment
- B. A genuinely inaccurate velocity calculation from the incorrect angle used
- C. No genuine effect, since vessel wall and flow direction are always identical
- D. Automatic system correction for any genuine wall-flow mismatch present

**87.** A sonographer insonates a vessel at a genuinely steep 80-degree angle rather than a recommended angle below 60 degrees. This steep angle most directly risks which of the following?

- A. A genuinely improved velocity measurement from this steeper angle
- B. No genuine effect on measurement accuracy at any angle whatsoever
- C. Automatic system correction applied for any genuinely steep angle used
- D. A genuinely large velocity error from a small angle-estimation mistake

**88.** A sonographer notices color signal genuinely extending visibly beyond the true vessel wall margin into surrounding tissue. Which setting is most likely responsible?

- A. An inappropriately narrow color box size currently selected
- B. An inappropriately low wall filter setting currently selected
- C. An inappropriately low current pulse repetition frequency setting
- D. Excessive color Doppler gain, currently set too high for this vessel

**89.** A sonographer needs to maintain adequate frame rate while still evaluating color flow across a genuinely wide anatomic region. Which adjustment most directly helps achieve both goals together?

- A. Narrow the color box to the genuinely smallest area still diagnostically needed

- B.** Widen the color box further, to genuinely cover the entire field of view
- C.** Increase persistence substantially, to compensate for a wide color box
- D.** Decrease overall gain substantially, to compensate for a wide color box

**90.** Compared to standard grayscale imaging, spectral Doppler's genuinely higher duty factor most directly raises which of the following considerations?

- A.** A genuinely reduced need for careful Doppler angle correction
- B.** A genuinely reduced need for appropriate sample volume placement
- C.** A genuinely reduced need for wall filter adjustment during the exam
- D.** Genuinely elevated thermal bioeffects potential requiring ALARA attention

**91.** A sonographer evaluating a vessel near the pleura observes an apparent duplicate flow signal on the opposite side of that strong reflective boundary. This finding is most consistent with which of the following?

- A.** A genuine second, anatomically distinct vessel at that specific location
- B.** Range ambiguity, a depth-domain artifact distinct from this mechanism
- C.** Mirror image artifact, from reflection off the pleura's strong surface
- D.** Aliasing, a frequency-domain artifact distinct from this mechanism

**92.** A sonographer using an unusually high PRF at significant sample volume depth notices signal appearing to originate from an anatomically implausible depth. This finding is most consistent with which of the following?

- A.** Range ambiguity, a depth-domain artifact from pulse-timing mismatch
- B.** Mirror image artifact, from reflection off a strong reflector present
- C.** Aliasing, a frequency-domain artifact tied to the Nyquist limit
- D.** An excessively high wall filter setting removing genuine flow signal

- 93.** A sonographer is uncertain whether an unusual Doppler finding represents aliasing or range ambiguity. Which systematic test most directly distinguishes between these two artifacts?
- A.** Increasing overall gain and observing whether the finding changes at all
  - B.** Increasing persistence and observing whether the finding changes at all
  - C.** Both artifacts are genuinely identical, so no distinguishing test exists
  - D.** Testing whether adjusting scale changes the finding in the predicted way
- 94.** A sonographer resolves aliasing by increasing scale, but the true velocity still genuinely exceeds the achievable PW Nyquist limit at maximum scale. Which of the following is the most appropriate next step?
- A.** Accept the aliased display as the final genuine result for this exam
  - B.** Switch to continuous-wave Doppler for this specific measurement
  - C.** Decrease the wall filter setting to its genuine minimum available value
  - D.** Increase persistence substantially to average additional sequential frames
- 95.** A sonographer suspects mirror image artifact and wants to confirm this before documenting a finding. Which action most directly helps confirm or rule out this suspicion?
- A.** Reposition the transducer or beam angle relative to the strong reflector
  - B.** Increase overall gain substantially to overpower the duplicated signal
  - C.** Increase the current pulse repetition frequency setting genuinely selected
  - D.** Decrease the wall filter setting to its genuine minimum available value
- 96.** When encountering any genuinely unclear or unexpected Doppler finding, the most reliable general approach is which of the following?
- A.** Assume the finding is artifactual, since most unusual findings are artifacts
  - B.** Identify the likely mechanism first, then apply the corresponding targeted test
  - C.** Assume the finding is genuine, since most unusual findings reflect true pathology

**D.** Switch to a genuinely different imaging modality without further review

**97.** A spectral trace obtained just distal to a genuine focal vessel stenosis shows spectral broadening with filling-in of the spectral window. This finding is most consistent with which of the following?

- A.** A genuinely normal, laminar flow pattern at this specific location
- B.** A technical artifact requiring no further genuine clinical consideration
- C.** An excessively high wall filter setting removing genuine flow signal
- D.** Turbulent flow, consistent with the genuine post-stenotic location

**98.** A sonographer has a known Doppler shift, transmitted frequency, and propagation speed, but needs to solve the Doppler equation for the genuine Doppler angle instead of velocity. Which of the following approaches is correct?

- A.** Algebraically isolate the cosine term, then solve for the angle itself
- B.** The Doppler angle can never genuinely be isolated within this equation
- C.** Divide the Doppler shift directly by the assumed propagation speed alone
- D.** Multiply the transmitted frequency by the assumed propagation speed alone

**99.** A sonographer notices that within the color box, a specific pixel shows both a genuine grayscale echo and a genuine color Doppler signal simultaneously. Under standard display convention, which signal is genuinely shown at that pixel?

- A.** Grayscale signal is genuinely always shown, overriding color entirely
- B.** Neither signal is genuinely displayed if both are present simultaneously
- C.** Both signals are genuinely blended into a single intermediate value
- D.** Color signal is generally given genuine display priority within the box

**100.** A sonographer is comparing two console-displayed safety indices during a routine exam and needs to identify which one specifically reflects genuine cavitation potential rather than heating potential. Which index is this?

- A.** The Thermal Index, reflecting genuine tissue heating potential instead
- B.** An unrelated display parameter, with no genuine bioeffects meaning
- C.** The Mechanical Index, reflecting genuine mechanical cavitation potential
- D.** A parameter genuinely relevant only to contrast-enhanced exams specifically

**101.** A sonographer performing an exam involving contrast agent microbubbles must weigh genuine cavitation risk against maintaining a detectable signal. This weighing is most directly governed by which of the following settings?

- A.** The current transmitted frequency selected for this specific exam
- B.** The current pulse repetition frequency setting genuinely selected
- C.** The current dynamic range setting genuinely selected for this exam
- D.** The Mechanical Index, deliberately kept low but genuinely non-zero

**102.** A sonographer applies the ALARA principle throughout a genuinely lengthy, technically difficult exam. Which of the following best describes how ALARA should genuinely be applied across that exam's full duration?

- A.** As a single setting genuinely applied only once, at the exam's start
- B.** Continuously, reassessed throughout the exam as clinical needs evolve
- C.** Only at the exam's genuine conclusion, reviewing overall exposure
- D.** ALARA genuinely applies only to obstetric exams specifically

**103.** A QA technologist wants to verify that on-screen caliper measurements genuinely correspond to a phantom's known true distances. Which specific QA parameter does this test?

- A.** Sensitivity (penetration), a genuinely separate QA parameter entirely
- B.** Dead zone, a genuinely separate near-field QA parameter entirely
- C.** Axial resolution, a genuinely separate QA parameter entirely
- D.** Distance (caliper) accuracy, verified against a phantom's known distances

**104.** A QA technologist wants to verify the minimum depth near the transducer face at which two closely spaced structures can genuinely first be resolved. Which specific QA parameter does this test?

- A.** Distance (caliper) accuracy, a genuinely separate QA parameter entirely
- B.** Sensitivity (penetration), a genuinely separate QA parameter entirely
- C.** Lateral resolution, a genuinely separate QA parameter entirely
- D.** Dead zone, a near-field limitation close to the transducer face

**105.** A facility documents QA results consistently across every scheduled testing interval, rather than discarding prior results after each new test. This practice most directly supports which of the following?

- A.** Detecting gradual performance drift that a single result could not reveal
- B.** Eliminating any genuine future need for continued QA testing at all
- C.** Satisfying regulatory paperwork requirements alone, with no other value
- D.** Replacing the genuine need for preventive maintenance inspection entirely

**106.** A QA test result for a specific transducer falls meaningfully outside established tolerance, while the system otherwise produces normal-looking clinical images. Which of the following is the most appropriate response?

- A.** Continue clinical use unchanged, since images otherwise look normal
- B.** Document the result with no further genuine corrective action taken
- C.** Remove that transducer from clinical service until corrected and re-verified
- D.** Increase the testing interval to encounter this result less frequently

**107.** A sonographer performing routine preventive maintenance notices a small crack on a transducer's acoustic lens surface. This finding most directly represents which of the following?

- A.** A cosmetic issue only, with no genuine patient safety implication
- B.** An issue relevant only to image quality, with no safety implication
- C.** A genuine patient safety concern, including possible electrical leakage risk

**D.** An issue that genuinely requires no action until the next scheduled QA cycle

**108.** A sonographer performing shear wave elastography obtains a genuine, absolute numeric stiffness value for a specific lesion, expressed in meters per second. Which elastography technique genuinely produces this type of output?

- A.** Shear wave elastography, providing an absolute, quantitative value
- B.** Strain elastography, providing only a relative, qualitative map
- C.** Neither technique genuinely provides any quantitative output at all
- D.** Standard B-mode imaging alone, without any elastography technique

**109.** A sonographer performing strain elastography compares tissue displacement before and after a manual compression, producing a color-coded map. This output is genuinely best characterized as which of the following?

- A.** An absolute, quantitative stiffness value in a genuine physical unit
- B.** A value genuinely identical in kind to a shear wave speed measurement
- C.** A relative, qualitative comparison of deformation between regions
- D.** A measurement genuinely requiring no operator technique consideration

**110.** A sonographer preparing for a contrast-enhanced exam confirms the console's Mechanical Index before microbubble injection. Setting MI too high for this specific exam most directly risks which of the following?

- A.** Genuinely improved microbubble signal with no other consequence at all
- B.** A genuinely reduced need for any further console adjustment at all
- C.** Automatic, genuine correction of the setting by the system itself
- D.** Destroying microbubbles via inertial cavitation, ending genuine signal

## Answers

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- 1. B.** Frequency equals 1 divided by period:  $1 / 0.00000025 \text{ s} = 4,000,000 \text{ Hz} = 4 \text{ MHz}$ . Options A, C, and D each misapply the frequency-period relationship.
- 2. B.** Amplitude is the maximum variation of an acoustic variable from its average value, a measure of a wave's genuine strength. Option A describes wavelength, option C describes frequency, and option D describes period.
- 3. A.** Because propagation speed genuinely changes between media while frequency remains fixed (set by the transducer), wavelength, which depends directly on propagation speed, genuinely changes correspondingly. Options B, C, and D each misstate what actually changes.
- 4. A.** Propagation speed is genuinely governed by the medium's stiffness and density together, not by either property in isolation or by any transmitted-pulse parameter. Options B, C, and D each misattribute this determination to unrelated parameters.
- 5. B.** Muscle tissue is genuinely stiffer than fat, producing a correspondingly faster propagation speed through muscle compared to fat. Options A, C, and D each misstate this actual tissue-speed relationship.
- 6. A.** Diagnostic ultrasound systems assume a standard propagation speed of 1540 m/s for average soft tissue, the basis for all distance and depth calculations. Options B, C, and D are not this standard assumed value.
- 7. C.** Total attenuation genuinely combines absorption, reflection, and scattering together, each contributing to the beam's progressive weakening with depth. Options A, B, and D each describe only a single, incomplete contributor.
- 8. D.** Total attenuation (dB) = attenuation coefficient x frequency (MHz) x total path length (cm):  $0.5 \times 3 \times 12$  (6 cm there, 6 cm back) = 18 dB. Options A, B, and C each miscalculate this round-trip total.
- 9. C.** The half-value layer directly indicates the approximate depth at which beam intensity has genuinely been reduced to half its original value, a practical measure of attenuation with depth. Options A, B, and D describe unrelated concepts.
- 10. A.** Higher transmitted frequency is genuinely attenuated more per centimeter than lower frequency, directly decreasing effective penetration depth. Options B, C, and D each misstate this actual frequency-penetration relationship.
- 11. B.** Acoustic impedance mismatch between two tissue types directly determines the proportion of sound genuinely reflected versus transmitted at that specific boundary. Options A, C, and D describe unrelated determining factors.

- 12. C.** A genuinely large acoustic impedance mismatch, as between soft tissue and bone, produces strong reflection, with only limited sound genuinely transmitted beyond that boundary. Options A, B, and D each misstate this actual relationship.
- 13. B.** A large, smooth organ capsule surface is genuinely large relative to wavelength and smooth, the defining conditions for specular reflection. Options A, C, and D each describe surfaces more likely to produce diffuse, not specular, reflection.
- 14. C.** Rayleigh scattering, from structures genuinely much smaller than the wavelength such as tissue parenchyma, produces the faint background echo texture characteristic of solid organs. Options A, B, and D describe unrelated phenomena.
- 15. D.** Refraction can genuinely cause beam bending at an oblique boundary, potentially misplacing a structure's apparent position on the display relative to its true location. Options A, B, and C each misstate refraction's actual clinical relevance.
- 16. B.** Because PRF and PRP are genuine mathematical inverses ( $PRF = 1/PRP$ ), doubling PRF directly halves PRP as a mathematical consequence. Options A, C, and D each misstate this actual inverse relationship.
- 17. B.** As imaging depth increases, PRP genuinely increases (more time needed for pulse return) while PRF genuinely decreases correspondingly, since they are inverse quantities. Options A, C, and D each misstate this actual depth relationship.
- 18. A.** Standard grayscale pulsed imaging genuinely operates at a very low duty factor, typically under 1 percent, since the system spends the vast majority of each cycle listening rather than transmitting. Options B, C, and D each substantially overstate this actual value.
- 19. D.** Spatial pulse length equals the number of cycles multiplied by wavelength:  $6 \times 0.2 \text{ mm} = 1.2 \text{ mm}$ . Options A, B, and C each apply an incorrect or incomplete calculation.
- 20. B.** Decreasing spatial pulse length directly improves axial resolution, the along-the-beam resolving capability established elsewhere in this framework. Options A, C, and D each misattribute this improvement to an unrelated resolution type.
- 21. A.** A shorter damping backing material produces fewer cycles per pulse, directly shortening spatial pulse length and thereby improving axial resolution. Options B, C, and D each describe a change that would lengthen, not shorten, spatial pulse length.
- 22. C.** Alternating the scanning hand and adjusting table height are genuine, evidence-based ergonomic practices shown to reduce cumulative musculoskeletal strain. Options A, B, and D each describe a practice that would genuinely increase injury risk.

- 23. C.** Appropriate transducer disinfection, consistent with its specific use category (e.g., surface, semi-critical), is a genuine, required infection control standard between sequential patient exams. Options A, B, and D each describe an inappropriate practice that would genuinely risk cross-contamination.
- 24. B.** Frame averaging (persistence) genuinely reduces random noise by combining sequential frames, but at the cost of potentially blurring structures that are genuinely moving between those frames. Options A, C, and D each misstate this actual trade-off.
- 25. A.** For a rapidly moving structure such as a fetal heart, a genuinely lower persistence setting preserves temporal detail that higher persistence would otherwise blur across averaged frames. Options B, C, and D each describe an inappropriate or dismissive approach to this scenario.
- 26. D.** Element thickness and resonant frequency are genuinely inversely proportional: a thinner element resonates at a higher frequency, and a thicker element at a lower frequency. Options A, B, and C each misstate this actual relationship.
- 27. A.** A linear array produces a genuinely rectangular field of view, with constant width at all depths, since all elements fire in parallel across the flat array face. Options B, C, and D describe field-of-view shapes characteristic of other array types.
- 28. D.** A phased array's genuinely small physical footprint allows it to fit within a narrow intercostal acoustic window, making it well suited to cardiac imaging specifically. Options A, B, and C describe applications better served by other array types with a different footprint.
- 29. B.** Electronic steering in a phased array is achieved through precisely timed firing delays applied sequentially across the element sequence, directing the beam without any physical movement. Options A, C, and D describe mechanisms the array does not actually use.
- 30. A.** A curvilinear array's curved footprint produces a field of view that genuinely widens progressively with increasing depth, well suited to abdominal applications needing a broad deep view. Options B, C, and D describe field-of-view characteristics of other array types.
- 31. D.** Grating lobes can genuinely place a strong reflector's echo at an incorrect apparent position on the display, a direct artifact consequence of element spacing relative to wavelength. Options A, B, and C each misstate this actual consequence.
- 32. A.** A matrix array's true two-dimensional grid of elements genuinely enables electronic beam steering and focusing in both the azimuthal and elevational planes simultaneously, unlike a standard 1D array limited to one plane. Options B, C, and D each misstate this actual capability.
- 33. B.** The acoustic lens physically focuses the beam in the elevational plane (the dimension not electronically steerable in a standard 1D array), complementing electronic focusing in the azimuthal plane. Options A, C, and D describe functions performed by other transducer components.

- 34. C.** Increasing pulser voltage produces a genuinely greater transmitted amplitude for that pulse, a direct voltage-amplitude relationship. Options A, B, and D each describe a parameter pulser voltage does not directly control.
- 35. A.** Within the receiver's processing sequence, amplification and time gain compensation are genuinely applied before compression, which itself precedes demodulation, in a defined general order. Options B, C, and D each misstate this actual sequence.
- 36. C.** Overall genuine image quality reflects the combined contribution of multiple resolution types together (axial, lateral, contrast, and temporal), not any single factor in isolation. Options A, B, and D each incorrectly isolate a single contributing factor.
- 37. A.** The digital scan converter's primary function is storing and manipulating acquired echo data for proper, genuine display on a monitor, translating acquisition geometry into a viewable image. Options B, C, and D describe functions of unrelated components.
- 38. D.** A pixel, the smallest unit of a digital image, directly stores a genuine brightness (grayscale) value corresponding to that specific spatial location. Options A, B, and C describe unrelated stored parameters.
- 39. A.** A genuinely higher display matrix size (more pixels) allows finer representation of the acquired data, genuinely improving displayed image detail. Options B, C, and D each misstate this actual relationship.
- 40. C.** Increasing line density requires additional pulses per frame to cover the same field, directly decreasing achievable frame rate for a fixed depth. Options A, B, and D each misstate this actual relationship.
- 41. D.** Line density and frame rate genuinely compete for the same limited pulse-time budget within each frame period, requiring a deliberate trade-off between genuine image detail and genuine update rate. Options A, B, and C each misstate this actual competing relationship.
- 42. B.** Temporal resolution, the ability to accurately depict genuine motion over time, is most directly tied to frame rate, the number of complete images displayed per second. Options A, C, and D describe unrelated resolution types or parameters.
- 43. A.** Decreasing imaging depth, line density, or the number of focal zones each reduces the total pulses required per frame, directly improving achievable frame rate and thus temporal resolution. Options B, C, and D each describe an adjustment that would not improve temporal resolution.
- 44. D.** Tissue harmonic imaging generates its image from harmonic frequencies genuinely produced as the transmitted sound propagates through tissue itself, rather than from the transducer's original fundamental frequency alone. Options A, B, and C each misstate this actual signal source.

- 45. D.** Tissue harmonic imaging genuinely reduces near-field artifact and improves border definition compared to fundamental frequency imaging, since harmonic signal is generated deeper in tissue, avoiding superficial reverberation sources. Options A, B, and C each misstate this actual clinical benefit.
- 46. A.** Spatial compounding, combining images from multiple genuine beam angles, reduces speckle noise and improves border definition by averaging genuinely differing angle-dependent information together. Options B, C, and D each misstate this actual primary benefit.
- 47. D.** Spatial compounding requires acquiring images at multiple genuine beam angles sequentially, directly reducing achievable frame rate compared to single-angle acquisition. Options A, B, and C each misstate this actual trade-off.
- 48. B.** Time gain compensation, adjusted specifically at the affected depth, directly compensates for depth-dependent attenuation causing dimming beyond a certain point despite appropriate shallower gain. Options A, C, and D each describe an adjustment that does not target this specific depth-related problem.
- 49. D.** The reject control eliminates low-level noise signal falling below a genuinely selected amplitude threshold, without affecting amplification applied to stronger, genuine echo signals above that threshold. Options A, B, and C describe functions reject does not actually perform.
- 50. B.** An unnecessarily aggressive reject setting risks eliminating genuine weak but real signal along with the intended background noise, since both can fall within a similar low-amplitude range. Options A, C, and D each misstate this actual consequence.
- 51. A.** Greater available bit depth allows the system to represent more gray shades across its genuine dynamic range, providing finer contrast distinctions. Options B, C, and D each misstate this actual relationship.
- 52. A.** Edge enhancement sharpens genuine boundaries between adjacent, differing tissue regions as a postprocessing function applied to already-acquired data, without altering underlying acquisition. Options B, C, and D describe functions edge enhancement does not perform.
- 53. B.** Smoothing softens transitions between adjacent regions, reducing apparent noise at some cost to genuine edge definition, the direct opposite effect of edge enhancement. Options A, C, and D describe functions smoothing does not perform.
- 54. C.** The orientation marker on both the transducer and display establishes consistent, genuinely correct image orientation, allowing the reader to reliably interpret left/right or superior/inferior relationships. Options A, B, and D describe functions unrelated to orientation.
- 55. D.** A displayed orientation not matching the expected anatomic convention most likely reflects the transducer marker's genuine orientation not matching the intended scanning convention for that exam type. Options A, B, and C each describe an unrelated control that does not affect image orientation.

- 56. C.** Additional focal zones require additional pulses per scan line, directly decreasing achievable frame rate, a genuine trade-off for the improved focal-zone resolution gained. Options A, B, and D each misstate this actual trade-off.
- 57. B.** Positioning the focal zone at or near the specific depth of the structure of interest directly maximizes lateral resolution genuinely achievable at that location. Options A, C, and D each describe an approach that does not optimize resolution at the structure's actual depth.
- 58. B.** Decreasing overall gain, or alternatively increasing persistence, reduces apparent image noise, directly addressing a genuinely grainy appearance without sacrificing adequate penetration already achieved. Options A, C, and D each describe an adjustment that does not address genuine noise reduction.
- 59. A.** Adjusting dynamic range or the gray map enhances the system's genuine ability to distinguish subtly different echogenicities, directly improving contrast resolution for this specific scenario. Options B, C, and D each describe an adjustment that does not address contrast resolution.
- 60. D.** Repositioning the transducer or adjusting the field of view directly recenters the structure of interest within the genuinely available display area. Options A, B, and C each describe an adjustment that does not address the structure's actual off-center position.
- 61. A.** Write zoom, applied during the genuine image acquisition itself, genuinely acquires additional scan lines within the magnified region, providing true resolution improvement rather than merely enlarging already-acquired data. Options B, C, and D each describe an approach that does not genuinely acquire new resolution.
- 62. B.** Electronic (pan) zoom applied to already-acquired data, even data already magnified by write zoom, provides further magnification of that existing data without acquiring any new genuine resolution. Options A, C, and D each misstate this actual limitation of pan zoom specifically.
- 63. D.** The Doppler shift is genuinely defined as the difference between the transmitted frequency and the received frequency, the direct basis of Doppler-based velocity measurement. Options A, B, and C each misstate this actual definition.
- 64. D.** A reflector moving toward the transducer genuinely compresses returning wavefronts, producing a received frequency higher than transmitted, a genuinely positive Doppler shift. Options A, B, and C each misstate this actual relationship.
- 65. A.** Assuming wall orientation matches flow direction, when flow is genuinely turbulent or non-parallel to the wall, risks an inaccurate velocity measurement from a genuinely mismatched angle assumption. Options B, C, and D each misstate this actual risk.
- 66. D.** Continuous-wave Doppler has no genuine Nyquist limit, since it does not rely on pulsed sampling, making it appropriate for measuring velocities that would exceed any achievable PW scale

setting. Options A, B, and C each describe a mode genuinely subject to this same limitation or lacking needed capability.

**67. B.** Pulsed-wave Doppler achieves genuine range resolution through a range-gated sample volume, allowing measurement at one specific depth without contamination from adjacent structures. Options A, C, and D each describe a mode lacking this specific range-resolving capability.

**68. B.** A genuinely smaller sample volume gate improves range specificity (isolating a narrower depth range) at the cost of reduced sensitivity, since less signal is genuinely captured within that smaller volume. Options A, C, and D each misstate this actual trade-off.

**69. C.** Enlarging the color box requires additional color-specific pulses to cover the expanded area, directly decreasing achievable frame rate. Options A, B, and D each misstate this actual relationship.

**70. C.** Power Doppler's superior sensitivity to low-flow states makes it well suited for detecting genuinely reduced or absent perfusion, such as in suspected testicular torsion, where directional information is not the primary clinical question. Options A, B, and D each describe a mode less suited to this specific low-flow priority.

**71. D.** Power Doppler is genuinely more susceptible to flash artifact from patient or transducer motion, since it displays amplitude without the directional filtering that can help distinguish genuine flow from motion in other modes. Options A, B, and C describe artifacts genuinely more associated with other mechanisms.

**72. B.** The Nyquist limit equals PRF divided by two:  $5000 / 2 = 2500$  Hz. Options A, C, and D each apply an incorrect calculation.

**73. D.** A waveform peak genuinely missing from the top and reappearing at the bottom, as though wrapped around, is the classic visual signature of aliasing. Options A, B, and C describe patterns inconsistent with this specific wraparound appearance.

**74. A.** Increasing sample volume depth genuinely means each pulse requires more time to return, directly decreasing the maximum achievable PRF at that new, deeper setting. Options B, C, and D each misstate this actual depth relationship.

**75. C.** Resistive index equals (peak systolic velocity minus end-diastolic velocity) divided by peak systolic velocity:  $(90-30)/90 = 0.67$ . Options A, B, and D each apply an incorrect formula.

**76. B.** Pulsatility index equals (peak systolic velocity minus end-diastolic velocity) divided by mean velocity:  $(90-30)/45 = 1.33$ . Options A, C, and D each apply an incorrect formula.

**77. C.** A triphasic waveform, with a sharp systolic peak, genuine early diastolic reversal, and a small late diastolic forward component, is the normal, healthy pattern for a typical peripheral artery under resting conditions. Options A, B, and D each misstate this actual normal pattern.

**78. A.** Continuous forward diastolic flow with a genuinely low resistive index is characteristic of a low-resistance vascular bed, such as the internal carotid artery or a normal kidney, organs requiring constant perfusion. Options B, C, and D each describe a pattern inconsistent with this specific low-resistance description.

**79. A.** A genuinely decreased resistive index, with no technical change identified, most directly suggests genuinely decreased downstream vascular resistance at that specific site, a real hemodynamic change rather than a technical artifact by default. Options B, C, and D each misattribute or dismiss this genuine finding.

**80. C.** Volume flow rate calculations genuinely require mean velocity, which averages the full velocity spectrum across the cardiac cycle, rather than the single peak systolic value alone. Options A, B, and D each describe a measure that does not support genuine volume flow calculation.

**81. A.** Estimating actual volume flow requires mean velocity combined with the vessel's genuine cross-sectional area, since volume flow equals mean velocity multiplied by that area. Options B, C, and D each omit or misapply a genuinely necessary component.

**82. A.** Venous flow is genuinely much lower in velocity than typical arterial flow, so a genuinely lower wall filter setting is needed to preserve this low-velocity signal without inadvertently removing it. Options B, C, and D each misstate this actual clinical consideration.

**83. B.** An absent venous spectral signal despite confirmed patency on grayscale most likely reflects a wall filter set too high for the genuinely low venous velocities present, inadvertently removing real flow signal. Options A, C, and D describe settings less directly responsible for this specific finding.

**84. C.** Increasing scale (PRF), when genuine room remains to do so at the current depth, directly raises the Nyquist limit, the appropriate first-step correction for aliasing in this specific scenario. Options A, B, and D each describe an adjustment that does not address aliasing as directly at this stage.

**85. A.** Shifting the baseline reallocates the display's vertical range toward the predominant flow direction, directly addressing a waveform genuinely compressed near one edge of an unshifted display. Options B, C, and D each describe an adjustment that does not address this specific display allocation problem.

**86. B.** Aligning the angle-correction cursor with the vessel wall, rather than the genuine direction of blood flow, produces a genuinely inaccurate velocity calculation whenever flow direction does not match wall orientation exactly. Options A, C, and D each misstate this actual risk.

**87. D.** Near 90 degrees, cosine changes rapidly per degree of angle error, so a genuinely steep 80-degree angle risks a large velocity error from even a small angle-estimation mistake. Options A, B, and C each misstate this actual accuracy risk.

- 88. D.** Excessive color Doppler gain, set too high for the specific vessel, produces color signal genuinely extending beyond the true vessel wall margin into surrounding tissue, a classic color-gain artifact. Options A, B, and C describe settings not primarily responsible for this specific visual finding.
- 89. A.** Narrowing the color box to the genuinely smallest diagnostically needed area directly reduces the pulses required per frame, helping maintain frame rate while still covering the clinically relevant region. Options B, C, and D each describe an adjustment that does not genuinely address this specific frame-rate goal.
- 90. D.** Spectral Doppler's genuinely higher duty factor, compared to standard grayscale imaging, directly raises thermal bioeffects potential, requiring genuine ALARA attention during extended or repeated spectral acquisition. Options A, B, and C each describe an unrelated or incorrect consideration.
- 91. C.** An apparent duplicate flow signal on the opposite side of a strong reflective boundary such as the pleura is characteristic of mirror image artifact, from sound reflecting off that specific strong reflector. Options A, B, and D each describe an unrelated finding or mechanism.
- 92. A.** Signal appearing to originate from an anatomically implausible depth, particularly at an unusually high PRF, is characteristic of range ambiguity, a depth-domain artifact from pulse-timing mismatch. Options B, C, and D each describe an unrelated finding or mechanism.
- 93. D.** Testing whether adjusting scale changes the finding in the predicted way genuinely distinguishes aliasing (which should respond to a scale increase) from range ambiguity (which requires a PRF decrease instead), since the two artifacts respond oppositely to this specific test. Options A, B, and C each describe an approach that does not genuinely distinguish between these two artifacts.
- 94. B.** When true velocity still genuinely exceeds the achievable PW Nyquist limit even at maximum scale, switching to continuous-wave Doppler avoids this limitation entirely for that specific measurement. Options A, C, and D each describe an inappropriate or ineffective next step.
- 95. A.** Repositioning the transducer or beam angle relative to the strong reflector, and observing whether the apparent duplicate signal changes character, directly helps confirm or rule out suspected mirror image artifact. Options B, C, and D each describe an action that does not directly test for this specific artifact.
- 96. B.** Identifying the likely underlying mechanism first, then applying the corresponding targeted test, is the most reliable general approach to any genuinely unclear Doppler finding, rather than assuming either a genuine or artifactual explanation by default. Options A, C, and D each describe an inappropriate, non-systematic response.
- 97. D.** Spectral broadening with filling-in of the spectral window, obtained just distal to a genuine focal stenosis, is the classic Doppler signature of post-stenotic turbulent flow. Options A, B, and C each describe a finding inconsistent with this specific post-stenotic turbulent pattern.

- 98. A.** Solving the Doppler equation for the angle itself requires algebraically isolating the cosine term, then applying the inverse cosine function to the resulting ratio. Options B, C, and D each describe an approach that does not correctly isolate the angle term.
- 99. D.** Standard display convention generally gives color Doppler signal genuine display priority within the color box when both grayscale and color signal are present at the same pixel simultaneously. Options A, B, and C each misstate this actual standard display convention.
- 100. C.** The Mechanical Index specifically reflects mechanical bioeffects potential, arising from genuine cavitation, distinct from the Thermal Index's reflection of heating potential. Options A, B, and D each misstate or dismiss this actual distinction.
- 101. D.** The Mechanical Index, deliberately kept low but genuinely non-zero, directly governs this specific balance between preserving microbubble integrity and maintaining detectable contrast signal. Options A, B, and C describe settings not primarily responsible for this specific balance.
- 102. B.** ALARA is genuinely applied continuously throughout an exam, reassessed as clinical needs evolve, rather than as a single setting fixed at the start or reviewed only afterward. Options A, C, and D each mischaracterize ALARA's actual, ongoing application.
- 103. D.** Verifying that on-screen caliper measurements genuinely correspond to a phantom's known true distances is specifically the distance (caliper) accuracy test. Options A, B, and C describe genuinely separate QA parameters.
- 104. D.** Verifying the minimum depth near the transducer face at which structures can first genuinely be resolved is specifically the dead zone test. Options A, B, and C describe genuinely separate QA parameters.
- 105. A.** Consistent documentation across every scheduled interval allows gradual performance drift to be detected, something a single isolated result could never reveal on its own. Options B, C, and D each misstate or dismiss this actual value.
- 106. C.** A QA result meaningfully outside tolerance indicates genuine risk regardless of how images subjectively appear, so the appropriate response is removing that specific transducer from service until corrected and re-verified. Options A, B, and D each describe an inappropriate response that fails to address the genuine underlying concern.
- 107. C.** A cracked transducer face represents a genuine patient safety concern, including possible electrical leakage current risk, independent of any scheduled QA testing date. Options A, B, and D each dismiss or understate this actual safety concern.
- 108. A.** Shear wave elastography genuinely produces an absolute, quantitative stiffness value, typically expressed in meters per second or converted to kilopascals, based on measured shear wave propagation speed. Options B, C, and D each misstate or dismiss this actual capability.

**109. C.** Strain elastography's comparison of tissue displacement before and after compression genuinely produces a relative, qualitative comparison of deformation between regions, not an absolute physical-unit value. Options A, B, and D each misstate this actual output.

**110. D.** Setting Mechanical Index too high during a contrast-enhanced exam risks destroying microbubbles via inertial cavitation, which both ends the genuine detectable signal and poses a genuine bioeffects concern. Options A, B, and C each misstate or dismiss this actual risk.