

COMPREHENSIVE MOCK EXAM 15

Supplemental to: Clinical Ultrasound Board Review 2026-2027

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ARDMS SPI (Sonography Principles and Instrumentation) Certification Exam — 110 questions, single-best-answer, four options (A–D), domain-weighted per the official ARDMS blueprint: Clinical Safety/Patient Care/QA 11, Physical Principles 16, Ultrasound Transducers 18, Imaging Principles & Instrumentation 31, Doppler Imaging Concepts 34.

Board-Review Questions

1. A vascular lab director explains that thermal index and mechanical index are tracked separately because they estimate genuinely different risks. Which pairing correctly matches each index to its risk?
 - A. TI estimates thermal (heating) risk; MI estimates mechanical (cavitation) risk
 - B. TI estimates cavitation risk; MI estimates thermal risk
 - C. Both indices estimate the identical bioeffect, cavitation, under different names
 - D. Neither index has any genuine connection to a specific bioeffect category

2. Fill in the blank: MI estimates the likelihood of a _____ bioeffect, while TI estimates the likelihood of a _____ bioeffect.
 - A. thermal; mechanical
 - B. chemical; electrical
 - C. mechanical; thermal
 - D. electrical; chemical

3. A microscopic gas bubble forms and violently collapses under a passing negative pressure phase. What is this specific bioeffect called?
 - A. Thermal injury
 - B. Inertial cavitation
 - C. Acoustic streaming
 - D. Attenuation

4. A sonographer reduces acoustic output once a diagnostic-quality image is obtained, rather than leaving it elevated for the rest of the exam. Which principle does this reflect?
 - A. A facility-specific policy with no broader clinical basis
 - B. A rule concerning transducer heat dissipation, unrelated to bioeffects
 - C. A rule that applies only to obstetric ultrasound specifically

D. ALARA, which calls for reducing output once diagnostic quality is achieved

5. A prostate exam is scheduled as a routine follow-up, but the sonographer does not pull up the prior comparable study before beginning. What genuine risk does skipping this step create?

A. A transducer malfunction unrelated to the review itself

B. A required supervisor sign-off before the exam can proceed

C. An automatic billing code error for this specific visit

D. A missed opportunity to use matched technique for detecting genuine interval change

6. True or False: Phantom testing is performed primarily to calibrate each individual sonographer's personal scanning habits.

A. True, since phantom results genuinely reflect operator skill above all else

B. False, since phantom testing verifies system performance parameters against a known standard, not operator skill

C. True, but only for endocavitary transducers specifically and exclusively

D. False, since phantom testing has genuinely no diagnostic purpose whatsoever

7. A technologist is asked to scan a musculoskeletal tendon exam they've never personally performed, though it nominally falls within department scope. What is the professionally sound response?

A. Complete only the portions that feel familiar, without noting the gap

B. Proceed as though it were routine, without disclosing any uncertainty

C. Decline all similar exams permanently, even after gaining future training

D. Openly acknowledge the unfamiliarity and involve a more experienced colleague or refer appropriately

8. Match the practice to its genuine purpose: transducer disinfection between patients primarily accomplishes which of the following?

A. Satisfying accreditation paperwork with no genuine infection-control benefit

- B.** Extending the transducer's own mechanical service life
- C.** Meeting a requirement that applies only to endocavitary transducers
- D.** Reducing the risk of transmitting infectious organisms via a shared contact surface

9. A worksheet notes: 'Distal common bile duct partially obscured by bowel gas.' What is the primary clinical value of including this specific note?

- A.** It tells the interpreting physician exactly how confidently to weigh a negative finding for that segment
- B.** It exists purely for internal department record-keeping
- C.** It matters only if the ordering physician specifically requested this detail
- D.** It shields the sonographer from any conceivable future liability claim

10. During a breast exam, an AI-assisted measurement tool flags a mass dimension automatically. Which responsibility does the sonographer retain regardless of the tool's use?

- A.** Verifying the AI-generated measurement is clinically plausible and correctly applied to this specific patient
- B.** None, since the AI tool's output can be trusted without independent review
- C.** Disabling the AI tool permanently regardless of its demonstrated accuracy
- D.** Documenting the AI tool's internal algorithm architecture in the chart

11. An order for a scrotal ultrasound arrives with no further clinical context beyond the request itself. What is the single most useful first step before scanning?

- A.** Proceed with the broadest possible survey without further inquiry
- B.** Use the protocol most recently applied to an unrelated patient
- C.** Decline the order until it is resubmitted with more detail
- D.** Contact the ordering provider or review the chart for the actual clinical question

12. Complete the equation: propagation speed = frequency × _____.

- A. Wavelength
- B. Amplitude
- C. Intensity
- D. Impedance

13. A prostate nodule's true propagation speed genuinely exceeds the system's fixed 1,540 m/s assumption. Compared to its true position, the system will display this nodule:

- A. At its correct depth, genuinely unaffected by any speed mismatch
- B. Deeper than its true depth, in this specific scenario
- C. Nowhere at all; the structure genuinely will not display
- D. Shallower than its true depth, because the echo returns before the assumed speed predicts

14. Which of the following is NOT a genuine mechanism contributing to total beam attenuation in tissue?

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

15. A testicular exam requires the sonographer to understand that acoustic impedance for any given tissue is mathematically defined as the product of which two properties?

- A. Beam intensity and pulse repetition frequency
- B. A tissue's density and its propagation speed of sound
- C. Attenuation coefficient and transmitted frequency
- D. Echogenicity and depth from the transducer face

16. Rank the following two boundaries by expected reflection strength: Boundary 1 has a small impedance mismatch; Boundary 2 has a large impedance mismatch. Which boundary reflects more strongly?

- A.** Boundary 2, the large-mismatch boundary
- B.** Boundary 1, the small-mismatch boundary
- C.** Both reflect identically regardless of mismatch magnitude
- D.** Neither; reflection strength is unrelated to impedance mismatch

17. A physics instructor asks which resolution type is being tested when two structures lying one directly behind the other, along the beam's path, are just barely distinguishable.

- A.** Axial resolution
- B.** Lateral resolution
- C.** Elevational resolution
- D.** Temporal resolution

18. During a popliteal fossa exam, a technologist notices a fainter, duplicated copy of a structure appearing symmetrically beyond a strong, smooth, curved reflector. This artifact is called:

- A.** Reverberation artifact
- B.** Mirror image artifact
- C.** Comet-tail artifact
- D.** Ring-down artifact

19. A simple ovarian cyst shows a bright band deep to it compared to surrounding tissue at the same depth. This finding is best explained by:

- A.** Posterior acoustic enhancement, since the cyst attenuates less than surrounding tissue
- B.** Acoustic shadowing arising specifically from the cyst itself
- C.** Reverberation occurring between two parallel reflectors nearby

D. A propagation speed mismatch occurring through the cyst itself

20. Fill in the blank: Snell's law relates the angle of incidence to the ratio of _____ between two media to predict the angle of refraction.

A. acoustic impedance values

B. beam intensity values

C. propagation speeds

D. element spacing values

21. A carotid exam shows equally spaced, progressively fainter bright bands extending well beyond the true depth of any genuine structure. This pattern is:

A. Reverberation artifact, from the beam bouncing between two strong parallel reflectors

B. Posterior acoustic enhancement from a nearby fluid-filled structure

C. Acoustic shadowing from a nearby densely attenuating structure

D. A propagation speed mismatch artifact through an intervening structure

22. A pancreatic tail measured through overlying fat shows a consistent, reproducible measurement discrepancy versus a fat-free approach. This is best explained by:

A. The beam reflecting between the pancreas and adjacent bowel gas

B. Fat's true, slower propagation speed differing from the system's fixed 1,540 m/s assumption

C. A frequency mismatch specifically attributed to the fat layer

D. The array transducer's own inherent element spacing pattern

23. A deep aortic segment is imaged at both a higher and lower transducer frequency during a screening exam. Which combined outcome is genuinely expected?

A. Both frequencies show identical resolution and penetration

B. The lower-frequency exam shows better axial resolution

- C. The higher-frequency exam shows worse resolution and worse penetration simultaneously
- D. The higher-frequency exam shows better axial resolution but achieves less penetration

24. A volumetric renal transplant dataset's slice-thickness dimension is measured separately from its two in-plane dimensions. What is this dimension called?

- A. Elevational resolution
- B. Axial resolution
- C. Lateral resolution
- D. Temporal resolution

25. A beam travels from soft tissue into an ovarian cyst at a distinctly oblique angle, with the two media having genuinely different propagation speeds. What physical result must occur at this specific boundary?

- A. No bending occurs unless impedance is also mismatched
- B. Refraction cannot occur at a boundary involving fluid
- C. Bending occurs only at a perpendicular angle of incidence
- D. The beam path genuinely bends, since this is exactly the condition refraction requires

26. If spatial pulse length is shortened, which resolution type improves most directly?

- A. Lateral resolution
- B. Axial resolution
- C. Elevational resolution
- D. Temporal resolution

27. A neonatal head exam encounters two tissue boundaries of differing impedance mismatch magnitude. The boundary with the larger mismatch will produce an echo that is:

- A. Stronger and brighter than the small-mismatch boundary's echo

- B.** Identical in strength to the small-mismatch boundary's echo
- C.** Entirely absent, with no reflection occurring
- D.** Weaker than the small-mismatch boundary's echo

28. Complete the statement: certain crystals generate a voltage when mechanically deformed, and deform when a voltage is applied. This bidirectional relationship is called the _____.

- A.** piezoelectric effect
- B.** Curie effect
- C.** Doppler effect
- D.** photoelectric effect

29. A biomedical engineering log records that a transducer permanently lost function after brief exposure to extreme autoclave heat. Which threshold was most likely exceeded?

- A.** The transducer's minimum rated storage temperature
- B.** The transducer's peak sensitivity temperature
- C.** A threshold unrelated to piezoelectric function
- D.** The Curie point, permanently destroying piezoelectric properties

30. A transducer manufacturer explains that a specific internal component was added specifically to shorten pulse duration, accepting reduced sensitivity as a trade-off. Which component is this?

- A.** The matching layer at the transducer face
- B.** The elevational focusing lens
- C.** The backing (damping) material behind the active element
- D.** The transducer's protective housing

31. Which transducer category genuinely requires physical movement of the element to sweep the beam, unlike array-based designs?

- A.** Linear sequential array, using purely electronic steering
- B.** Mechanical sector transducer, requiring physical movement
- C.** Phased array, using purely electronic steering
- D.** Curvilinear array, using purely electronic steering

32. A biomedical text describes a transducer layer positioned directly at the skin interface, whose sole purpose is minimizing the impedance gap between the crystal and the patient. This layer is the:

- A.** Backing (damping) layer, positioned behind the element
- B.** Active piezoelectric element itself
- C.** Matching layer, positioned at the face
- D.** External protective housing of the probe

33. A biomedical text describes an array geometry using concentric rings rather than a linear row of elements, noting it still needs mechanical steering despite its electronic focusing capability. Which array is this?

- A.** Annular array
- B.** Phased array
- C.** Linear sequential array
- D.** Curvilinear array

34. A physics reviewer describes a beam region that is narrow and converging up to a specific point, beyond which it diverges. This converging region is the:

- A.** Far field (Fraunhofer zone)
- B.** Near field (Fresnel zone)
- C.** Region unique to continuous wave Doppler
- D.** A region that does not exist on modern arrays

35. Holding frequency constant, increasing a transducer element's aperture (diameter) has which effect on near field length?
- A. Decreases it proportionally as aperture increases
 - B. Increases it, extending the natural focus further out
 - C. Eliminates it entirely beyond a threshold
 - D. Has no meaningful effect regardless of aperture size
36. A fetal cardiac matrix probe is described as sweeping electronically through successive imaging planes to build a live volume, with the probe housing held perfectly still throughout. What specific capability makes this possible?
- A. A fixed elevational focus set permanently at the time of manufacture
 - B. Manual physical rotation performed directly by the sonographer
 - C. Electronic steering added in the elevational plane, alongside azimuthal steering
 - D. A single mechanically swept row of elements moving through space
37. A transducer's 'bandwidth,' as listed on a spec sheet, specifically describes:
- A. The physical width, in centimeters, of the footprint
 - B. The range of frequencies within the transmitted pulse, tied to pulse length and damping
 - C. The maximum imaging depth genuinely achievable with that probe
 - D. The total count of individual piezoelectric elements
38. During a transrectal exam, a higher-frequency probe remains the better choice for the nearby structure of interest, despite frequency's usual penetration trade-off. Why?
- A. The structure sits close to the probe face, capturing the resolution benefit without a meaningful penetration penalty
 - B. Regulatory standards specifically require higher frequency for this application
 - C. Higher frequency inherently reduces manufacturing cost for smaller probes

D. Lower-frequency elements cannot physically fit inside the probe housing

39. A trainee asks how a phased array probe changes its beam's angle mid-exam with the probe itself never physically moving. What is the actual mechanism?

- A.** The probe housing itself physically tilts
- B.** A single crystal element mechanically rotates
- C.** Timed firing delays across elements create an angled wavefront
- D.** Separate element sets are physically swapped for each angle

40. A 3D matrix probe requires dramatically more electronic channels than a comparable 1D linear probe. What accounts for this?

- A.** Matrix crystals are each physically larger than linear crystals
- B.** Matrix probes operate at a fundamentally different frequency band
- C.** Matrix probes must independently steer elements across two dimensions instead of one
- D.** Matrix and linear probes actually use identical element counts

41. A superficial vascular exam is performed with a probe whose field-of-view width stays constant with depth, rather than widening progressively. This probe is a:

- A.** Linear sequential array
- B.** Curvilinear array
- C.** Phased array
- D.** Mechanical sector array

42. A sonographer switches from a linear probe to a curvilinear probe for a deep abdominal aortic survey, specifically because the curvilinear design offers which genuine advantage over the linear probe at that depth?

- A.** A wider field of view at depth, while keeping a reasonably manageable footprint
- B.** An identical rectangular field of view to the linear probe

- C. A smaller footprint while keeping the linear probe's field shape unchanged
- D. Electronic steering, which the linear probe genuinely lacks

43. A device inventory notes one specific transducer type is stocked exclusively for cardiac imaging because of its small footprint for intercostal access. This is the:

- A. Linear sequential array, given its rectangular field
- B. Curvilinear array, given its wide field at depth
- C. Phased array, for its compact, purely electronic footprint
- D. Mechanical sector array, given its simple construction

44. An artifact review notes that a specific artifact simply cannot occur on a genuinely continuous, non-segmented crystal, only on array-based designs. What causes this artifact?

- A. Excessive time gain compensation applied at one specific depth
- B. The discrete, regularly spaced element structure of array design
- C. A matching layer artifact
- D. A transmit/receive frequency mismatch

45. A biomedical engineer contrasts two focusing approaches for a class of sonography students: one physically bonded lens fixed at manufacture, and one using timed element delays adjustable in real time. Which approach allows focal depth to change instantly, mid-scan, with no physical movement?

- A. Electronic focusing, using timed firing delays across elements
- B. A single, permanently fixed focal zone
- C. Changing transmitted frequency to shift the focal point
- D. The fixed acoustic lens bonded to the transducer face

46. A trainee places a musculoskeletal tendon at the very bottom edge of the display with zero margin beyond it. What genuine risk does this specific habit introduce?

- A. A mandatory, unwanted reduction in the currently selected transducer frequency

- B.** An automatic, unavoidable increase in the currently selected acoustic output
- C.** The structure risks vanishing off-screen with minor movement, with no margin beyond
- D.** None; this is genuinely considered efficient, correct scanning technique

47. A student mixes up overall gain and TGC on a written exam. What is the accurate distinction between the two?

- A.** They are identical controls under different names
- B.** TGC amplifies uniformly; overall gain amplifies selectively by depth
- C.** Overall gain amplifies uniformly across the field; TGC amplifies selectively by depth
- D.** Overall gain changes acoustic output; TGC never does

48. During a thyroid nodule exam, finer resolved detail is needed before saving the image, and a lower frame rate is an acceptable cost. Which technique genuinely adds this detail?

- A.** Post-processing (read) zoom applied after acquisition
- B.** Write (pre-processing) zoom, narrowing the scanned sector before acquisition
- C.** Raising overall gain at the same time as any zoom
- D.** Widening the dynamic range over the region

49. A hepatic parenchyma exam is optimized with a wide dynamic range setting specifically to reveal subtle textural gradation across the liver, at the deliberate expense of sharp boundary contrast elsewhere. What is being traded away?

- A.** A substantial, unavoidable rise in acoustic output
- B.** Complete loss of TGC availability on that image
- C.** Contrast at any sharp boundary elsewhere in the same image
- D.** A mandatory drop in achievable frame rate

50. An equipment brochure claims a new console delivers stronger signal on deep patients without raising displayed acoustic output. Which engineering approach genuinely achieves this?

- A.** Automatically switching to a substantially lower transducer frequency
- B.** Applying more aggressive TGC uniformly at every depth
- C.** Coded excitation, transmitting a longer structured pulse and compressing it on reception
- D.** Automatically reducing the currently selected imaging depth

51. An imaging mode filters out the transmitted fundamental frequency and processes only tissue-generated harmonic frequencies. What is the primary genuine benefit of this mode?

- A.** Improved lateral resolution uniformly at every imaging depth
- B.** Reduced near-field clutter, since harmonic signal is comparatively weak there
- C.** An automatic increase in the currently achievable frame rate
- D.** Complete elimination of the need for any TGC adjustment

52. A biophysics phenomenon test question: raising persistence while imaging a rapidly beating structure produces which visible consequence?

- A.** The rapid motion appears smoothed and blurred, since several frames are averaged together
- B.** The rapid motion appears sharper than at a lower persistence setting
- C.** Frame rate automatically compensates for any resulting blur
- D.** No visible consequence occurs regardless of persistence setting

53. A varicose great saphenous vein routinely extends beyond what any single transducer footprint can capture in one frame. A sonographer needs its complete length documented as one continuous saved image. Which technique accomplishes this?

- A.** Spatial compounding
- B.** Tissue harmonic imaging
- C.** Frequency compounding
- D.** Extended field of view

54. A static 3D volume of a fetal profile shows no motion when reviewed later. A colleague asks how 4D acquisition of the same profile would genuinely differ.
- A. 3D and 4D are simply two names for one identical acquisition method
 - B. 3D acquisition requires an entirely different, incompatible transducer
 - C. 4D genuinely captures fewer spatial dimensions than static 3D
 - D. 4D adds real-time motion, a fourth dimension, on top of the same three spatial dimensions 3D captures
55. A multi-site imaging network requires that any study, acquired on any vendor's equipment, open correctly on any workstation across every site. Which standard makes this achievable?
- A. A proprietary format restricted to one specific manufacturer
 - B. DICOM, the standardized format and protocol enabling cross-manufacturer interoperability
 - C. An automatic converter for legacy analog videotape studies
 - D. A rule eliminating the need for shared network infrastructure
56. A brachial artery segment measured perpendicular to its axis at baseline is measured obliquely at a follow-up visit. What happens to the follow-up measurement as a direct result?
- A. Nothing; caliper measurements are angle-independent
 - B. It becomes foreshortened or elongated relative to the true size
 - C. It becomes more accurate than the original
 - D. The system automatically corrects the discrepancy
57. A quality review traces a wrong-site procedure back to a single archived image in which right had been documented as left. Why does this specific error category carry such outsized clinical weight?
- A. It can lead directly to the wrong side of the body being biopsied, treated, or monitored
 - B. It carries no genuine clinical weight, purely an administrative matter
 - C. It occurs less often than other genuine documentation errors

D. It is the only specific error type that ever affects billing

58. During a lower-extremity DVT survey, a pulsed wave Doppler sample volume is inadvertently placed against the popliteal vein wall rather than centered in the true lumen. What effect does this specifically have on the recorded velocity?

A. None; sample volume position has no genuine bearing on the recorded velocity

B. The system automatically detects and recenters the sample volume

C. A falsely elevated reading, attributed to wall-related turbulence

D. A falsely low reading, since slower, non-representative flow near the wall is sampled instead

59. A sonographer notices frame rate drops sharply the instant triplex display is activated on a mesenteric artery survey. What explains this drop?

A. No genuine relationship exists between triplex and frame rate

B. Triplex requires a slower, incompatible transducer

C. Triplex automatically increases imaging depth

D. Triplex must simultaneously update three information streams instead of two

60. A ventricular structure's apparent diameter differs measurably when measured at end-systole versus end-diastole on the same static image set. What does this emphasize for a comparison study?

A. Cyclic timing has no bearing on caliper accuracy

B. This effect occurs only in Doppler, never grayscale measurements

C. The specific phase of the cycle measured must be matched consistently between studies

D. Measurement technique is unaffected by cardiac timing

61. An axillary lymph node measured through overlying fat, with calipers correctly placed both times, still shows a small reproducible bias versus a fat-free approach at a different site. What accounts for this?

A. Fat physically blocks the beam, making measurement unreliable

- B.** The system's 1,540 m/s assumption does not match fat's true, slower propagation speed
- C.** The transducer automatically lowers frequency near fat
- D.** Caliper placement is inherently degraded near fat

62. A processed uterine image shows a visibly crisper endometrial stripe boundary than the raw acquisition suggests, with no indication additional scan lines were acquired there. What explains this?

- A.** New scan lines were genuinely acquired specifically at the boundary
- B.** Acoustic output was specifically increased at the boundary
- C.** Imaging depth was automatically increased near the edges
- D.** Edge enhancement, raising contrast at abrupt intensity changes without adding data

63. A single static image shows an ovarian follicle sharp at its shallow edge but distinctly blurred at its deep edge. What single instrumentation factor most plausibly explains this?

- A.** A genuine transducer element malfunction limited to part of the array
- B.** An incorrect TGC setting entirely unrelated to focal zone
- C.** A reverberation artifact isolated specifically to the blur
- D.** The focal zone's placement, sharpest there and worsening with distance

64. A sonographer wants to reduce speckle noise on an actively pulsating carotid bulb without the motion-blur high persistence would cause. Which technique genuinely fits this constraint?

- A.** Increasing the currently selected wall filter threshold
- B.** Increasing overall gain across the entire field
- C.** Frequency compounding, averaging multiple frequencies rather than frames over time
- D.** Narrowing the currently selected dynamic range setting

65. An IT briefing describes the department's core imaging infrastructure as 'the networked system storing, retrieving, and distributing every acquired study.' What is being described?

- A.** PACS, the networked digital infrastructure for storage/retrieval/distribution
- B.** DICOM, the format and protocol itself
- C.** A single dedicated storage device reserved for one modality
- D.** An outdated approach fully replaced by cloud storage

66. A worksheet template deliberately lists musculoskeletal findings in the same order as the scanning protocol, rather than the order images happened to be saved. Why does this matter?

- A.** It has no genuine bearing on how a physician reviews the study
- B.** It exists solely for billing and coding purposes at the facility
- C.** It lets a reviewing physician follow the study logically without reconstructing order
- D.** It is entirely optional, and most departments deliberately avoid it

67. A retroperitoneal structure is confidently labeled the right gonadal vein based specifically on its consistent drainage pattern relative to the renal vein and IVC. What justifies this confident, specific label?

- A.** The structure's relationship to reliable, consistently positioned anatomic landmarks
- B.** The specific ultrasound system manufacturer used
- C.** The specific brightness and contrast settings at save time
- D.** The sonographer's general years of overall experience

68. A narrow dynamic range setting is deliberately chosen to sharply define a simple renal cyst's wall border. What is this setting specifically optimized to achieve?

- A.** Reducing speckle noise uniformly
- B.** Improving penetration for a deep structure
- C.** Reducing frame rate for temporal averaging
- D.** Sharply defining a boundary through increased contrast

69. A new hire is confused about how PACS and DICOM genuinely relate to one another, since coworkers use the terms interchangeably. What is the accurate clarification?

- A.** DICOM is physical hardware; PACS is a software-only format
- B.** PACS is the archiving/retrieval system; DICOM is the protocol enabling images to move within it
- C.** PACS has fully and permanently replaced DICOM, now obsolete
- D.** They are simply interchangeable names for one identical system

70. A hepatic mass's border is crisply defined when insonated from one direction, but noticeably indistinct when the same mass is approached from a slightly different angle. Which technique specifically compensates for this angle-dependent inconsistency?

- A.** Extended field of view, stitching along a path of motion
- B.** Frequency compounding, combining multiple frequencies
- C.** Spatial compounding, which combines multiple beam angles into one composite image
- D.** Persistence, averaging multiple frames over time

71. A flawlessly optimized pancreatic head image is acquired during a rushed shift, but the sonographer forgets to save any measurement or label before moving to the next patient. What does this scenario most directly illustrate?

- A.** Documentation is purely optional, with no genuine bearing on the exam
- B.** Instrumentation quality and documentation quality are genuinely unrelated
- C.** Image optimization alone has already fully served the patient's needs
- D.** Documentation is what makes careful optimization clinically usable, since future clinicians depend on the record

72. A retroperitoneal vessel is labeled the inferior mesenteric vein specifically because of its consistent course and confluence pattern relative to the splenic vein, rather than being described merely as 'a vessel.' What genuinely justifies this specific label?

- A.** The specific ultrasound system manufacturer used to acquire the image

- B.** The specific brightness and contrast settings active at the time of saving
- C.** The vessel's relationship to reliable, consistently positioned anatomic landmarks nearby
- D.** The sonographer's general years of overall clinical experience

73. A vascular study displays live grayscale anatomy alongside a real-time spectral tracing of a mesenteric vessel simultaneously, without switching modes. What is this simultaneous display called?

- A.** Duplex scanning, combining grayscale B-mode and pulsed wave spectral Doppler
- B.** Two separate grayscale images at two different frequencies
- C.** Color Doppler and power Doppler shown as separate images
- D.** Extended field of view with 3D acquisition

74. During a thyroid nodule exam, the entire displayed image reads uniformly too dark, though focus quality appears genuinely adequate throughout the field. Which single processing step most plausibly explains this global dimness?

- A.** Focal zone placement, a possibility already ruled out by the adequate focus described
- B.** Transducer or frequency selection, a factor gain adjustment alone cannot correct
- C.** TGC specifically, a control that addresses depth-selective rather than global brightness
- D.** Overall gain, since global (not depth-selective) dimness points directly to insufficient amplification

75. Comparing spatial compounding, extended field of view, and volumetric 3D/4D acquisition, a sonography instructor notes that none of these three is ever set as a facility-wide default mode. What principle explains this deliberate choice?

- A.** All three genuinely require identical transducer hardware and scanning conditions
- B.** Each addresses a genuinely different, specific limitation, so the right choice depends on what a given exam actually encounters
- C.** Only one of these three techniques should ever be enabled on a system at any given time
- D.** The three techniques are functionally identical, simply marketed under different names

76. A superficial soft-tissue mass is imaged in a single static frame; it appears crisply resolved close to the transducer but is distinctly blurred toward its deepest margin. What does this specific within-image pattern most likely reflect?

- A.** A genuine transducer element malfunction limited to part of the array
- B.** An incorrect TGC setting entirely unrelated to focal zone placement
- C.** The mass's position relative to the placed focal zone, sharpest there and worsening with distance from it
- D.** A reverberation artifact isolated specifically to the blurred portion

77. A returning echo frequency during a mesenteric Doppler survey is consistently below the transmitted frequency at one sample gate. What does this indicate about flow at that location?

- A.** Flow direction cannot be determined from this information
- B.** Flow is moving toward the transducer
- C.** Flow has genuinely stopped
- D.** Flow is moving away from the transducer

78. A resident asks why angle correction technique is treated as a critical Doppler step rather than a minor adjustment during a renal artery survey. What is the physics-based answer?

- A.** It only genuinely affects grayscale brightness, not velocity calculation
- B.** The Doppler equation's cosine term ties velocity directly to the beam-flow angle
- C.** It only genuinely matters for continuous wave acquisitions specifically
- D.** It is purely a display cosmetic feature with no calculation impact

79. During a lower-extremity arterial survey, a popliteal artery tracing displays consistently above the baseline throughout the entire cardiac cycle, matching known antegrade flow in that vessel. What convention does this specific tracing confirm?

- A.** Flow moving toward the transducer is displayed above the baseline, by standard convention
- B.** Baseline position genuinely alternates unpredictably between cycles

- C. Baseline placement has no real relationship to true flow direction
- D. Flow moving toward the transducer is instead displayed below the baseline

80. A vascular technologist struggles to achieve a Doppler angle below 60 degrees on a deep, curving iliac vessel and considers accepting 80 to 85 degrees instead. What genuine physics-based concern applies specifically at that steeper angle range?

- A. No detectable Doppler shift exists at all beyond exactly 60 degrees
- B. Regulatory standards specifically prohibit any Doppler angle beyond 60 degrees
- C. Cosine's sensitivity to a given angle-placement error worsens sharply as the angle nears 90 degrees
- D. A steeper insonation angle would genuinely yield the single highest possible calculated velocity

81. A deep uterine artery's achievable PRF is insufficient to avoid aliasing for the true velocity present during a first-trimester screening exam. What is the underlying reason PRF is limited at this depth?

- A. Deeper structures automatically require the use of a lower frequency
- B. A deeper sample volume needs a longer round-trip time before the next pulse
- C. Increased depth automatically increases the currently selected sample volume
- D. Regulatory output limits become more restrictive at greater depths

82. A specific vessel study is performed with a PRF locked at 4,000 Hz. Without changing any other setting, what is the maximum true velocity this system can accurately display before aliasing occurs, expressed relative to that 4,000 Hz value?

- A. Exactly half of the 4,000 Hz PRF value
- B. Exactly double the 4,000 Hz PRF value
- C. A value entirely unrelated to the selected PRF
- D. A value determined solely by the currently selected acoustic output

83. A vertebral artery waveform's systolic peak appears to wrap around and continue below the baseline, even though the sonographer confirms true flow direction genuinely has not changed. What does this specific finding represent?

- A.** A genuine, newly developed reversal of flow direction in the vertebral artery
- B.** A transducer malfunction isolated specifically to the Doppler processing circuitry
- C.** Aliasing, occurring because true velocity has exceeded the currently selected Nyquist limit
- D.** An inappropriately high wall filter threshold selected for this specific vessel

84. Which single adjustment corrects an aliased tracing on a difficult subclavian steal exam without altering the actual flow being measured?

- A.** Increase PRF, directly raising the Nyquist limit above the true velocity
- B.** Decrease the currently selected wall filter threshold
- C.** Enlarge the currently selected sample volume size
- D.** Switch to a substantially lower imaging depth setting

85. A vascular lab protocol specifies that isolating flow to one precisely chosen depth matters more than achieving an unlimited velocity ceiling for a specific mesenteric survey. Which mode fits this priority?

- A.** Continuous wave Doppler, for its unlimited velocity range
- B.** Continuous wave Doppler, for its aliasing immunity
- C.** Pulsed wave Doppler, for its unlimited velocity ceiling
- D.** Pulsed wave Doppler, offering genuine spatial specificity at one chosen depth

86. A cardiac probe uses two dedicated, simultaneously active elements, one only transmitting, one only receiving, specifically to evaluate a suspected high-velocity aortic jet. What capability does this design provide?

- A.** Improved axial resolution versus a single-element design
- B.** The ability to acquire genuine three-dimensional volumetric data
- C.** An unlimited velocity range, since no sampling interval creates a Nyquist limit

D. Automatic elimination of any angle correction requirement

87. During a subclavian steal workup, continuous wave Doppler detects a genuinely high velocity somewhere along the beam path, but the vascular technologist cannot determine whether the signal originates from a shallow or deep segment of that same vessel. What specific limitation does this scenario demonstrate?

A. An inability to measure any velocity below a specific minimum threshold

B. Range ambiguity, the inability to determine which depth along the beam a detected signal actually originates from

C. A limitation genuinely specific to sample volume size rather than to the acquisition mode itself

D. An inability to distinguish flow moving toward the transducer from flow moving away

88. A pediatric cardiologist anticipates a coarctation jet likely to exceed pulsed wave Doppler's achievable range at the necessary depth. Which technique reliably captures the true peak velocity?

A. Pulsed wave Doppler with the wall filter raised

B. Continuous wave Doppler, since it has no theoretical velocity ceiling

C. Pulsed wave Doppler with the sample volume enlarged

D. M-mode, for its temporal resolution

89. A hepatic transplant surveillance report lists a single calculated ratio, derived from two directly measured waveform values, used to flag rising downstream vascular resistance over serial exams. Which two waveform values feed into this specific ratio?

A. The currently selected PRF and the Nyquist limit at that setting

B. The currently selected wall filter threshold and the sample volume size used

C. The angle of insonation used and the transducer frequency selected

D. Peak systolic velocity and end-diastolic velocity, the two values measured directly from the waveform

90. A native (non-transplant) hepatic artery waveform in a patient with known portal hypertension shows a sharp systolic upstroke followed by essentially absent forward diastolic flow. This pattern most closely resembles which type of vascular bed?

- A.** A low-resistance pattern, similar to the normal kidney or brain
- B.** A pattern with no meaningful resistance characteristics whatsoever
- C.** A high-resistance pattern, similar to resting skeletal muscle
- D.** A pattern that genuinely cannot be characterized by waveform shape at all

91. During a color Doppler survey of the portal and splenic confluence, two vessels carrying flow in genuinely opposite directions appear in two visibly different colors on the display, despite comparable flow speeds in each. What does this specific color contrast primarily convey?

- A.** The precise peak velocity value present within each of the two vessels
- B.** Flow direction relative to the transducer, which color hue is primarily encoding here
- C.** The specific transducer frequency currently selected for this acquisition
- D.** The relative vascular resistance index present within each of the two vessels

92. During a mesenteric color Doppler survey, an abrupt shift from bright red to bright blue appears at one specific point along a vessel segment that grayscale confirms is genuinely straight, with no true branch or flow reversal at that location. What most likely explains this abrupt color change?

- A.** A genuine anatomic branch point that grayscale simply failed to detect
- B.** A transducer element malfunction specifically affecting color assignment at that point
- C.** Color aliasing, occurring because true velocity at that point exceeds the current color scale's Nyquist limit
- D.** An intentional system feature specifically designed to flag a stenosis at that exact location

93. A urology clinic notes that power Doppler reliably detects flow in small, slow, poorly angled scrotal vessels that color Doppler frequently misses on the identical patient. What specific signal property explains this consistent advantage?

- A.** Power Doppler eliminates the need for an adequate angle of insonation altogether

- B.** Power Doppler uses a fundamentally different, higher-frequency transducer
- C.** Power Doppler automatically increases output whenever slow flow is detected
- D.** Amplitude is a more robust signal than frequency shift, less affected by slow flow or angle

94. A vascular lab protocol specifically calls for color Doppler when assessing flow direction and relative velocity in one exam, but calls for power Doppler on a different exam simply to confirm whether any flow is present at all. What does this deliberate protocol distinction illustrate?

- A.** One of these two modes has now completely and permanently replaced the other in modern practice
- B.** Each mode genuinely displays a different aspect of the underlying Doppler signal, suiting a different specific clinical question
- C.** The two modes actually display genuinely identical information using merely different color schemes
- D.** One of these two modes genuinely requires entirely incompatible transducer hardware from the other

95. During a subcostal survey, a duplicated, fainter flow signal appears at an anatomically implausible depth directly beyond the diaphragm, with grayscale confirming no genuine vessel exists at that specific depth. What structural property of the diaphragm most directly explains this specific artifact?

- A.** Its irregular, granular reflective texture, similar in character to a small calculus
- B.** Its strong, smooth reflective surface, capable of reflecting the beam both before and after it genuinely insonates true flow
- C.** Its genuinely weak reflective properties relative to the surrounding hepatic tissue
- D.** Its highly scattering acoustic properties, similar in character to adjacent bowel gas

96. During a hurried renal transplant exam, a brief burst of color fills a broad region unrelated to any genuinely visible vessel, then completely vanishes the instant the sonographer deliberately holds the transducer perfectly still. What does this specific behavior most likely represent?

- A.** Flash artifact, specifically triggered by tissue or transducer motion rather than by true blood flow
- B.** Twinkle artifact, specifically arising from a strongly reflective, granular surface nearby

- C. Aliasing, since the detected velocity has genuinely exceeded the current Nyquist limit
- D. A genuine, previously undocumented small vessel becoming transiently visible on this pass

97. A rapidly alternating color signal appears directly behind a small, echogenic, granular focus in the renal collecting system that grayscale alone left ambiguous. What does this specific finding suggest, and why is it genuinely useful?

- A. Mirror image artifact, confirming a nearby strong, smooth reflector
- B. Flash artifact, confirming recent bulk tissue motion occurred nearby
- C. Aliasing, confirming the velocity exceeded the color Nyquist limit
- D. Twinkle artifact, which can help confirm a small calculus on grayscale

98. During a testicular torsion workup, an uncertain Doppler finding appears partway through the exam. Before touching any console setting whatsoever, what should genuinely be evaluated first?

- A. The exact model and manufacturer of the transducer currently being used
- B. Whether the finding is genuinely physiologically plausible given the actual anatomy present at that location
- C. The exact acoustic output power setting active at that specific moment
- D. The total number of years of clinical experience the performing sonographer currently holds

99. A splenic vein study evaluating low-velocity flow uses an excessively high wall filter threshold. What is the most likely consequence for this specific vessel?

- A. The system automatically lowers the wall filter to compensate
- B. Genuine low-velocity flow signal may be removed along with the intended clutter
- C. The sample volume automatically repositions
- D. Aliasing becomes substantially more pronounced

100. A pancreatic head exam shows persistent, bright, alternating color adjacent to a small echogenic focus grayscale alone could not characterize. Once identified as twinkle artifact, what is the appropriate next step?

- A.** Switch specifically and exclusively to continuous wave Doppler instead
- B.** Immediately and permanently discontinue the entire Doppler exam
- C.** Ensure it is completely eliminated before the exam is genuinely complete
- D.** Generally no correction is needed, since it is often useful, though ruling out a separate finding matters

101. A spectral tracing obtained during a technically difficult mesenteric exam on a large-bodied patient appears genuinely thin and washed out, with the true systolic peak barely distinguishable from background noise. Which single adjustment most directly addresses this specific presentation?

- A.** Increase the spectral gain setting to strengthen the genuine underlying signal
- B.** Increase the currently selected wall filter threshold substantially
- C.** Decrease the currently selected PRF substantially
- D.** Enlarge the currently selected sample volume substantially

102. A quality review finds a Doppler artifact was present in archived images from a subclavian exam but caused no downstream clinical consequence. What single factor explains why no harm resulted?

- A.** The mere physical presence of the artifact, regardless of recognition
- B.** The specific transducer frequency used during acquisition
- C.** The artifact was recognized and documented correctly, rather than reported as genuine pathology
- D.** Whether color or power Doppler was the specific mode used

103. During a splenic survey, a color signal briefly floods a broad region unrelated to any genuine vessel, then completely disappears on the very next acquired frame, with no deliberate transducer or patient motion having been introduced. What single characteristic of this finding most strongly points toward artifact rather than true flow?

- A.** Its overall color intensity appeared brighter than nearby genuine venous flow signals

- B.** Its location happened to be relatively close to the transducer face itself
- C.** Its color pattern included a genuine mixture of both red and blue hues simultaneously
- D.** Its brief, single-frame, transient nature, which is specifically consistent with motion-triggered flash artifact

104. A renal transplant surveillance report cites a resistive index of 0.70 for a specific interlobar artery segment. This specific numeric value was calculated directly from which two waveform measurements?

- A.** The currently selected Nyquist limit and the currently selected PRF
- B.** Peak systolic velocity and end-diastolic velocity, the two values measured directly from the waveform
- C.** The transmitted transducer frequency and the currently selected wall filter setting
- D.** The currently selected sample volume size and the angle of insonation used

105. A new sonography graduate genuinely assumes that thoroughly mastering grayscale artifact recognition alone will fully prepare them for every Doppler artifact they'll encounter clinically, with no further dedicated study needed. Why is this specific assumption genuinely mistaken?

- A.** Doppler artifacts introduce genuinely new failure modes tied to frequency-shift, motion, and color assignment
- B.** Doppler artifacts are corrected using identical techniques to every single grayscale artifact
- C.** Doppler artifacts do not genuinely occur at all during real clinical scanning
- D.** Doppler artifacts occur only when grayscale imaging has been entirely switched off

106. A senior technologist advises a trainee to treat an ambiguous color Doppler finding in the mesentery with more caution than an equally ambiguous grayscale finding at the same location. Why?

- A.** Doppler findings cannot be documented in the same reporting systems
- B.** Doppler findings are permanently retained in a way grayscale findings are not
- C.** Doppler displays are read as representing genuine motion, so an artifact risks mimicking real pathology
- D.** Doppler artifacts always require immediate termination of the exam

107. During a subclavian steal workup, a technologist repositions the transducer specifically to disrupt a suspected artifact's underlying geometric mechanism, yet the finding persists completely unchanged afterward. What is the most reasonable interpretation of this specific result?

- A.** No further clinical reasoning is genuinely needed once any single technique change has been attempted
- B.** The finding may genuinely represent a real, if unusual, finding rather than the artifact originally suspected
- C.** Acoustic output should be substantially and immediately increased until the finding disappears entirely
- D.** This specific technique change alone definitively and completely confirms the artifact interpretation

108. Before formally signing off a completed mesenteric Doppler study, a sonographer deliberately runs a brief self-check: confirming every image is clearly labeled, every measurement matches prior technique, and every technical limitation is explicitly documented. What is the genuine value of this specific habit?

- A.** It genuinely separates documentation that reliably serves every future reader from documentation that merely appears complete at a glance
- B.** It genuinely has no bearing on study quality once the actual images themselves have already been acquired
- C.** It genuinely exists purely to extend total exam length for scheduling purposes
- D.** It is genuinely required only for facilities still using an older, legacy PACS system specifically

109. A final-review question asks why documentation is specifically described as 'completing' the instrumentation chain built across an entire vascular imaging curriculum, rather than being treated as a separate, unrelated, add-on topic. What is the genuinely accurate answer?

- A.** A perfectly optimized live image genuinely has no lasting diagnostic value unless it is also saved, measured, and labeled correctly for future use
- B.** Documentation genuinely only becomes relevant once a specific finding requires formal litigation or legal review
- C.** Documentation is genuinely entirely unrelated to the instrumentation controls covered earlier in that same curriculum

D. Instrumentation controls genuinely automatically generate correct documentation without any sonographer input required

110. A comparison study for a previously identified splenic lesion is being documented at a six-month follow-up. Which practice most directly supports accurate detection of genuine interval change?

A. Increasing transducer frequency for the follow-up regardless of prior frequency

B. Measuring only once, without reference to the prior study

C. Using whichever technique is fastest, regardless of the prior technique

D. Matching the exact measurement technique, including caliper edge placement and plane, used previously

Answers

1. A. TI and MI genuinely separate into two distinct bioeffect categories: TI for thermal (heating) risk, MI for mechanical (cavitation) risk, not a reversed pairing, an identical measure, or an unrelated pairing.

2. C. MI estimates the likelihood of a mechanical bioeffect (such as cavitation), while TI estimates the likelihood of a thermal bioeffect (heating) — the correct order is mechanical, then thermal, not reversed, chemical, or electrical.

3. B. The formation and violent collapse of a gas bubble under acoustic pressure fluctuation is specifically inertial cavitation, distinct from thermal injury (heating), streaming (bulk fluid motion), or attenuation (signal loss).

4. D. ALARA calls for reducing acoustic output once diagnostic image quality is achieved, rather than leaving it elevated for the remainder of the exam; this is a genuine bioeffect-related safety principle, not a facility policy, transducer-heat rule, or obstetric-only rule.

5. D. Skipping review of a prior comparable study risks missing the opportunity to use matched, comparable technique for detecting genuine interval change, distinct from a transducer, sign-off, or billing issue.

6. B. This is false: phantom testing verifies genuine system performance parameters, such as depth calibration and resolution, against a known standardized reference — a technical equipment check, not a measure of operator skill, and not limited to one transducer type or purposeless.

7. D. Openly acknowledging genuine unfamiliarity and involving a more experienced colleague or referring appropriately is the professionally sound response, not silent omission, undisclosed proceeding, or a permanent refusal.

- 8. D.** Transducer disinfection primarily reduces the risk of transmitting infectious organisms between patients via a shared contact surface, a genuine patient-safety measure, not a paperwork formality, a service-life concern, or limited to endocavitary use.
- 9. A.** This note tells the interpreting physician exactly how confidently to weigh a negative or equivocal finding for that specific segment, a genuine diagnostic-completeness signal, not merely record-keeping, contingent on a request, or a blanket liability shield.
- 10. A.** Regardless of automated assistance, the sonographer retains responsibility for verifying that any AI-generated measurement is clinically plausible and correctly applied to the specific patient, not blind trust, permanent disabling, or unrelated algorithmic documentation.
- 11. D.** Contacting the ordering provider or reviewing the chart for the actual clinical question is the single most useful step, allowing the exam to be genuinely focused, rather than a broad survey, an unrelated protocol, or refusing outright.
- 12. A.** The wave equation states propagation speed equals frequency multiplied by wavelength; amplitude, intensity, and impedance are not part of this specific relationship.
- 13. D.** A faster true propagation speed means the echo returns sooner than the 1,540 m/s assumption predicts, so the system calculates and displays the structure shallower than its true depth.
- 14. B.** Refraction is the bending of the beam's path at an oblique boundary and does not itself remove energy from the beam; attenuation genuinely results from absorption, scattering, and reflection acting together.
- 15. B.** Acoustic impedance is the mathematical product of a tissue's density and its propagation speed of sound, a property of the tissue itself, not intensity/PRF, attenuation/frequency, or echogenicity/depth.
- 16. A.** A larger acoustic impedance mismatch (Boundary 2) produces a stronger reflection, since the fraction of energy reflected versus transmitted scales directly with the magnitude of the impedance difference between the two media.
- 17. A.** Two structures lying one behind the other along the beam's direction of travel tests axial resolution specifically, most directly determined by spatial pulse length.
- 18. B.** Mirror image artifact occurs when the beam reflects off a strong, smooth, curved reflector, displaying a genuine structure as a fainter, duplicated copy at an equidistant position on the opposite side of that reflector.
- 19. A.** Posterior acoustic enhancement appears as increased brightness deep to a structure attenuating less than surrounding tissue, such as a simple cyst, since less signal is lost traveling through it.
- 20. C.** Snell's law relates the angle of incidence and the ratio of propagation speeds between the two media to predict the resulting angle of refraction, distinct from impedance, intensity, or element spacing.

- 21. A.** Reverberation artifact produces equally spaced, progressively fainter parallel bands when the beam bounces repeatedly between two strong, closely spaced reflectors, each bounce interpreted as a progressively deeper structure.
- 22. B.** Fat's true, genuinely slower propagation speed differs from the system's fixed 1,540 m/s assumption, producing a predictable, reproducible depth-measurement discrepancy, distinct from reverberation, a frequency mismatch, or element spacing.
- 23. D.** Higher frequency improves axial resolution (shorter pulse length) but attenuates more rapidly, reducing achievable penetration — the well-established trade-off; lower frequency does not improve axial resolution.
- 24. A.** The slice-thickness dimension, perpendicular to the original two-dimensional imaging plane, is elevational resolution, distinct from axial, lateral, or temporal resolution.
- 25. D.** Refraction specifically requires an oblique boundary between media with differing propagation speeds — exactly the condition described — not a perpendicular angle or a fluid-specific exclusion.
- 26. B.** Spatial pulse length directly governs axial resolution, the ability to distinguish two structures lying along the beam's direction of travel.
- 27. A.** A larger impedance mismatch produces a stronger, brighter reflected echo, since the fraction of energy reflected versus transmitted scales directly with the magnitude of the impedance difference.
- 28. A.** This bidirectional relationship is the piezoelectric effect, the foundational principle of transducer transmission and reception, distinct from the Curie point (a temperature threshold), the Doppler effect (frequency shift), or the photoelectric effect (light-based).
- 29. D.** Exceeding the Curie point permanently and irreversibly destroys a piezoelectric crystal's functional properties, a genuine hazard during high-temperature sterilization.
- 30. C.** The backing (damping) material is specifically added to shorten the transmitted pulse by absorbing excess ringing, genuinely improving axial resolution at some cost to sensitivity, distinct from the matching layer, lens, or housing.
- 31. B.** A mechanical sector transducer genuinely requires physical movement, such as oscillation, to sweep the beam and form an image, unlike linear, curvilinear, or phased arrays, all of which steer electronically.
- 32. C.** The matching layer is specifically positioned between the crystal and skin to reduce the significant impedance mismatch, improving acoustic energy transmission efficiency.
- 33. A.** The annular array's concentric ring geometry achieves symmetric electronic focusing in both planes simultaneously, but genuinely still requires mechanical steering to sweep the beam.

- 34. B.** The region of a narrow, converging beam extending to the transducer's natural focus is the near field (Fresnel zone); beyond that point, the beam diverges in the far field.
- 35. B.** A larger aperture increases near field length, extending the beam's natural focus point further from the transducer face, a direct, predictable geometric relationship.
- 36. C.** Electronic steering added specifically in the elevational plane, alongside the azimuthal steering every array already provides, is what enables volumetric sweeping without any physical probe movement.
- 37. B.** Bandwidth describes the range of frequencies contained within the transmitted pulse, directly tied to pulse length and damping quality.
- 38. A.** Because the structure of interest sits close to the probe face, the higher frequency's resolution benefit is captured without the penetration penalty that would matter at greater distance.
- 39. C.** Precisely timed firing delays across individual elements, producing an angled wavefront through constructive interference, is the genuine mechanism behind phased array beam steering, with no physical movement of any kind.
- 40. C.** A matrix probe must independently control elements across two full dimensions, azimuthal and elevational, rather than the single dimension a 1D linear probe controls, requiring substantially more electronic channels.
- 41. A.** A linear sequential array specifically produces a rectangular field of view, constant in width throughout the image depth, unlike the progressively widening sector field of curvilinear or phased array designs.
- 42. A.** A curvilinear probe's curved element arrangement produces a wider field of view at depth than a comparable linear probe, while the footprint stays reasonably manageable; linear arrays also steer electronically, so that is not the distinguishing factor.
- 43. C.** The phased array's compact footprint, achieved through purely electronic rather than physical steering, is specifically valued for the narrow intercostal acoustic window in cardiac imaging.
- 44. B.** Grating lobes arise specifically from the discrete, regularly spaced element structure inherent to array design, an artifact that genuinely cannot occur on a continuous crystal.
- 45. A.** Electronic focusing uses precisely timed firing delays across an array's elements to converge the beam at a chosen depth, allowing instant, real-time adjustment with no physical movement, unlike a fixed lens, fixed zone, or frequency-based approach.
- 46. C.** Setting depth with no margin beyond the structure of interest risks it disappearing off-screen with minor movement, and offers no confirmation that nothing relevant lies just beyond — a genuine, avoidable technique error.

- 47. C.** Overall gain amplifies uniformly across the entire field, while TGC amplifies selectively by depth to compensate for depth-dependent attenuation — genuinely distinct, complementary controls.
- 48. B.** Write (pre-processing) zoom, applied before the image is fully formed, narrows the scanned sector and increases effective scan line density, genuinely adding resolved detail.
- 49. C.** A wide dynamic range setting preserves gray-scale gradation useful for parenchymal texture, but the genuine cost is reduced contrast at any sharp boundary elsewhere in the same image, unrelated to output, TGC, or frame rate.
- 50. C.** Coded excitation transmits a longer, structured pulse and compresses it during receive-side processing, achieving stronger signal without raising transmitted acoustic output.
- 51. B.** Tissue harmonic imaging's primary genuine benefit is reduced near-field clutter, since harmonic frequencies generated within tissue are comparatively weak at common reverberation-type artifact sources, unlike a lateral-resolution, frame-rate, or TGC-elimination claim.
- 52. A.** High persistence averages several sequential frames together to reduce noise, but this same averaging smooths and blurs genuinely rapid motion, the correct, non-trivial consequence.
- 53. D.** Extended field of view specifically stitches sequential images together into a panoramic composite wider than any single footprint, directly addressing a vein exceeding one field of view.
- 54. D.** 4D imaging is 3D imaging acquired and displayed in real time, adding motion as a genuine fourth dimension on top of the same three spatial dimensions static 3D already captures.
- 55. B.** DICOM is the standardized format and protocol enabling an image from any manufacturer's system to open correctly on any other workstation within a shared network.
- 56. B.** Measuring at a genuinely oblique angle rather than perpendicular to the true axis produces a foreshortened or elongated apparent dimension — a real geometric error the system does not detect or correct.
- 57. A.** A laterality error can lead directly to the wrong side of the body being biopsied, treated, or monitored, a genuine, elevated patient-safety concern.
- 58. D.** A sample volume placed against the vessel wall rather than centered in the true flow stream samples slower, non-representative flow, producing a falsely low reading, not a no-effect, automatic-correction, or falsely-elevated outcome.
- 59. D.** Triplex display must simultaneously update three distinct streams, grayscale, spectral Doppler, and color Doppler, rather than the two duplex updates, directly raising processing demand.
- 60. C.** A structure's apparent size genuinely differs across the cardiac cycle, so the specific phase measured must be matched consistently between studies to detect genuine interval change accurately.

- 61. B.** The system's fixed 1,540 m/s assumption does not match fat's true, genuinely slower propagation speed, producing a predictable, physics-based depth error even with correctly placed calipers.
- 62. D.** Edge enhancement selectively raises visual contrast at locations where existing data shows an abrupt echo intensity change, sharpening a boundary without adding genuinely new information.
- 63. D.** Because lateral resolution is sharpest at the focal zone and degrades with distance, a structure sharp at one edge and blurred at a deeper edge most plausibly reflects focal zone placement.
- 64. C.** Frequency compounding reduces speckle by averaging multiple transmitted frequencies rather than multiple sequential frames over time, making it more motion-tolerant than persistence.
- 65. A.** PACS is the networked digital infrastructure for storing, retrieving, and distributing images across departments; DICOM is the format/protocol operating within it.
- 66. C.** Organizing a worksheet in the same logical sequence as the scanning protocol lets a reviewing physician follow the study without confusion, a genuine documentation-quality benefit.
- 67. A.** Confident, specific labeling is genuinely justified by a structure's relationship to reliable anatomic landmarks, such as its drainage pattern relative to the renal vein and IVC, not manufacturer, display settings, or general experience alone.
- 68. D.** A narrow dynamic range setting increases contrast, specifically sharpening a boundary such as a cyst wall, not noise reduction, penetration, or a frame-rate purpose.
- 69. B.** PACS is the networked archiving and retrieval system; DICOM is the standardized format and protocol enabling images to move correctly within that network.
- 70. C.** Spatial compounding combines multiple beam angles into one composite image specifically to capture a boundary's true definition more completely, directly addressing angle-dependent inconsistency.
- 71. D.** A technically perfect image never correctly documented has not actually served the patient, since future clinicians depend entirely on the saved record rather than the live exam.
- 72. C.** Confident, specific labeling is genuinely justified by a structure's relationship to reliable, consistently positioned anatomic landmarks, such as its confluence pattern relative to the splenic vein, not manufacturer, display settings, or general experience alone.
- 73. A.** Simultaneous grayscale B-mode imaging with real-time pulsed wave spectral Doppler, without switching modes, is duplex scanning specifically.
- 74. D.** Because the dimness is described as uniform across the whole field rather than confined to one depth range, overall gain, the uniform amplification control, is the most direct explanation, unlike focal zone, transducer/frequency, or TGC.

- 75. B.** Each of these three techniques addresses a genuinely different, specific limitation of standard imaging, so the correct choice depends entirely on which limitation a given exam actually encounters, not identical hardware requirements, exclusivity, or identical function.
- 76. C.** Because lateral resolution is genuinely sharpest directly at the focal zone and worsens with distance, a mass sharp near the transducer but blurred at its deepest margin most likely reflects focal zone placement, not a malfunction, TGC issue, or reverberation artifact.
- 77. D.** A returning frequency below the transmitted frequency is a negative Doppler shift, indicating flow moving away from the transducer.
- 78. B.** The Doppler equation's cosine term directly ties calculated velocity to the angle between the beam and true flow direction, precisely why angle correction is treated as critical.
- 79. A.** By standard spectral Doppler convention, flow moving toward the transducer produces a positive shift displayed above the baseline, consistent with the antegrade popliteal flow described; flow away from the transducer would instead display below.
- 80. C.** Cosine's sensitivity to a given angle-placement error worsens sharply as the angle approaches 90 degrees, making velocity measurement increasingly unreliable at 80-85 degrees, not a hard detection cutoff, a regulatory rule, or a velocity-maximizing benefit.
- 81. B.** PRF is fundamentally limited by imaging depth because a deeper sample volume requires a longer round-trip travel time for each pulse's echo to return.
- 82. A.** The Nyquist limit, the maximum velocity accurately displayable without aliasing, is mathematically exactly half the current PRF — in this case, half of 4,000 Hz — not double the PRF, an unrelated value, or an output-determined figure.
- 83. C.** A peak wrapping around the baseline despite genuinely unchanged flow direction is the classic signature of aliasing, occurring when true velocity exceeds the current Nyquist limit, not a genuine reversal, equipment malfunction, or wall filter issue.
- 84. A.** Increasing PRF directly raises the Nyquist limit; once it exceeds the true velocity, aliasing resolves without altering the actual flow being measured.
- 85. D.** Pulsed wave Doppler's defining advantage is genuine spatial specificity, isolating flow to one precisely chosen depth.
- 86. C.** A dedicated two-element, simultaneously-active design is the defining feature of continuous wave Doppler, eliminating the sampling interval responsible for the Nyquist limit.
- 87. B.** The inability to determine which depth along the beam path a detected signal actually originates from is range ambiguity, a genuine, defining limitation of continuous wave Doppler's continuous, non-depth-selective reception.

- 88. B.** Continuous wave Doppler has no theoretical velocity ceiling regardless of depth, making it appropriate when a jet is anticipated to exceed pulsed wave Doppler's range.
- 89. D.** A resistance index is calculated directly from peak systolic velocity and end-diastolic velocity, the two values measured directly from the spectral waveform, not from PRF/Nyquist, wall filter/sample volume, or angle/frequency.
- 90. C.** Sharp systolic upstroke with essentially absent diastolic flow is the characteristic high-resistance pattern, similar to resting skeletal muscle, the opposite of a low-resistance bed like the normal kidney or brain.
- 91. B.** Color hue on a standard color Doppler display primarily encodes flow direction relative to the transducer; two vessels with genuinely opposite flow directions display in different colors even at comparable speeds, since hue reflects direction, not velocity, frequency, or resistance index.
- 92. C.** An abrupt color change without a genuine flow direction change is the color Doppler equivalent of spectral aliasing, occurring when true velocity at that specific point exceeds the current color scale's Nyquist limit, consistent with the stem's own statement that grayscale confirms no true branch exists there.
- 93. D.** Because amplitude is a genuinely more robust underlying signal than a precisely measured frequency shift, power Doppler is less affected by slow flow or a poor insonation angle than color Doppler, which depends on accurately detecting a directional frequency shift.
- 94. B.** Color and power Doppler each display a genuinely different aspect of the underlying Doppler signal, direction/velocity versus amplitude, suiting a genuinely different clinical question, which is exactly why a protocol would deliberately specify one over the other by exam type.
- 95. B.** The diaphragm's strong, smooth reflective surface is capable of reflecting the beam both before and after it genuinely insonates true flow, producing mirror image artifact, distinct from the granular texture of a calculus, weak reflection, or the scattering behavior of bowel gas.
- 96. A.** A brief color burst unrelated to any genuine vessel, resolving the instant motion stops, is flash artifact, specifically triggered by tissue or transducer motion rather than true blood flow, distinct from twinkle artifact, aliasing, or a genuine vessel.
- 97. D.** A rapidly alternating color signal behind a small, granular focus is twinkle artifact, genuinely useful for confirming a small calculus difficult to identify confidently on grayscale alone.
- 98. B.** Before any instrument adjustment whatsoever, assessing whether a finding is genuinely physiologically plausible given the actual anatomy present is the single most useful first screening step, not transducer model, output setting, or sonographer experience.
- 99. B.** An excessively high wall filter threshold removes signal below it indiscriminately, meaning genuine low-velocity flow of real clinical interest can be removed along with intended clutter.

- 100. D.** Twinkle artifact generally requires no correction once identified, since it is often diagnostically useful, though confirming it is not masking a separate genuine finding remains important.
- 101. A.** A thin, washed-out waveform with a barely distinguishable peak against noise points specifically to underset spectral gain; increasing spectral gain strengthens the genuine underlying signal, unlike a wall filter increase, PRF decrease, or sample volume enlargement.
- 102. C.** Genuine diagnostic harm depends specifically on whether an artifact was recognized and documented correctly, versus mistakenly reported as pathology.
- 103. D.** A finding present for only a single transient frame and then genuinely gone is most consistent with flash artifact, which characteristically resolves within a frame or two once triggering motion stops, unlike brightness, proximity, or mixed color pattern.
- 104. B.** The resistive index is calculated directly from peak systolic velocity and end-diastolic velocity, the two values measured directly from a spectral waveform, not from Nyquist/PRF, frequency/wall filter, or sample volume/angle.
- 105. A.** Doppler artifacts genuinely introduce new failure modes tied specifically to frequency-shift processing, motion detection, and color assignment, none of which have a direct grayscale equivalent, making the graduate's assumption genuinely mistaken.
- 106. C.** Because Doppler displays are specifically interpreted as representing genuine physiologic motion, an unrecognized Doppler artifact is particularly likely to be mistaken for real hemodynamic pathology.
- 107. B.** A finding that genuinely fails to resolve despite a technique change specifically expected to disrupt the suspected mechanism deserves reconsideration as possibly genuine and unusual, not automatic confirmation, an output-power response, or a reason to abandon further reasoning.
- 108. A.** This brief, deliberate self-check genuinely separates documentation that reliably serves every future reader from documentation that merely appears complete at a glance but leaves genuine ambiguity, a real quality safeguard.
- 109. A.** A perfectly optimized live image genuinely has no lasting diagnostic value unless it is also saved, measured, and labeled correctly, since future clinicians depend entirely on that documented record rather than the live exam itself, directly completing the instrumentation chain.
- 110. D.** Matching the exact measurement technique used previously, including caliper edge placement and plane, is what allows genuine interval change to be detected accurately.