COMPREHENSIVE MOCK EXAM 8

Supplemental to: Clinical Ultrasound Board Review 2026-2027

Travis L. Bricker

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 technologist scanning a bariatric patient at maximum output for over ten minutes finally obtains a diagnostic image but forgets to lower the output for the rest of the exam. What has this specifically violated?

A. Nothing; output only matters at the moment of image capture

B. ALARA, which calls for reducing output once diagnostic quality is achieved, not leaving it elevated

C. A rule that applies only to obstetric ultrasound specifically

D. A rule concerning transducer heat dissipation, unrelated to bioeffects

2. Two indices are compared on a console: one predicts tissue heating risk, the other predicts the likelihood of microbubble collapse. Which index predicts the heating risk specifically?

A. MI, the mechanical index

B. PRF, the pulse repetition frequency

C. TGC, time gain compensation

D. TI, the thermal index

3. A gas bubble in tissue rapidly collapses under a passing negative pressure phase of the ultrasound wave. What is this specific bioeffect called?

A. Thermal injury

B. Acoustic streaming

C. Inertial cavitation

D. Attenuation

4. A sonographer scans a follow-up patient without reviewing the prior comparable study first. What genuine risk does this specifically create?

A. An automatic billing code error affecting this specific visit

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

C. A transducer malfunction entirely unrelated to prior study review

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

5. A department runs monthly phantom testing on every scanner. What is the primary purpose of this practice?

A. To eliminate the need for any manufacturer service contract entirely

B. To verify system performance parameters, such as depth calibration and resolution, against a known standard

C. To satisfy a purely administrative requirement with no bearing on image quality

D. To calibrate each individual sonographer's own personal scanning habits

6. A sonographer is asked to perform an exam type outside their typical comfort zone but nominally within department scope. What is the professionally sound response?

A. Silently complete only the familiar portions without disclosure

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

C. Openly acknowledge the unfamiliarity and involve a more experienced colleague or make an appropriate referral

D. Decline all similar exams permanently, even after future training

7. Why does transducer disinfection between patients matter clinically, not just administratively?

A. It is required only for endocavitary probes, never for external ones

B. It directly reduces the risk of transmitting infectious organisms via a shared contact surface

C. It exists solely to satisfy accreditation paperwork requirements

D. It has no measurable bearing on genuine patient safety at all

8. A worksheet notes: 'Right kidney lower pole obscured by overlying bowel gas.' What is the primary clinical value of this specific documentation?

A. It protects the sonographer from any conceivable future liability claim

B. It tells the interpreting physician exactly how confidently to weigh a negative finding for that segment

C. It only matters if the ordering physician specifically requested this level of detail

D. It exists purely for internal department record-keeping

9. A sonographer uses an AI-assisted measurement tool during a thyroid exam. What responsibility does the sonographer retain regardless of the tool's use?

A. None; the AI tool's output can genuinely be trusted without independent review

B. Disabling the AI tool permanently, regardless of its demonstrated track record

C. Verifying the AI-generated measurement is clinically plausible and correctly applied to this specific patient

D. Documenting the AI tool's internal algorithm architecture in the patient's own chart

10. An order reads only 'renal ultrasound' with no further clinical context. What is the single most useful first step before scanning?

A. Use the most recently applied renal protocol from an unrelated patient

B. Contact the ordering provider or review the chart for the actual clinical question

C. Proceed with the broadest possible renal survey without further inquiry

D. Decline the order until it is resubmitted with more detail

11. A quality assurance program specifically tracks 'documented technical limitations per exam' as one of its metrics. Why would this metric genuinely matter to a QA director?

A. It has no genuine bearing on diagnostic quality, reflecting only staffing efficiency metrics

B. It solely reflects how quickly exams are being completed department-wide overall

C. Higher counts always indicate substandard, careless scanning technique specifically

D. It reflects how consistently limitations are being flagged for interpreting physicians, a genuine diagnostic-completeness signal

12. A sound wave's frequency is doubled while its propagation speed through the medium stays fixed. What happens to wavelength?

A. Wavelength doubles as well

B. Wavelength is unaffected

C. Wavelength is halved

D. Wavelength becomes undefined

13. A structure's true propagation speed is slower than the system's fixed 1,540 m/s assumption. Where does the system display this structure relative to its true depth?

A. At its correct depth, unaffected

B. Deeper than its true depth

C. Shallower than its true depth

D. The structure disappears from the display

14. Which combination of mechanisms together account for total beam attenuation in tissue?

A. Refraction alone, with no other genuine mechanism contributing

B. Absorption, scattering, and reflection together, each removing energy

C. Reflection alone, with no other genuine mechanism contributing

D. Absorption alone, with no other genuine mechanism contributing

15. A physics reviewer asks a trainee to name the two tissue-specific factors multiplied together to yield acoustic impedance. What is the correct pairing?

A. A tissue's density and its propagation speed of sound

B. Its attenuation coefficient and its transmitted frequency

C. Its echogenicity and its depth from the transducer face

D. Its thermal conductivity and its specific heat capacity

16. Two tissue boundaries are compared: one with a small impedance mismatch, one with a large impedance mismatch. Which boundary reflects more strongly?

A. Neither; reflection strength is unrelated to impedance mismatch

B. The boundary with the large impedance mismatch

C. The boundary with the small impedance mismatch

D. Both reflect identically regardless of mismatch

17. A student measuring resolution along the beam's own direction of travel is testing which specific resolution type?

A. Lateral resolution

B. Elevational resolution

C. Axial resolution

D. Temporal resolution

18. During a subcostal liver scan, a technologist notices what looks like a second, fainter copy of the liver parenchyma appearing symmetrically on the far side of the diaphragm. What is this artifact called?

A. Reverberation artifact

B. Grating lobe artifact

C. Comet-tail artifact

D. Mirror image artifact

19. A bright band appears deep to a simple fluid-filled cyst compared to surrounding tissue at the same depth. What causes this?

A. Acoustic shadowing arising specifically from the cyst itself

B. Posterior acoustic enhancement, since the cyst attenuates less than surrounding tissue

C. Reverberation occurring between two parallel reflectors nearby

D. A propagation speed mismatch occurring through the cyst itself

20. A refraction calculation at a tissue interface requires plugging in which two specific input values?

A. Acoustic impedance values on either side of the interface

B. Beam intensity values on either side of the interface

C. The angle of incidence and the ratio of propagation speeds

D. Transducer element count and spacing

21. Equally spaced, progressively fainter bright bands extend well beyond the true depth of any genuine structure. What artifact is this?

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 densely attenuating structure nearby

D. A propagation speed mismatch artifact through an intervening structure

22. A kidney measured through perinephric fat shows a consistent, reproducible measurement discrepancy versus a fat-free approach. What explains this?

A. The beam reflecting repeatedly between the kidney and adjacent bowel gas

B. A frequency mismatch specifically attributed to the fat layer

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

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

23. A deep structure is imaged at both a higher and lower transducer frequency. What combined outcome is genuinely expected?

A. The higher-frequency exam shows better axial resolution but less penetration

B. Both frequencies show identical resolution and penetration

C. The lower-frequency exam shows better axial resolution

D. The higher-frequency exam shows worse resolution and worse penetration simultaneously

24. A 3D dataset's out-of-plane, third dimension is described separately from its two in-plane dimensions. What is this third dimension called?

A. Axial resolution, along the original beam direction

B. Lateral resolution, along the original sweep direction

C. Elevational resolution, the slice-thickness dimension

D. Temporal resolution, across successive acquired frames

25. A beam crosses obliquely from soft tissue into a structure with a genuinely different propagation speed. What must occur at this boundary?

A. No bending occurs unless impedance is also mismatched

B. Refraction cannot occur at a fluid boundary

C. The beam path bends, since refraction requires exactly this combination

D. Bending occurs only at a perpendicular angle

26. Which single parameter, if shortened, most directly improves axial resolution?

A. Spatial pulse length

B. Beam width in the lateral direction

C. Slice thickness

D. Frame rate

27. A large versus small acoustic impedance mismatch at two different boundaries is compared. What effect does the larger mismatch have on echo strength?

A. It produces an identical echo regardless of mismatch

B. It produces a stronger, brighter echo than the small-mismatch boundary

C. It eliminates any reflection entirely

D. It produces a weaker echo than the small-mismatch boundary

28. Certain crystals generate a voltage when mechanically deformed, and deform when a voltage is applied. What principle is this?

A. Curie effect

B. Piezoelectric effect

C. Doppler effect

D. Photoelectric effect

29. A transducer permanently loses function after accidental exposure to extreme heat during autoclaving. What threshold was most likely exceeded?

A. The transducer's minimum rated storage temperature threshold

B. The transducer's peak sensitivity temperature threshold

C. A temperature threshold genuinely unrelated to piezoelectric function

D. The Curie point, permanently destroying piezoelectric properties

30. A manufacturer's engineer explains that a specific transducer component was added specifically to shorten pulse duration, accepting some loss of sensitivity as a result. Which component is being described?

A. The transducer housing's protective plastic casing

B. The matching layer positioned at the transducer face

C. The backing (damping) material behind the active element

D. The elevational focusing lens bonded to the crystal

31. A veterinary ultrasound unit uses an older probe design that physically oscillates its single crystal element back and forth to build each frame. What transducer category does this describe?

A. A linear sequential array probe, steering electronically

B. A curvilinear array probe, steering electronically

C. A phased array probe, steering electronically

D. A mechanical sector transducer, requiring physical movement

32. Between the crystal and the patient's skin sits a specific transducer layer whose entire purpose is minimizing the impedance gap between those two surfaces. What is this layer called?

A. The backing (damping) layer, positioned behind the element

B. The matching layer, positioned at the transducer face

C. The active piezoelectric element itself

D. The transducer's external protective housing

33. Which array achieves symmetric electronic focusing in both azimuthal and elevational planes at once, but still requires mechanical steering to sweep the beam?

A. Annular array

B. Phased array

C. Linear sequential array

D. Curvilinear array

34. A transducer's beam is narrow and converging up to a specific point, beyond which it diverges. What is this converging region called?

A. The far field (Fraunhofer zone)

B. A region unique to continuous wave Doppler

C. The near field (Fresnel zone)

D. A region that does not exist on modern arrays

35. An engineering student is told that widening a transducer element's diameter, with frequency unchanged, pushes the beam's natural focus further from the face. Which parameter was widened?

A. Wavelength, the distance between successive pressure peaks

B. Pulse repetition frequency, the rate of pulse transmission

C. Aperture, the physical diameter of the transducer element

D. Dynamic range, the ratio of largest to smallest signal

36. A matrix array sweeps electronically through multiple planes to build a volume, without physically tilting the probe. What capability enables this?

A. Electronic steering added in the elevational plane, alongside existing azimuthal steering

B. A fixed elevational focus set permanently at the time of manufacture

C. Manual physical rotation of the probe performed directly by the sonographer

D. A single mechanically swept row of elements moving through space

37. A spec sheet lists a transducer's 'bandwidth.' What does this figure describe?

A. The physical width, measured in centimeters, of the transducer's 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 in the array

38. Why does a higher-frequency endocavitary probe remain the better choice for a structure close to the probe face, despite frequency's usual penetration trade-off?

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 endocavitary use

C. Higher frequency inherently reduces manufacturing cost for smaller probes

D. Lower-frequency elements cannot physically fit inside an endocavitary housing

39. A phased array steers to a specific angle without any physical movement. What mechanism accomplishes this?

A. The entire housing physically tilts to the desired angle

B. Precisely timed firing delays across elements produce an angled wavefront

C. A single large crystal element mechanically rotates back and forth

D. Two separate dedicated element sets are switched between

40. Why do 2D matrix probes require dramatically more electronic channels than 1D linear probes?

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. Comparing two probes side by side on the same superficial vessel, one produces a field of view whose width stays constant with depth, the other's widens progressively. Which probe produces the constant-width field?

A. A curvilinear probe

B. A linear sequential array

C. A phased array

D. A mechanical sector probe

42. A curvilinear probe is chosen over a similarly sized linear probe specifically for its field-of-view characteristics. What advantage is sought?

A. An identical rectangular field to the linear probe

B. A smaller footprint with an unchanged field shape

C. Electronic steering the linear probe lacks

D. A wider field of view at depth, while the footprint remains manageable

43. Which transducer type is most classically valued for cardiac imaging, specifically for its small footprint accessing intercostal spaces?

A. Linear sequential array, given its rectangular field

B. Curvilinear array, given its wide field at depth

C. Mechanical sector array, given its simple construction

D. Phased array, for its compact, purely electronic footprint

44. Grating lobes 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. An artifact caused by the transducer's own matching layer

C. The discrete, regularly spaced element structure of array design

D. A mismatch between the transmitted and received frequency

45. Which focusing method allows focal depth to change instantly without physically moving any component?

A. A fixed acoustic lens permanently bonded to the face

B. A single, permanently fixed focal zone set at manufacture

C. Electronic focusing, using timed firing delays to converge the beam

D. Changing the transmitted frequency to shift the focal point

46. A sonographer places a structure at the very bottom edge of the display with zero margin. What genuine risk does this introduce?

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

B. The structure risks vanishing off-screen with minor movement, with no margin to confirm nothing lies beyond

C. An automatic, unavoidable increase in the currently selected acoustic output

D. None; this is genuinely considered efficient, correct scanning technique

47. How do overall gain and TGC genuinely differ?

A. They are identical controls under different names

B. Overall gain changes acoustic output; TGC never does

C. Overall gain amplifies uniformly across the field; TGC amplifies selectively by depth

D. TGC amplifies uniformly; overall gain amplifies selectively by depth

48. A sonographer needs finer resolved detail on a small structure before saving the image and accepts a lower frame rate. Which technique genuinely adds this detail?

A. Post-processing (read) zoom applied after acquisition

B. Raising overall gain at the same time as any zoom

C. Widening the dynamic range over the region

D. Write (pre-processing) zoom, narrowing the scanned sector before acquisition

49. A wide dynamic range setting is chosen to show subtle parenchymal texture rather than sharp boundary contrast. What trade-off accompanies this?

A. A mandatory, unavoidable drop in acoustic output delivered

B. Complete loss of TGC availability on that specific image

C. A mandatory reduction in achievable frame rate throughout

D. Reduced contrast at any sharp boundary elsewhere in the same image

50. A vendor claims stronger signal on deep patients without raising displayed acoustic output. Which engineering approach achieves this?

A. Coded excitation, transmitting a longer structured pulse and compressing it on reception

B. Automatically switching to a substantially lower transducer frequency

C. Applying more aggressive TGC uniformly at every depth

D. Automatically reducing the currently selected imaging depth

51. A mode filters out the fundamental frequency and processes only tissue-generated harmonic frequencies, reducing near-field clutter. Which mode is this?

A. Spatial compounding

B. Persistence

C. Tissue harmonic imaging

D. Frequency compounding

52. A fetal heart is imaged while actively beating, and a high persistence setting causes the chambers to appear smeared together. What explains this?

A. Persistence averages several sequential frames, smoothing rapid motion along with noise

B. Imaging depth was set inappropriately shallow for this specific fetal exam

C. TGC was set inappropriately for this specific fetal depth range

D. Transducer frequency was set inappropriately too high for this exam

53. A vein routinely runs longer than any single transducer footprint can capture. Which technique documents its full length in one image?

A. Extended field of view, stitching sequential images into one panoramic frame

B. Spatial compounding, combining multiple beam angles

C. Frequency compounding, combining multiple frequencies

D. Tissue harmonic imaging, filtering the fundamental frequency

54. A static 3D volume shows no motion. How does 4D acquisition of the same structure genuinely differ?

A. 3D and 4D are simply two different marketing names for one method

B. 3D acquisition requires an entirely different, incompatible transducer

C. 4D adds real-time motion, a fourth dimension, on top of the same three spatial dimensions 3D captures

D. 4D genuinely captures fewer spatial dimensions than static 3D

55. A multi-site group requires any image, from any vendor's machine, to open correctly on any workstation network-wide. What standard makes this achievable?

A. A proprietary format restricted to one specific manufacturer

B. An automatic converter for legacy analog videotape studies

C. DICOM, the standardized format and protocol enabling cross-manufacturer interoperability

D. A rule eliminating the need for shared network infrastructure

56. A nodule measured perpendicular to its axis at baseline is measured obliquely at follow-up. What happens to the follow-up measurement?

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 wrong-site biopsy is traced to a single image where right had been documented as left. Why does this error carry such outsized clinical weight?

A. It occurs less often than other genuine documentation errors

B. It carries no genuine clinical weight, purely an administrative matter

C. It can lead directly to the wrong side of the body being biopsied, treated, or monitored

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

58. A sample volume sits near a vessel wall rather than centered in the lumen. What is the most likely effect on the resulting velocity?

A. No effect; sample volume position is irrelevant to velocity

B. A falsely low reading, since slower non-representative flow is sampled

C. The system automatically recenters the sample volume

D. A falsely elevated reading from wall turbulence

59. Frame rate drops noticeably the moment triplex display is activated. What explains this?

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

B. Triplex requires a slower, incompatible transducer

C. Triplex automatically increases imaging depth

D. No genuine relationship exists between triplex and frame rate

60. A structure's apparent diameter differs when measured at end-systole versus end-diastole. What does this emphasize for a comparison study?

A. Cyclic timing has no bearing on caliper accuracy

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

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

D. Measurement technique is unaffected by cardiac timing

61. A liver lesion measured through an overlying layer of subcutaneous fat, with calipers correctly placed both times, still shows a small, reproducible measurement bias compared to a fat-free imaging window. What explains this?

A. Fat physically blocks the beam entirely, making any measurement through it unreliable

B. Caliper placement is inherently degraded whenever fat is present in the field

C. The transducer automatically and silently lowers its frequency whenever fat is detected

D. The system's 1,540 m/s assumption does not match fat's true, genuinely slower propagation speed

62. A processed image shows a crisper boundary than the raw acquisition suggests, with no new scan lines indicated at that boundary. What explains this?

A. New scan lines were genuinely acquired specifically at the boundary

B. Edge enhancement, raising contrast at abrupt intensity changes without adding data

C. Acoustic output was specifically increased at the boundary

D. Imaging depth was automatically increased near the edges

63. A mass appears sharp at its shallow edge but blurred at its deep edge within one static image. What single factor most plausibly explains this?

A. A genuine transducer element malfunction limited to part of the array

B. The focal zone's placement, sharpest there and worsening with distance

C. An incorrect TGC setting entirely unrelated to focal zone placement

D. A reverberation artifact isolated to the blurred portion

64. A sonographer wants to reduce speckle noise on a moving structure without the motion-blur high persistence would cause. Which technique fits?

A. Frequency compounding, averaging multiple frequencies rather than frames over time

B. Increasing the wall filter threshold for this specific exam

C. Increasing overall gain across the entire field

D. Narrowing the currently selected dynamic range setting

65. A facility describes its core imaging infrastructure as 'the networked system storing, retrieving, and distributing every study.' What is this?

A. DICOM, the format and protocol itself

B. A single dedicated storage device reserved for one modality

C. An outdated approach fully replaced by modern cloud storage

D. PACS, the networked digital infrastructure for storage/retrieval/distribution

66. A worksheet lists findings in the same order as the scanning protocol, not the save order. Why does this deliberate choice matter?

A. It has no genuine bearing on how a physician reviews the study

B. It is entirely optional, and most departments deliberately avoid it

C. It lets a reviewing physician follow the study logically without reconstructing order

D. It exists solely for billing and coding purposes

67. A structure is confidently labeled the splenic vein based on its course relative to the pancreas and splenic hilum. What justifies this label?

A. The specific ultrasound system manufacturer used to acquire it

B. The structure's relationship to reliable, consistently positioned anatomic landmarks

C. The specific brightness and contrast settings at save time

D. The sonographer's general years of overall clinical experience

68. A narrow dynamic range setting is chosen to sharply define a cyst wall's border. What is it optimized to achieve?

A. Sharply defining a boundary through increased contrast

B. Reducing speckle noise uniformly

C. Improving penetration for a deep structure

D. Reducing frame rate for temporal averaging

69. How do PACS and DICOM genuinely relate to one another?

A. DICOM is physical hardware; PACS is a software-only format

B. They are simply interchangeable names for one identical system

C. PACS has fully and permanently replaced DICOM, now obsolete

D. PACS is the archiving/retrieval system; DICOM is the protocol enabling images to move within it

70. A plaque's border appears crisp from one angle but indistinct from a slightly different angle. Which technique addresses this specific inconsistency?

A. Spatial compounding, combining multiple beam angles to more completely capture the border

B. Frequency compounding, combining multiple transmitted frequencies

C. Persistence, averaging multiple sequential frames over time

D. Extended field of view, stitching along a path of motion

71. A flawless liver image is acquired, but the sonographer forgets to save measurements or a label before the next patient. What does this illustrate?

A. Documentation is purely optional, with no genuine bearing on the exam itself

B. Instrumentation quality and documentation quality are genuinely unrelated concerns

C. Image optimization alone has already fully served the patient's genuine needs

D. Documentation is what makes careful optimization clinically usable, since future clinicians depend on the record

72. A structure is labeled the common hepatic duct based specifically on its course anterior to the portal vein and its confluence pattern near the porta hepatis, rather than simply noting 'a duct.' What justifies this confidence?

A. The specific ultrasound system manufacturer used to acquire it

B. The specific brightness and contrast settings active at save time

C. The sonographer's general years of overall clinical experience

D. The structure's relationship to reliable, consistently positioned anatomic landmarks

73. A study shows live grayscale anatomy alongside a real-time spectral tracing simultaneously, without switching modes. What is this 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 combined with 3D acquisition

74. An image is globally too dim with otherwise adequate focus. Which processing step most likely explains this?

A. Focal zone placement, already ruled out by adequate focus

B. Transducer or frequency selection, uncorrectable by gain alone

C. Overall gain, since a globally dim image points to insufficient amplification

D. TGC specifically, independent of overall brightness

75. Spatial compounding, extended field of view, and 3D/4D acquisition are each selected for genuinely different exams. Why is no single one the universal default?

A. All three genuinely require identical transducer hardware and conditions

B. They are functionally identical techniques, simply marketed differently

C. Only one of the three should ever be available on a system

D. Each addresses a genuinely different, specific limitation, chosen by what an exam actually encounters

76. A gallbladder polyp appears sharply resolved at one specific depth within a static image, but distinctly blurred at a shallower depth within that same image. What does this 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 polyp's position relative to the focal zone, sharpest there and worsening with distance

D. A reverberation artifact isolated to the blurred portion of the display

77. A returning echo frequency is consistently below the transmitted frequency at one sample location. What does this indicate about flow?

A. Flow is moving toward the transducer

B. Flow direction cannot be determined from this information

C. Flow is moving away from the transducer

D. Flow has genuinely stopped

78. Why is angle correction treated as a critical Doppler technique step rather than a minor adjustment?

A. The Doppler equation's cosine term ties calculated velocity directly to the angle between beam and flow

B. Angle correction only genuinely affects grayscale image brightness, not velocity

C. Angle correction only genuinely matters for continuous wave Doppler acquisitions

D. Angle correction is purely a display cosmetic feature with no calculation impact

79. A femoral artery waveform displays entirely above the baseline, consistent with known antegrade flow. What convention does this confirm?

A. Flow toward the transducer displays below the baseline

B. Baseline position alternates unpredictably

C. Flow toward the transducer displays above the baseline

D. Baseline has no relationship to flow direction

80. A sonographer wonders whether pushing the Doppler angle to 80-85 degrees, rather than staying below 60, would still be acceptable. What is the physics-based concern?

A. No shift can be detected beyond exactly 60 degrees

B. Regulatory standards prohibit any angle beyond 60 degrees

C. Cosine sensitivity to angle error worsens sharply approaching 90 degrees

D. A steeper angle produces the single highest possible velocity

81. A deep vessel's achievable PRF is insufficient to avoid aliasing for the true velocity present. What is the underlying reason PRF is limited at depth?

A. A deeper sample volume requires a longer round-trip travel time before the next pulse can be sent

B. Deeper structures automatically require the use of a lower frequency

C. Increased depth automatically increases the sample volume size

D. Regulatory output limits become more restrictive at greater depths

82. A PRF of 6,000 Hz is set for a specific vessel. What is the maximum velocity displayable without aliasing, expressed as a fraction of that value?

A. Double the PRF value

B. A fixed value unrelated to PRF

C. Exactly half the PRF value

D. A value determined solely by acoustic output

83. A tracing's systolic peak wraps around to appear below the baseline despite unchanged true flow direction. What does this represent?

A. A true reversal of flow direction

B. A transducer malfunction isolated to Doppler circuitry

C. An inappropriately high wall filter threshold

D. Aliasing, since true velocity has exceeded the current Nyquist limit

84. Which adjustment corrects an aliased tracing without altering the actual flow being measured?

A. Decrease the currently selected wall filter threshold

B. Increase PRF, directly raising the Nyquist limit above the true velocity

C. Enlarge the currently selected sample volume size

D. Switch to a substantially lower imaging depth setting

85. Which mode offers genuine spatial specificity, isolating flow to one precisely chosen depth?

A. Continuous wave Doppler, for its unlimited velocity range

B. Continuous wave Doppler, for its aliasing immunity

C. Pulsed wave Doppler, offering genuine spatial specificity at one chosen depth

D. Pulsed wave Doppler, for its unlimited velocity ceiling

86. A probe uses two dedicated, simultaneously active elements, one only transmitting, one only receiving. What capability does this provide?

A. Improved axial resolution compared to a single-element design

B. An unlimited velocity range, since no sampling interval creates a Nyquist limit

C. The ability to acquire genuine three-dimensional volumetric data

D. Automatic elimination of any angle correction requirement

87. A continuous wave signal detects high velocity but the sonographer cannot tell whether it originates shallow or deep along the same vessel. What limitation is this?

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

B. Range ambiguity, the inability to determine which depth a signal originates from

C. A limitation specific to sample volume size, not acquisition mode

D. An inability to distinguish flow direction toward versus away

88. A stenotic valve jet is anticipated to exceed pulsed wave Doppler's achievable range at depth. Which technique reliably captures the true peak velocity?

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

B. Pulsed wave Doppler with the wall filter raised

C. Pulsed wave Doppler with the sample volume enlarged

D. M-mode, for its temporal resolution

89. A renal surveillance report includes a single ratio derived from two waveform values, flagging rising downstream resistance. Which two values feed into it?

A. Peak systolic velocity and end-diastolic velocity

B. PRF and the Nyquist limit at that setting

C. Wall filter threshold and sample volume size

D. Angle of insonation and transducer frequency

90. A post-transplant hepatic artery waveform shows sharp systolic upstroke with essentially absent forward diastolic flow. What vascular bed pattern does this resemble?

A. A low-resistance pattern, like the kidney or brain

B. A pattern with no meaningful resistance characteristics

C. A pattern that cannot be characterized by waveform shape

D. A high-resistance pattern, like resting skeletal muscle

91. Two vessels flowing in opposite directions through the same color box display in different colors despite comparable speeds. What does this reflect?

A. The precise peak velocity present within each of the two vessels

B. The transducer frequency currently selected for this acquisition

C. Flow direction relative to the transducer, which color hue primarily conveys

D. The relative vascular resistance index present in each vessel

92. A color tracing shows an abrupt shift from red to blue at one point along a vessel that grayscale confirms runs straight with no true branch there. What explains this?

A. Color aliasing, since true velocity exceeds the current color scale's Nyquist limit

B. A transducer element malfunction specifically affecting color assignment

C. An intentional system feature specifically designed to flag stenosis

D. A genuine anatomic branch point present at that specific location

93. Power Doppler consistently detects flow in a small, slow, poorly angled vessel that color Doppler misses. What property explains this?

A. Power Doppler eliminates the need for adequate insonation angle

B. Power Doppler uses a fundamentally different, higher-frequency transducer

C. Power Doppler automatically increases output when slow flow is detected

D. Amplitude is a more robust signal than frequency shift, less affected by slow flow or angle

94. A technologist chooses color Doppler to assess direction/velocity, then power Doppler on a different exam simply to confirm any flow presence. What does this illustrate?

A. One mode has now completely and permanently replaced the other

B. The two modes display genuinely identical information with different color schemes

C. One mode genuinely requires entirely incompatible transducer hardware

D. Each mode displays a genuinely different aspect of the signal, suiting a different clinical question

95. A duplicated, fainter flow signal appears beyond the diaphragm on a subcostal Doppler view, with no true vessel present at that depth on grayscale. What property of the diaphragm explains this?

A. Its strong, smooth surface, reflecting the beam before and after insonating flow

B. Its irregular, granular reflective texture, similar to a calculus

C. Its genuinely weak reflective properties compared to nearby tissue

D. Its highly scattering acoustic properties, similar to bowel gas

96. A brief color burst fills a broad region unrelated to any vessel, then vanishes once the transducer is held still. What does this represent?

A. A genuine, previously undocumented small vessel becoming visible

B. Twinkle artifact, arising from a nearby granular reflective surface

C. Aliasing, since detected velocity exceeded the Nyquist limit

D. Flash artifact, triggered by tissue or transducer motion rather than true flow

97. A rapidly alternating color signal appears behind a small, echogenic, granular focus that grayscale alone left ambiguous. What does this suggest, and why is it useful?

A. Twinkle artifact, which can help confirm a small calculus difficult to identify on grayscale alone

B. Mirror image artifact, confirming a nearby strong, smooth reflector

C. Flash artifact, confirming recent bulk tissue motion occurred nearby

D. Aliasing, confirming the velocity exceeded the color Nyquist limit

98. An uncertain Doppler finding appears mid-exam. What should be evaluated first, before any console adjustment?

A. The exact model and manufacturer of the transducer used

B. The total number of years of sonographer experience held

C. The exact acoustic output power setting active currently

D. Whether the finding is physiologically plausible given the actual anatomy present

99. A renal study evaluating end-diastolic flow uses an excessively high wall filter, in a vessel known for genuinely low-velocity diastolic flow. What is the most likely consequence?

A. The system automatically lowers the wall filter to compensate

B. The sample volume automatically repositions to a new depth

C. Aliasing artifact becomes substantially more pronounced

D. Genuine low-velocity diastolic flow may be removed along with the intended clutter

100. A pancreatic head exam shows a small, bright, alternating color signal directly behind a tiny echogenic focus that grayscale alone couldn't confidently call a stone. This is correctly identified as twinkle artifact. What should happen next?

A. Switch specifically and exclusively to continuous wave Doppler instead

B. Immediately and permanently discontinue the entire Doppler exam

C. Generally no correction is needed, since it is often useful, though ruling out a separate finding matters

D. Ensure it is completely eliminated before the exam is genuinely complete

101. A spectral tracing on a difficult patient appears thin and washed out, with the peak barely distinguishable from noise. Which adjustment addresses this?

A. Increase spectral gain to strengthen the genuine underlying signal

B. Increase the currently selected wall filter threshold

C. Decrease the currently selected PRF substantially

D. Enlarge the currently selected sample volume substantially

102. A Doppler artifact was present in images but caused no downstream clinical consequence. What single factor explains why no harm resulted?

A. The artifact was recognized and documented correctly, rather than reported as genuine pathology

B. The specific transducer frequency used during acquisition

C. Whether color or power Doppler was the specific mode used

D. The mere physical presence of the artifact, regardless of recognition

103. A color signal briefly fills a broad region, then vanishes on the very next frame, with no deliberate motion introduced. What characteristic most strongly points to artifact?

A. Its overall color intensity was brighter than nearby genuine signals

B. Its location happened to be close to the transducer face

C. Its color pattern included a mixture of red and blue hues

D. Its brief, single-frame, transient nature, consistent with motion-triggered flash artifact

104. A vascular report cites a resistive index of 0.80 for a specific segment. Which two waveform values was this calculated from?

A. The Nyquist limit and PRF

B. Sample volume size and angle of insonation

C. Peak systolic velocity and end-diastolic velocity

D. Transducer frequency and wall filter setting

105. A new graduate assumes mastering grayscale artifact recognition alone fully prepares them for Doppler artifacts. Why is this mistaken?

A. Doppler artifacts occur only when grayscale imaging has been switched off

B. Doppler artifacts are corrected using identical techniques to every grayscale artifact

C. Doppler artifacts do not genuinely occur at all in real clinical scanning

D. Doppler artifacts introduce genuinely new failure modes tied to frequency-shift, motion, and color assignment

106. A trainee is told to treat an ambiguous color Doppler finding with more caution than an equally ambiguous grayscale finding. Why?

A. Doppler findings cannot be documented in the same reporting systems

B. Doppler displays are read as representing genuine motion, so an artifact risks mimicking real pathology

C. Doppler findings are permanently retained in a way grayscale findings are not

D. Doppler artifacts always require immediate termination of the exam

107. A transducer is repositioned specifically to disrupt a suspected artifact's geometry, yet the finding persists unchanged. What is the most reasonable interpretation?

A. The finding may be genuine and unusual rather than the artifact originally suspected

B. No further reasoning is needed once any technique change is attempted

C. Acoustic output should be substantially increased until it disappears

D. The technique change alone definitively confirms the artifact

108. Before signing off a Doppler study, a sonographer runs a brief self-check: labels, matched technique, documented limitations. What is the genuine value of this habit?

A. It is required only for facilities using an older, legacy PACS

B. It has no genuine bearing on quality once images are acquired

C. It exists purely to extend total exam length for scheduling

D. It separates documentation that serves every reader from documentation that only looks complete

109. Why is documentation described as 'completing' the instrumentation chain rather than a separate, add-on topic?

A. Instrumentation controls automatically generate correct documentation on their own

B. Documentation only genuinely matters once formal litigation becomes involved

C. Documentation is entirely unrelated to the instrumentation controls covered

D. A perfectly optimized live image has no lasting diagnostic value unless also saved, measured, and labeled correctly

110. A radiologist reviewing serial studies of a thyroid nodule stresses that follow-up sonographers must scan it 'exactly the way it was scanned the first time.' Which specific practice does this instruction most directly support?

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

B. Measuring only once, without reference to how the prior study was actually measured

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

D. Using whichever measurement technique is genuinely fastest, regardless of the prior technique

Answers

1. B. 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 an obstetric-only rule, a transducer-heat rule, or something irrelevant once the image is captured.

2. D. TI (thermal index) specifically predicts tissue heating risk, while MI (mechanical index) predicts the likelihood of a mechanical bioeffect such as microbubble collapse (cavitation); PRF and TGC are unrelated display/timing parameters, not bioeffect indices.

3. C. The rapid, 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. Skipping review of a prior comparable study risks missing the opportunity to use matched, comparable technique for detecting genuine interval change, a real clinical consequence distinct from a billing, sign-off, or equipment-related issue.

5. B. Phantom testing verifies genuine system performance parameters, such as depth calibration and resolution, against a known standardized reference, a real technical check, not a substitute for service contracts, a purely administrative box to check, or sonographer-specific calibration.

6. C. Openly acknowledging genuine unfamiliarity and involving a more experienced colleague or referring appropriately is the professionally sound response, unlike silent omission, proceeding without disclosure, or a permanent refusal that ignores future training.

7. B. Transducer disinfection directly reduces the risk of transmitting infectious organisms between patients via a shared contact surface, a genuine patient-safety measure, not limited to endocavitary probes, and not merely a paperwork or irrelevant formality.

8. B. This documentation 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, blanket liability protection, or contingent on a specific physician request.

9. C. 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 feature disabling, or unrelated algorithmic documentation.

10. B. 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 defaulting to an unrelated protocol, a maximally broad survey, or refusing the order outright.

11. D. Tracking documented technical limitations reflects how consistently genuine limitations are being flagged for interpreting physicians, a real diagnostic-completeness signal, not a pure efficiency metric, an automatic quality indictment, or something with no bearing on diagnostic quality.

12. C. Since propagation speed equals frequency times wavelength, holding speed fixed and doubling frequency requires wavelength to be halved to satisfy that relationship.

13. B. A slower true propagation speed means the echo returns later than the 1,540 m/s assumption predicts, so the system calculates and displays the structure deeper than its true depth.

14. B. Total attenuation results from absorption, scattering, and reflection acting together, each removing energy from the main beam; no single mechanism alone accounts for it.

15. A. Acoustic impedance is the mathematical product of a tissue's density and its propagation speed of sound, a property of the tissue itself, not attenuation/frequency, echogenicity/depth, or thermal properties.

16. B. A larger acoustic impedance mismatch at a boundary 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. C. Resolution measured along the beam's own direction of travel is axial resolution, most directly determined by spatial pulse length; a shorter pulse improves axial resolution.

18. D. Mirror image artifact occurs when the beam reflects off a strong, smooth, curved reflector such as the diaphragm, displaying genuine liver parenchyma as a fainter, duplicated copy at an equidistant position on the far side of that reflector.

19. B. 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 compared to adjacent solid tissue.

20. C. A refraction calculation requires the angle of incidence and the ratio of propagation speeds between the two media, per Snell's law, distinct from impedance, intensity, or element geometry.

21. A. Reverberation artifact produces equally spaced, progressively fainter parallel bands when the beam bounces repeatedly between two strong, closely spaced reflectors before finally returning, each bounce interpreted as a progressively deeper structure.

22. C. 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, a propagation speed artifact, distinct from reverberation, a frequency mismatch, or element spacing.

23. A. Higher frequency improves axial resolution (shorter pulse length) but attenuates more rapidly, reducing achievable penetration — the well-established trade-off; frequency is not irrelevant, and lower frequency does not improve axial resolution.

24. C. The out-of-plane, third dimension of a 2D-derived volume is elevational resolution, the slice-thickness dimension perpendicular to the original imaging plane, distinct from axial, lateral, or temporal resolution.

25. C. Refraction, the bending of the beam's path, specifically requires an oblique boundary between media with differing propagation speeds — exactly the condition described — not a perpendicular angle, a fluid-specific exclusion, or an added impedance-matching requirement.

26. A. Spatial pulse length directly governs axial resolution; shortening it improves the ability to distinguish two structures lying along the beam's direction of travel, distinct from lateral beam width, slice thickness, or frame rate.

27. B. 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 between the two media.

28. B. This bidirectional relationship, mechanical deformation producing voltage and applied voltage producing deformation, is the piezoelectric effect, the foundational principle of transducer transmission and reception.

29. D. Exceeding the Curie point permanently and irreversibly destroys a piezoelectric crystal's functional properties, a genuine hazard during high-temperature sterilization, distinct from storage temperature, peak sensitivity, or an unrelated threshold.

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 related to reduced bandwidth, distinct from housing, matching layer, or lens.

31. D. A probe that physically oscillates a single element to sweep the beam and build each frame is a mechanical sector transducer, unlike linear, curvilinear, or phased arrays, all of which steer electronically with no physical movement.

32. B. The matching layer is specifically positioned between the crystal and skin to reduce the significant impedance mismatch, improving acoustic energy transmission efficiency, distinct from the backing layer, the crystal itself, or the housing.

33. A. The annular array's concentric ring geometry achieves symmetric electronic focusing in both planes simultaneously, but genuinely still requires mechanical steering to actually sweep the beam and form an image.

34. C. 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 (Fraunhofer zone).

35. C. Widening the aperture (element diameter), holding frequency constant, increases near field length and pushes the beam's natural focus further from the transducer face, a direct geometric relationship distinct from wavelength, PRF, or dynamic range.

36. A. Electronic steering added specifically in the elevational plane, alongside the azimuthal steering every array already provides, is what enables sweeping through multiple planes without physical probe movement.

37. B. Bandwidth describes the range of frequencies contained within the transmitted pulse, directly tied to pulse length and damping quality, not physical footprint, depth, or element count.

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, not a regulatory, cost, or physical-fit explanation.

39. B. Precisely timed firing delays across individual elements, producing an angled wavefront through constructive interference, is the genuine mechanism behind phased array beam steering, without any physical movement.

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. B. 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. D. A curvilinear probe's curved element arrangement produces a wider field of view at depth than a comparable linear probe, while keeping a reasonably manageable footprint; both use electronic steering, so that is not the distinguishing advantage.

43. D. 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. C. 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, unlike TGC, the matching layer, or a frequency mismatch.

45. C. Electronic focusing uses precisely timed firing delays across an array's elements to converge the beam at a chosen depth, allowing instant adjustment with no physical movement, unlike a fixed lens, fixed zone, or frequency-based approach.

46. B. 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, not identical, reversed, or output-power-related.

48. D. 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, unlike read zoom, gain, or dynamic range adjustment.

49. D. A wide dynamic range setting preserves gray-scale gradation for texture, but trades away contrast at any sharp boundary elsewhere in the image, the genuine trade-off, unrelated to output, TGC availability, or frame rate.

50. A. Coded excitation transmits a longer, structured pulse and compresses it during receive-side processing, achieving stronger signal without raising transmitted acoustic output, unlike a frequency change, aggressive TGC, or depth reduction.

51. C. Tissue harmonic imaging specifically filters out the fundamental frequency and processes harmonic frequencies generated within tissue, reducing near-field clutter, distinct from spatial compounding, persistence, or frequency compounding.

52. A. High persistence averages several sequential frames together to reduce noise, but this same averaging smooths and blurs genuinely rapid cardiac motion, unlike depth, TGC, or frequency, none of which produce this specific artifact.

53. A. Extended field of view specifically stitches sequential images into a panoramic composite wider than any single footprint, directly addressing an elongated vein exceeding one field of view.

54. C. 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, not a different technique or reduction in dimensions.

55. C. 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, genuine cross-manufacturer interoperability.

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. C. A laterality error can lead directly to the wrong side of the body being biopsied, treated, or monitored, a genuine, elevated patient-safety concern, not a frequency, administrative, or billing-only issue.

58. B. A sample volume near 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 result.

59. A. Triplex display must simultaneously update three distinct streams, grayscale, spectral Doppler, and color Doppler, rather than the two duplex updates, directly raising processing demand and lowering frame rate.

60. B. 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. D. 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, not a beam-blocking, caliper-degradation, or automatic-frequency issue.

62. B. 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. B. Because lateral resolution is sharpest at the focal zone and degrades with distance, a mass sharp at one edge and blurred at a deeper edge most plausibly reflects focal zone placement.

64. A. Frequency compounding reduces speckle by averaging multiple transmitted frequencies rather than multiple frames over time, making it more motion-tolerant than persistence for a moving structure.

65. D. PACS is the networked digital infrastructure for storing, retrieving, and distributing images across departments; DICOM is the format/protocol operating within it, distinct from a single device or obsolete approach.

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. B. Confident, specific labeling is genuinely justified by a structure's relationship to reliable anatomic landmarks, such as its course relative to the pancreas and splenic hilum, not manufacturer, display settings, or general experience alone.

68. A. 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. D. PACS is the networked archiving and retrieval system; DICOM is the standardized format and protocol enabling images to move correctly within that network, genuinely distinct, complementary concepts.

70. A. Spatial compounding combines multiple beam angles 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. D. Confident, specific labeling is genuinely justified by a structure's relationship to reliable, consistently positioned anatomic landmarks, such as its course relative to the portal vein and porta hepatis, 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. C. An image globally too dim, not dim only at a specific depth range, points most directly to overall gain, the uniform amplification step, rather than focal zone, transducer/frequency, or TGC specifically.

75. D. Each technique addresses a genuinely different, specific limitation, field size, angle-dependent definition, or genuine spatial dimensionality, so the correct choice depends on the exam's actual limitation.

76. C. Lateral resolution is genuinely best directly at the focal zone and worsens with distance from it, so a structure sharp at one depth and blurred at a different depth within the same image most likely reflects focal zone placement, not a malfunction, TGC issue, or reverberation artifact.

77. C. A returning frequency below the transmitted frequency is a negative Doppler shift, indicating flow moving away from the transducer; a positive shift would indicate flow toward it.

78. A. 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. C. By standard convention, flow moving toward the transducer (a positive shift) displays above the baseline, consistent with this tracing; flow away would display below.

80. C. Cosine's sensitivity to a given angle-placement error worsens sharply as the angle approaches 90 degrees, making measurement increasingly unreliable at 80-85 degrees, not a hard cutoff or regulatory rule.

81. A. 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 before the next pulse can be transmitted.

82. C. The Nyquist limit is mathematically exactly half the current PRF, directly determining the maximum velocity accurately displayable without aliasing at that setting.

83. D. 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.

84. B. Increasing PRF directly raises the Nyquist limit; once it exceeds the true velocity, aliasing resolves without altering the actual flow being measured.

85. C. Pulsed wave Doppler's defining advantage is genuine spatial specificity, isolating flow to one precisely chosen depth, in contrast to continuous wave Doppler's own unlimited-velocity-range advantage without depth-selectivity.

86. B. A dedicated two-element, simultaneously-active design is the defining feature of continuous wave Doppler, eliminating the sampling interval responsible for the Nyquist limit and providing an unlimited velocity range.

87. B. The inability to determine which depth along the beam a detected signal originates from is range ambiguity, a genuine, defining limitation of continuous wave Doppler's continuous, non-depth-selective reception.

88. A. 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; the other options do not resolve this physical limitation.

89. A. A resistance index is calculated directly from peak systolic velocity and end-diastolic velocity, the two values measured directly from the waveform.

90. D. Sharp systolic upstroke with essentially absent diastolic flow is the characteristic high-resistance pattern, like resting skeletal muscle, the opposite of a low-resistance bed like the kidney or brain.

91. C. Color hue on a standard color Doppler display primarily encodes flow direction relative to the transducer; vessels flowing oppositely display in different colors even at similar speeds.

92. A. An abrupt color change without a genuine flow direction change is the color Doppler equivalent of spectral aliasing, occurring when true velocity exceeds the current color scale's Nyquist limit — consistent with the stem's own statement that no true branch point exists there.

93. D. Because amplitude is a more robust underlying signal than a precisely measured frequency shift, power Doppler is genuinely less affected by slow flow or a poor angle than color Doppler, which depends on detecting a directional shift.

94. D. Color and power Doppler each display a genuinely different aspect of the underlying signal, direction/velocity versus amplitude, suiting a genuinely different clinical question, not one replacing the other.

95. A. The diaphragm's strong, smooth reflective surface reflects the beam both before and after it insonates true flow, producing mirror image artifact, not the texture of a calculus, weak reflection, or scattering behavior.

96. D. A brief color burst unrelated to any genuine vessel, resolving once motion stops, is flash artifact, specifically triggered by motion rather than true blood flow.

97. A. 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. D. Before any instrument adjustment, assessing whether a finding is physiologically plausible given the actual anatomy present is the single most useful first screening step.

99. D. An excessively high wall filter threshold removes signal below it indiscriminately, meaning genuine low-velocity diastolic flow of real clinical interest can be removed along with intended clutter.

100. C. 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, rather than requiring a mode switch, discontinuation, or forced elimination.

101. A. A thin, washed-out waveform with a barely distinguishable peak points to underset spectral gain; increasing spectral gain strengthens the genuine signal, unlike wall filter, PRF, or sample volume adjustment.

102. A. Genuine diagnostic harm depends specifically on whether an artifact was recognized and documented correctly, versus mistakenly reported as pathology, not the artifact's mere presence, frequency, or mode.

103. D. A finding present for only a single transient frame is most consistent with flash artifact, characteristically resolving within a frame or two once triggering motion stops.

104. C. The resistive index is calculated directly from peak systolic velocity and end-diastolic velocity, the two values measured from a spectral waveform.

105. D. Doppler artifacts introduce genuinely new failure modes tied specifically to frequency-shift processing, motion detection, and color assignment, none with a direct grayscale equivalent.

106. B. 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. A. A finding that fails to resolve despite a technique change specifically expected to disrupt the suspected mechanism deserves reconsideration as possibly genuine and unusual, not automatic confirmation.

108. D. This brief self-check separates documentation that reliably serves every future reader from documentation that merely appears complete but leaves genuine ambiguity.

109. D. A perfectly optimized live image has no lasting diagnostic value unless also saved, measured, and labeled correctly, since future clinicians depend entirely on that record, directly completing the instrumentation chain.

110. C. Matching the exact measurement technique used previously, including caliper edge placement and plane, is what allows genuine interval change to be detected accurately rather than confounded by a technique-driven artifact, precisely what the radiologist's instruction is protecting against.