

COMPREHENSIVE MOCK EXAM 14

Supplemental to: Ultrasound Physics Board Review 2026-2027

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ARDMS SPI (Sonography Principles & Instrumentation) Examination, Inteleos — 110 questions, single-best-answer, four options (A-D), domain-weighted per official ARDMS SPI Content Outline (v17.3)

Board-Review Questions

- 1.** Before beginning a scheduled ultrasound exam, confirming the correct laterality (right vs. left) against the order is a safety check aimed primarily at preventing which error?
 - A.** Excessive total scan duration
 - B.** Selection of an incorrect transducer frequency
 - C.** Failure to obtain a signed consent form
 - D.** A wrong-site exam performed on the incorrect side

- 2.** A sonographer explains to a worried patient that ultrasound differs from x-ray/CT primarily because ultrasound:
 - A.** Uses non-ionizing sound energy, not ionizing radiation
 - B.** Uses a lower dose of the same ionizing radiation
 - C.** Uses ionizing radiation only in Doppler mode
 - D.** Uses ionizing radiation only for 3D/4D acquisition

- 3.** A sonographer notices the shared gel bottle at a workstation is refilled from a large communal container without documented cleaning between refills. This practice raises which specific concern?
 - A.** Excessive gel viscosity affecting image quality
 - B.** Cross-contamination risk via the gel dispenser
 - C.** Increased risk of transducer element damage
 - D.** Reduced accuracy of TGC calibration

- 4.** A facility implementing password-protected, encrypted access to its networked ultrasound systems is primarily addressing which safety domain?
 - A.** Sterile technique for invasive procedures
 - B.** Cybersecurity and protection of patient data
 - C.** Bioeffects and ALARA compliance

D. Transducer element-integrity QA

5. Expired ultrasound coupling gel or contrast agent found in stock should be handled according to which principle?
- A. Continued use as long as the bottle appears full**
 - B. Use only for non-invasive exams regardless of expiration**
 - C. Dilution with saline to extend its usable life**
 - D. Proper disposal per facility/manufacturer expiration and waste policy**
6. For a transvaginal exam, positioning the patient to reduce aspiration risk is most relevant in which specific clinical scenario?
- A. A patient who is heavily sedated or has an altered level of consciousness**
 - B. Every transvaginal exam regardless of patient status**
 - C. Only patients under general anesthesia in an OR setting**
 - D. Only pediatric patients undergoing any pelvic imaging**
7. Before starting a clinical exam, confirming that the ultrasound system's software is running the currently validated version (not a pending, untested update) primarily protects against which risk?
- A. Unexpected behavior from an unvalidated software state**
 - B. Increased risk of transducer element burnout**
 - C. Reduced disinfectant efficacy on the probe**
 - D. Improper patient billing code assignment**
8. A formal Root Cause Analysis (RCA) following a significant safety event differs from a routine periodic QA review primarily in that RCA is:
- A. A scheduled, calendar-based review of general department performance**
 - B. Conducted only by external regulatory inspectors, never internal staff**

- C.** A focused, event-triggered investigation into the specific contributing factors of one incident
- D.** Required solely for billing compliance, not patient safety

9. When an exam proves technically limited despite reasonable effort, the appropriate next step is generally to:

- A.** Document the limitation clearly and communicate it to the interpreting physician rather than force completion
- B.** Continue indefinitely until every standard view is obtained regardless of image quality
- C.** Fabricate placeholder measurements to complete the worksheet
- D.** Discharge the patient without any documentation of the limitation

10. Before scanning, a sonographer checks that the ordering provider's stated clinical indication reasonably matches the exam that has been scheduled. This check primarily helps ensure:

- A.** The patient's insurance will definitely cover the exam
- B.** The exam will be completed faster than average
- C.** The sonographer's individual productivity metric improves
- D.** The correct exam is being performed for the patient's actual clinical question

11. A sonographer notices a patient appears anxious and asks several questions about what the exam will involve. The most appropriate response is to:

- A.** Tell the patient no explanation can be provided until the physician arrives
- B.** Proceed silently without addressing the patient's questions
- C.** Provide a detailed clinical interpretation of expected findings
- D.** Briefly explain the exam process in plain language to help ease the patient's concern

12. A pulse has a duty factor of 0.002 and a PRF of 5,000 Hz. Approximately how many cycles occur in one pulse at a transducer frequency of 4 MHz?

- A.** About 16 cycles

- B.** About 0.16 cycles
- C.** About 1.6 cycles
- D.** About 160 cycles

13. At a soft-tissue/muscle interface, roughly what percentage of incident intensity is transmitted, given the two media have relatively close acoustic impedance values?

- A.** Roughly half the intensity is transmitted
- B.** Nearly all the intensity is reflected, very little transmitted
- C.** Exactly 50% is reflected and 50% transmitted in every case
- D.** A large majority (well over 90%) of the intensity is transmitted

14. Intensity ratios use $10 \cdot \log$ while amplitude/pressure ratios use $20 \cdot \log$ in decibel notation. This distinction exists because:

- A.** The 20 multiplier is an outdated convention
- B.** Intensity's square relationship to amplitude doubles the log multiplier
- C.** Amplitude ratios are never expressed in decibels
- D.** The 10 vs 20 choice is arbitrary and interchangeable

15. At an equal displayed Thermal Index (TI) value, which tissue type generally experiences the greatest actual temperature elevation?

- A.** Soft tissue, due to its higher water content
- B.** Bone, due to its higher absorption of ultrasound energy
- C.** Fluid-filled structures, due to low attenuation
- D.** All tissue types experience identical elevation at equal TI

16. The near field of an unfocused ultrasound beam shows relatively complex intensity variation because:

- A.** The beam has not yet begun propagating
- B.** Attenuation is uniquely absent in the near field
- C.** Interference between wavelets creates constructive/destructive zones
- D.** The transducer is still physically vibrating throughout

17. The far-field beam divergence angle for a circular transducer is approximately proportional to which relationship?

- A.** Aperture diameter divided by wavelength
- B.** Wavelength divided by aperture diameter
- C.** Frequency multiplied by aperture diameter
- D.** Propagation speed divided by aperture diameter

18. An acoustically 'matched load,' where two adjacent media have identical impedance, produces which outcome at their interface?

- A.** Complete reflection of all incident energy
- B.** Exactly 50% reflection regardless of angle
- C.** Essentially no reflection; nearly all energy is transmitted
- D.** Total absorption of all incident energy at the boundary

19. Which expression correctly isolates velocity from a known Doppler shift, transmit frequency, propagation speed, and angle?

- A.** Velocity equals shift divided by propagation speed, times twice the transmit frequency
- B.** Velocity equals transmit frequency divided by shift, times propagation speed
- C.** Velocity equals shift times transmit frequency, divided by propagation speed
- D.** Velocity equals shift times propagation speed, divided by twice the transmit frequency times cosine of the angle

20. Fractional bandwidth, calculated as bandwidth divided by center frequency, is used to characterize a transducer primarily as:

- A.** An absolute measure of maximum penetration depth
- B.** A direct measure of the transducer's footprint size
- C.** A relative measure distinguishing broadband from narrowband design
- D.** A measure exclusive to continuous-wave probes

21. SPTA (spatial-peak temporal-average) intensity combines which two underlying measurements?

- A.** The lowest-intensity point in the beam, averaged only during active transmission
- B.** The highest-intensity point in the beam, averaged over the full pulse repetition period including quiet time
- C.** The highest-intensity point, averaged only during active transmission (equivalent to SPTP)
- D.** The average intensity across the entire beam cross-section, at a single instant in time

22. Bioeffect risk assessment relies primarily on measures of acoustic intensity rather than pressure alone because:

- A.** Intensity reflects cumulative energy delivery, driving heating/bioeffects
- B.** Pressure cannot be measured with any equipment
- C.** Pressure and intensity are mathematically identical
- D.** Intensity is easier to display, with no biological relevance

23. Given a propagation speed of 1580 m/s and a transducer frequency of 4 MHz, what is the approximate wavelength?

- A.** About 0.40 mm
- B.** About 4.0 mm
- C.** About 0.20 mm
- D.** About 1.58 mm

- 24.** Acoustic power (watts) differs from acoustic intensity (W/cm^2) in which way?
- A.** Power and intensity are two names for one measurement
 - B.** Power is total beam energy rate; intensity normalizes it per area
 - C.** Power applies only to Doppler; intensity only to B-mode
 - D.** Intensity is always numerically larger than power
- 25.** Given an axial resolution of 0.5 mm from a pulse containing 3 cycles, what is the approximate wavelength?
- A.** About 1.5 mm
 - B.** About 0.17 mm
 - C.** About 0.33 mm
 - D.** About 3.0 mm
- 26.** In a dispersive medium where propagation speed varies slightly with frequency, harmonic imaging's timing characteristics can be subtly affected because:
- A.** Harmonic imaging is impossible in a dispersive medium
 - B.** Dispersion eliminates the fundamental frequency entirely
 - C.** Dispersion affects only CW Doppler, never pulsed harmonic imaging
 - D.** The harmonic component may propagate at a slightly different speed
- 27.** Which statement correctly describes a key difference between acoustic amplitude and acoustic intensity as physical quantities?
- A.** Amplitude and intensity are always numerically identical
 - B.** Amplitude can be negative; intensity is not expressed as negative
 - C.** Intensity is measured in dB; amplitude has no valid unit
 - D.** Amplitude applies only to Doppler, never standard B-mode

28. A regulatory-compliance usage-log feature tracking cumulative hours of clinical use built into a transducer is primarily intended to support:

- A.** Real-time adjustment of the transducer's transmitted frequency
- B.** Lifecycle/maintenance tracking and eventual retirement planning for the device
- C.** Automatic disinfection scheduling with no operator input needed
- D.** Direct calculation of patient billing charges

29. Grounding a floating shield plane within a transducer's internal wiring primarily helps reduce which issue?

- A.** Physical wear on the acoustic lens surface
- B.** Reduced maximum achievable frame rate
- C.** Increased risk of Curie-point depoling
- D.** Cross-talk interference between adjacent elements or channels

30. Coupling gel viscosity, apart from its role in infection control, primarily affects image quality through which mechanism?

- A.** Directly altering the transducer's resonant frequency
- B.** Maintaining consistent, air-gap-free acoustic contact between the transducer and skin
- C.** Changing the propagation speed assumed by the system's software
- D.** Increasing the transducer's maximum bandwidth

31. Periodic recalibration against a reference tissue-mimicking phantom, distinct from simple element-dropout testing, is primarily intended to detect which issue?

- A.** Gradual drift in transducer sensitivity or accuracy
- B.** Sudden complete failure of a single element
- C.** Physical cracking of the transducer housing
- D.** Incorrect patient demographic data entry

32. A '1.75D' array design is best understood as an intermediate step between which two other array types?

- A.** Between a linear array and a curvilinear array, in footprint shape
- B.** Between a 1.5D array and a full 2D matrix array, in elevational steering capability
- C.** Between a phased array and an annular array, in steering mechanism
- D.** Between a CW probe and a pulsed imaging probe, in transmission mode

33. Handheld, battery-powered pocket ultrasound devices generally accept greater tradeoffs in which area, compared to full-size cart-based systems, due to power constraints?

- A.** Patient safety output limits, which are relaxed for portable devices
- B.** The fundamental physics of sound propagation in tissue
- C.** Basic B-mode imaging capability, which portable devices generally lack entirely
- D.** Processing power and some image-quality refinements

34. A transducer that will not initialize on a particular system, despite functioning normally on another system from the same manufacturer, most likely reflects which issue?

- A.** A compatibility mismatch with that system's software version
- B.** A universal failure affecting every transducer of that model
- C.** Deliberate output-power throttling unrelated to compatibility
- D.** A patient-safety recall affecting the probe worldwide

35. Repeated high-level disinfection cycles can gradually degrade which specific transducer component, potentially affecting image quality over the device's lifespan?

- A.** The acoustic matching layer or lens material, through chemical exposure over time
- B.** The internal digital circuitry, through purely mechanical wear
- C.** The system console's monitor, unrelated to probe disinfection
- D.** The patient's own skin, through repeated gel exposure

36. A transducer connector containing embedded identification circuitry that automatically informs the system of the probe's model and capabilities represents which mechanism, distinct from an external optical barcode label?

- A.** A manually entered probe-model dropdown menu on the console
- B.** A visual color-coded cable jacket the operator must interpret
- C.** A separate handheld barcode scanner device required each use
- D.** Electronic auto-identification via the connector's internal circuitry

37. Piezoelectric material subjected to repeated moderate thermal cycling, even without ever reaching the Curie point in any single event, can experience which cumulative effect over time?

- A.** Gradual reduction in piezoelectric performance from accumulated thermal stress
- B.** No effect whatsoever, since only a single Curie-point event matters
- C.** Immediate, complete depoling after the very first thermal cycle
- D.** Permanent improvement in sensitivity from repeated heating

38. A handle material selected specifically for its smooth, non-porous surface on an ultrasound transducer is chosen primarily to support which goal?

- A.** Improved acoustic coupling to the patient's skin
- B.** Reduced overall transducer manufacturing cost in every case
- C.** Increased maximum operating frequency of the crystal
- D.** Effective cleaning and disinfection between patient uses

39. The curing process of the epoxy or adhesive bonding layers within a transducer's acoustic stack, if improperly controlled during manufacturing, most directly risks which downstream problem?

- A.** Immediate, complete loss of the transducer's electrical grounding
- B.** A permanent shift in the system's software version
- C.** Delamination or bond-layer failure affecting acoustic transmission efficiency

D. Automatic voiding of the patient's informed consent

40. A transducer's internal electronic noise floor is significant primarily because it affects which capability?

- A.** The transducer's maximum physical operating temperature limit
- B.** The system's ability to detect and display genuinely weak returning signals
- C.** The disinfection-cycle-count limit assigned to that probe model
- D.** The transducer's compatibility with a specific cable length

41. A dedicated Doppler-only transducer is often designed with a lower typical operating frequency range than a comparable imaging transducer primarily because:

- A.** Lower frequencies are required for any B-mode image
- B.** Lower frequencies reduce aliasing and improve deep-vessel penetration
- C.** Doppler transducers cannot generate frequencies above 2 MHz
- D.** Frequency has no bearing on Doppler transducer design

42. A transducer 'sweet spot' — the region of the active face producing the most consistent image quality — is a consideration primarily relevant to which scanning technique?

- A.** Selecting the correct disinfectant for that probe
- B.** Determining the transducer's maximum safe depth
- C.** Calculating the transducer's fractional bandwidth
- D.** Consistent positioning to use the best-performing region

43. A transmit/receive (T/R) switch within transducer-associated circuitry serves which specific function?

- A.** Physically switching between two different transducer frequencies
- B.** Protecting sensitive receive electronics from the much higher-voltage transmit pulse

- C. Automatically selecting the correct patient exam preset
- D. Controlling the on-screen depth marker display

44. Per-element sensitivity calibration, performed during transducer manufacturing or periodic QA, is intended to correct for which issue?

- A. A single dead element that has stopped functioning
- B. Natural sensitivity variation across individual elements
- C. The system's overall gain setting chosen by the operator
- D. The patient's individual body habitus

45. A transducer's connector containing a color-coded ring, distinct from an electronic ID chip, primarily serves which practical purpose?

- A. Electrically isolating the transducer from the system entirely
- B. Automatically calibrating the acoustic output power
- C. Quick visual identification of probe type by operators during a busy workflow
- D. Serving as a required sterilization indicator strip

46. Simultaneous acquisition of B-mode and color Doppler information along overlapping beam paths generally results in which system tradeoff?

- A. Increased frame rate compared to either mode acquired independently
- B. No change in frame rate compared to B-mode alone
- C. Complete elimination of the need for a dedicated color box
- D. Reduced overall frame rate compared to either mode acquired independently

47. A saved, patient-specific imaging preset that automatically restores a sonographer's preferred depth, gain, and TGC settings on a repeat exam serves which primary purpose?

- A. Improving workflow efficiency and consistency for follow-up studies on the same patient

- B.** Automatically diagnosing interval change without operator review
- C.** Replacing the need for any fresh image optimization
- D.** Permanently locking those settings for every future patient

48. An adjustable opacity/blending slider for an elastography color overlay on top of the underlying B-mode image allows the operator to:

- A.** Change the actual measured stiffness value of the tissue
- B.** Balance visibility of the elastography data against the underlying grayscale anatomy
- C.** Switch the exam from elastography to standard B-mode permanently
- D.** Increase the mechanical push-pulse strength used for acquisition

49. An on-screen warning that automatically appears when part of the displayed image has become saturated (pure white, clipped) is intended to alert the operator to:

- A.** A hardware failure requiring immediate probe replacement
- B.** A patient safety event requiring the exam to stop immediately
- C.** Excessive gain or output causing loss of true image detail in that region
- D.** An error in the stored patient demographic information

50. A live histogram display showing the distribution of brightness values across the current image is a tool primarily used to:

- A.** Automatically calculate the patient's estimated fetal weight
- B.** Directly measure blood flow velocity within the image
- C.** Replace the need for any caliper-based measurement
- D.** Help the operator judge whether gain/dynamic range settings are well balanced

51. A worksheet feature that automatically populates report fields directly from the measurement values captured during the exam serves primarily to:

- A.** Automatically generate the physician's final diagnostic impression
- B.** Eliminate the need for the sonographer to perform any measurements
- C.** Reduce manual transcription errors between the worksheet and the final report
- D.** Guarantee every measurement is clinically normal

52. A configurable default imaging preset that automatically loads based on the scheduled exam type at system startup primarily benefits workflow by:

- A.** Eliminating the need to select a transducer for the exam
- B.** Automatically completing the entire exam without an operator
- C.** Ensuring every patient receives an identical exam duration
- D.** Reducing setup time by starting closer to appropriate settings for that exam type

53. Switching between a left/right orientation convention and a superior/inferior orientation convention on the display is most relevant for which type of imaging?

- A.** Every exam performed in the department, without exception
- B.** Only exams performed on pediatric patients
- C.** Only exams using a curvilinear transducer
- D.** Certain specialized views with a non-standard convention

54. An automatic audible alert triggered when a transducer's surface temperature approaches its safety limit is intended primarily to prevent which outcome?

- A.** Damage to the ultrasound system's power supply
- B.** Loss of the current exam's saved images
- C.** Patient skin discomfort or thermal injury from prolonged probe contact
- D.** Incorrect patient billing for the exam performed

55. An automatically generated sparkline (small trend graphic) showing a measurement's change across multiple prior exams, displayed directly within the current worksheet, is primarily useful for:

- A.** Automatically diagnosing the cause of any observed change
- B.** Replacing the need to document the current numeric value at all
- C.** Calculating a statistically significant p-value for the observed change
- D.** Quickly visualizing a trend without needing to open each individual prior report

56. A live cine-review scrub bar showing the current frame number out of the total captured frames allows the operator to:

- A.** Automatically identify the single best diagnostic frame with no review needed
- B.** Permanently delete all frames except the currently displayed one
- C.** Precisely navigate to and select a specific frame within a captured cine loop
- D.** Change the original acquisition frame rate retroactively

57. A dual live B-mode display allowing two windows to each have independently adjustable TGC settings is most useful when:

- A.** The two windows must always show identical settings for consistency
- B.** Comparing two structures or regions that have meaningfully different attenuation characteristics
- C.** Only one window can ever be actively adjusted at any given time
- D.** TGC has no relevance in a dual-window display configuration

58. A configurable auto-freeze timeout, which automatically freezes the live image after a period of scanning inactivity, primarily serves which purpose?

- A.** Automatically completing the worksheet after timeout
- B.** Preventing the system from ever being unfrozen again
- C.** Guaranteeing every captured image is diagnostic quality
- D.** Reducing exposure time during idle scanning moments

59. Overlaying the exact measurement location from a prior exam onto the current live image is a feature primarily intended to support:

- A.** Automatically transferring the prior numeric value into the current exam without a new measurement
- B.** Eliminating any need to document the current exam's findings
- C.** Converting the current exam into a permanent 3D reconstruction
- D.** More precise, reproducible remeasurement of the same anatomic location over time

60. An automated flag indicating a measurement falls outside two standard deviations of the expected normal range is intended to:

- A.** Automatically confirm the value represents a true pathological finding
- B.** Draw the reviewing physician's attention to a potentially significant outlier value
- C.** Automatically correct the measurement to fall within normal range
- D.** Replace the physician's own clinical judgment entirely

61. A configurable default annotation-label library specific to each exam type primarily helps:

- A.** Generating the physician's clinical impression from labels
- B.** Speeding consistent labeling with exam-relevant preset terms
- C.** Preventing the operator from typing a custom label
- D.** Guaranteeing every image receives at least one label

62. Automatic image reorientation ensuring a curved-array image consistently displays according to a standard anatomic convention, regardless of physical probe rotation, primarily helps prevent which error?

- A.** Left-right or orientation confusion when interpreting the resulting image
- B.** Incorrect Doppler angle-correction calculations
- C.** Reduced maximum imaging depth for that exam

D. Excessive TGC applied automatically by the system

63. A real-time signal-to-noise ratio (SNR) readout displayed during acquisition is a tool primarily intended to help the operator:

- A. Judging whether settings are producing a clean signal**
- B. Automatically diagnosing the underlying pathology**
- C. Replacing the need for any further gain adjustment**
- D. Calculating the patient's cumulative radiation dose**

64. A facility-wide configurable keyboard and footswitch shortcut remapping feature primarily supports which goal?

- A. Standardizing every sonographer's workflow identically**
- B. Letting individuals customize workflow to their preference**
- C. Automatically adjusting the transducer's output power**
- D. Replacing the console entirely with voice-only control**

65. An automated timestamped log entry created each time a QC phantom test is performed serves which primary purpose?

- A. Automatically passing or failing the phantom test without any human review**
- B. Replacing the requirement to perform the phantom test at all**
- C. Adjusting the transducer's frequency based on the test result automatically**
- D. Providing a verifiable, auditable record of ongoing quality-control compliance over time**

66. A live on-screen overlay grid or ruler, used for rough freehand size estimation without formal calipers, is most appropriately used in which situation?

- A. The sole, final documented measurement for the report**
- B. Only when the formal caliper tool is unavailable**

- C. Exclusively for measuring Doppler velocity values
- D. A quick informal impression, confirmed later with calipers

67. A split-screen display comparing two different transducer views of the same anatomic structure, acquired moments apart, is most useful for:

- A. Automatically averaging the two views into one composite measurement
- B. Confirming a finding is consistent and reproducible across different imaging approaches or angles
- C. Doubling the effective frame rate of the live acquisition
- D. Eliminating the need to document either view individually

68. An automated flag noting that a required standard view, per the department's protocol, appears to be missing from the current exam is intended to:

- A. Generating a substitute image from stored 3D data
- B. Canceling the exam and requiring full rescheduling
- C. Prompting the sonographer to obtain the missing view
- D. Replacing the physician's own completeness review

69. A live indicator showing remaining image-storage capacity during a busy clinical day is primarily useful for preventing which workflow disruption?

- A. Automatically deleting the oldest patient's images without warning
- B. Reducing the transducer's maximum achievable frame rate
- C. Changing the patient's scheduled appointment time
- D. Running out of storage space mid-exam, interrupting image capture

70. Adjusting the image compression ratio used for long-term archival storage primarily involves balancing which two competing factors?

- A. Patient safety versus billing accuracy

- B.** Preserved image detail versus required storage space
- C.** Transducer frequency versus penetration depth
- D.** Doppler angle versus measured velocity accuracy

71. A live indicator distinguishing whether the system is currently acquiring standard 2D imaging versus an active 3D/4D volumetric acquisition is primarily useful for:

- A.** Retroactively converting all 2D images into 3D data
- B.** Keeping the operator aware of which mode is active
- C.** Eliminating the need to manually select 3D/4D mode
- D.** Guaranteeing higher quality whenever 3D/4D is active

72. A remote 'control room' display mirroring feature, allowing a supervising sonographer or instructor to view a trainee's live screen from another room, primarily supports which use case?

- A.** Real-time teaching, supervision, or quality oversight without requiring physical presence at the bedside
- B.** Automatically correcting the trainee's scanning technique without any communication
- C.** Replacing the requirement for hands-on clinical training entirely
- D.** Storing the mirrored session as the patient's official permanent medical record

73. An automated flag indicating the system's most recent calibration date has become overdue is intended primarily to prompt which action?

- A.** Automatically shutting the system down until manually overridden by IT
- B.** Ignoring the flag as long as images still appear visually normal
- C.** Scheduling and completing the overdue calibration before continued reliance on quantitative measurements
- D.** Immediately replacing the entire ultrasound system with a new unit

74. A live overlay showing a biopsy needle's predicted trajectory line, calculated before the needle is actually inserted, is primarily intended to help the operator:

- A.** Plan and adjust the approach angle before committing to needle insertion
- B.** Automatically insert the needle to the predicted target without operator control
- C.** Replace the need for any real-time imaging once insertion begins
- D.** Guarantee the needle will reach the intended target with zero adjustment needed

75. Allowing a facility to configure its default measurement display units (e.g., metric vs. a mixed convention) primarily supports which goal?

- A.** Changing the actual physical size of the anatomic structure measured
- B.** Matching institutional or regional reporting conventions and preferences
- C.** Automatically converting historical reports retroactively to the new unit
- D.** Improving the underlying accuracy of the measurement itself

76. A configurable on-screen warning that triggers when current acquisition settings push frame rate below a clinically useful threshold serves which purpose?

- A.** Automatically reverting settings to factory default
- B.** Permanently disabling further line-density increases
- C.** Confirming the exam met every protocol requirement
- D.** Alerting the operator that temporal resolution may be inadequate

77. Given a Doppler shift of 3 kHz from a 5 MHz transmitted beam at a 60-degree angle, in tissue with 1540 m/s propagation speed, which expression correctly calculates the flow velocity?

- A.** $(3000 \times 5,000,000) / (2 \times 1540 \times \cos 60)$
- B.** $(1540 \times \cos 60) / (2 \times 5,000,000 \times 3000)$
- C.** $(3000 \times 1540) / (2 \times 5,000,000 \times \cos 60)$
- D.** $(2 \times 5,000,000 \times \cos 60) / (3000 \times 1540)$

78. Angle-independent techniques such as power Doppler are valued specifically because they avoid which limitation of standard spectral Doppler?

- A.** The requirement for coupling gel during the exam
- B.** The need for a functioning transducer element array
- C.** Steep angle-error sensitivity near 90 degrees
- D.** The requirement to freeze the image before measurement

79. Resistance indices such as RI and PI are calculated for arterial waveforms but are not typically applied to normal venous waveforms because:

- A.** Venous flow velocity can never be measured with Doppler
- B.** Venous waveforms are always perfectly flat
- C.** Resistance indices would be identical for every vein
- D.** Venous flow lacks a discrete systolic-diastolic cycle

80. Ovarian vein thrombosis occurring in the postpartum period most classically presents in which clinical context?

- A.** An entirely asymptomatic finding, always discovered incidentally years later
- B.** A condition exclusively affecting nulliparous women who have never delivered
- C.** Right-sided, fever and abdominal pain following delivery, particularly cesarean section
- D.** A finding limited strictly to the third trimester before any delivery occurs

81. An internal iliac artery aneurysm is clinically significant primarily due to which risk?

- A.** Rupture risk, given its retroperitoneal, pelvic location and often delayed detection
- B.** An exclusively cosmetic finding with no functional consequence
- C.** Spontaneous conversion into a benign lipoma over time
- D.** A condition occurring only in pediatric patients

- 82.** A ureteral jet, visualized on bladder ultrasound with color Doppler, is used clinically to assess:
- A.** Renal arterial resistive index
 - B.** Patency of ureteral flow into the bladder
 - C.** Bladder wall muscular contractility
 - D.** Cardiac stroke volume, indirectly
- 83.** Renal transplant artery stenosis, when significant, is classically suggested by which finding on spectral Doppler at the stenotic site?
- A.** A completely normal, unremarkable waveform at every sampled location
 - B.** Absent flow throughout the entire transplant kidney
 - C.** A markedly elevated peak systolic velocity with post-stenotic turbulence
 - D.** A waveform identical in every parameter to the native contralateral kidney
- 84.** Coarctation of the aorta, when evaluated with Doppler, classically produces which spectral waveform finding distal to the coarctation site?
- A.** A completely normal triphasic peripheral arterial waveform
 - B.** Aliasing at every sampled location regardless of scale setting
 - C.** Absent flow throughout the entire distal aorta
 - D.** A dampened waveform with a characteristic prolonged, gradual diastolic runoff
- 85.** Superior vena cava (SVC) syndrome, when evaluated with venous Doppler, is classically associated with which finding?
- A.** A markedly increased, supraphysiologic flow velocity throughout the SVC
 - B.** Loss of normal respiratory phasicity and diminished flow in the veins draining into the obstructed SVC
 - C.** A completely normal Doppler waveform in every affected vein
 - D.** A finding restricted exclusively to the internal jugular veins

- 86.** An axillary artery pseudoaneurysm, distinct from a brachial artery pseudoaneurysm, most commonly arises in which clinical context?
- A.** Spontaneously, with no identifiable prior instrumentation in nearly all cases
 - B.** Following axillary arterial access for a cardiac or vascular catheterization procedure
 - C.** Exclusively as a congenital finding present since birth
 - D.** Only following blunt trauma to the lower extremity
- 87.** Popliteal vein thrombosis identified on initial ultrasound is often followed by surveillance imaging primarily to monitor for which finding?
- A.** Spontaneous conversion of the thrombus into arterial tissue
 - B.** Complete disappearance of the vein itself from the anatomy
 - C.** Proximal or distal extension of the thrombus over time
 - D.** Automatic resolution requiring no further clinical correlation
- 88.** A traumatic renal arteriovenous fistula is characterized on Doppler by which finding?
- A.** Complete absence of any detectable flow at the injury site
 - B.** A perfectly normal, unremarkable renal arterial waveform throughout
 - C.** Flow limited exclusively to the venous side, with no arterial component detected
 - D.** High-velocity, turbulent, low-resistance flow with venous flow arterialization at the fistula site
- 89.** Adrenal vein thrombosis, though uncommon, is most frequently associated with which underlying clinical scenario?
- A.** A hypercoagulable state or adjacent severe illness, such as sepsis or malignancy
 - B.** A routine, expected finding in every healthy adult over age 40
 - C.** An exclusively pediatric condition, never described in adults
 - D.** A condition caused solely by excessive caffeine consumption

90. Ovarian torsion with Doppler flow that remains partially preserved does NOT reliably exclude torsion because:

- A.** Doppler ultrasound cannot technically assess ovarian blood flow at all
- B.** Preserved flow always definitively rules out torsion with complete certainty
- C.** Torsion exclusively and permanently obstructs all arterial and venous flow immediately upon onset
- D.** The ovary's dual blood supply and intermittent torsion pattern can allow some detectable flow despite genuine torsion

91. Reynolds number, as it applies to blood flow, is a dimensionless value used to predict which flow characteristic?

- A.** Whether flow is likely to remain laminar or transition to turbulent
- B.** The exact numeric resistive index of the vessel
- C.** The precise diameter of the vessel in millimeters
- D.** The total blood volume passing through the vessel per minute

92. The continuity equation, applied to blood flow through a vessel with a focal narrowing, is based on which underlying physical principle?

- A.** Conservation of volume flow rate, requiring velocity to increase where cross-sectional area decreases
- B.** Conservation of pressure, requiring pressure to remain identical at every point
- C.** Conservation of vessel wall thickness along the entire vessel length
- D.** Conservation of Doppler angle, which must stay constant throughout the vessel

93. A 'plug flow' velocity profile, characteristically seen near the origin of a vessel just distal to its take-off, is best described as:

- A.** A profile with velocity highest at the vessel wall and lowest at the center
- B.** A profile identical in every respect to fully developed turbulent flow

- C. A profile seen exclusively in veins, never in any artery
- D. A relatively flat velocity profile across the vessel diameter, before the parabolic profile fully develops

94. A high-resistance vascular bed, such as a resting skeletal muscle artery, differs from a low-resistance bed, such as the internal carotid artery, primarily in which physiologic characteristic?

- A. The high-resistance bed always has a larger diameter
- B. Lower downstream metabolic demand underlies high resistance
- C. Low-resistance beds never show any diastolic flow
- D. The two terms describe identical physiology

95. A splenic artery Doppler waveform obtained after a meal (postprandial) is expected to show which change compared to a fasting waveform?

- A. A marked increase in diastolic flow, similar to the postprandial superior mesenteric artery response
- B. A complete cessation of all detectable flow after eating
- C. Minimal to no significant change, since the spleen is not a digestive organ affected by feeding state
- D. A shift from arterial to purely venous waveform morphology

96. Inferior vena cava (IVC) diameter and its degree of respiratory collapsibility are used clinically as a noninvasive surrogate for estimating:

- A. Left ventricular ejection fraction directly
- B. Pulmonary artery systolic pressure directly
- C. Aortic valve area directly
- D. Central venous pressure/volume status

- 97.** A functioning, mature arteriovenous fistula for hemodialysis access is characterized by which Doppler finding in the feeding artery?
- A.** A high-resistance waveform pattern identical to a resting limb artery
 - B.** Complete absence of any detectable diastolic flow
 - C.** Increased volume flow with a low-resistance waveform pattern
 - D.** A waveform indistinguishable from the contralateral, non-fistula limb
- 98.** A dialysis graft (synthetic AV graft) surveillance protocol using Doppler primarily monitors for early signs of which complication?
- A.** Spontaneous conversion of the graft material into native tissue
 - B.** A required annual replacement regardless of any Doppler findings
 - C.** Stenosis, typically at the venous anastomosis, threatening graft patency
 - D.** An expected, harmless finding requiring no further action ever
- 99.** A native (non-graft) arteriovenous fistula compared to a synthetic AV graft generally shows which difference in typical Doppler waveform characteristics when both are functioning normally?
- A.** Grafts always show a high-resistance waveform, unlike any native fistula
 - B.** Native fistulas can never achieve adequate flow for dialysis use
 - C.** Grafts require no Doppler surveillance at all, unlike native fistulas
 - D.** Similar low-resistance physiology, though native fistulas often show somewhat different maturation timelines
- 100.** A carotid endarterectomy surveillance scan performed postoperatively is primarily intended to detect which complication?
- A.** Restenosis at the endarterectomy site over time
 - B.** A completely new, unrelated aneurysm forming spontaneously elsewhere
 - C.** Normal healing progress requiring no comparison to any baseline

D. A finding that has no established clinical management pathway if detected

101. A congenital duplicated inferior vena cava variant is distinguished from an acquired IVC thrombosis primarily by which feature?

A. Both conditions are radiographically and sonographically indistinguishable in every case

B. A congenital variant always requires the same urgent anticoagulation as acute thrombosis

C. A duplicated IVC is, by definition, always symptomatic and clinically significant

D. The duplicated segment shows normal flow and vessel-wall characteristics, without an occluding thrombus

102. Aliasing occurring in a high-velocity jet because the color scale (PRF) was set too low is corrected primarily by which adjustment?

A. Decreasing the color scale to further lower the Nyquist limit

B. Increasing the wall filter setting instead of the scale

C. Increasing the color scale (PRF) to raise the effective Nyquist limit

D. Switching exclusively to power Doppler mode, which cannot alias

103. Confirming catheter tip position during adrenal vein sampling is aided by Doppler primarily through which technique?

A. Confirming the catheter's flow signal is from the adrenal vein

B. Measuring the patient's total cardiac output

C. Calculating the adrenal gland's overall volume

D. Assessing bone density of the adjacent vertebra

104. Confirming vascular pedicle patency in a free tissue flap following reconstructive surgery with Doppler is primarily intended to detect early signs of which complication?

A. Normal, expected post-surgical swelling requiring no further action

B. Cosmetic asymmetry unrelated to the flap's blood supply

- C. A finding relevant only to the patient's unrelated original underlying condition
- D. Flap-threatening vascular compromise from thrombosis or kinking of the pedicle

105. A post-cesarean uterine scar niche (isthmocele) is distinguished from a cesarean scar ectopic pregnancy primarily by which feature?

- A. The two conditions are managed identically
- B. A niche always needs emergent surgical management
- C. Only an ectopic pregnancy can be visualized at all
- D. A niche lacks gestational tissue; an ectopic implants it

106. A splenic vein diameter trend followed over serial exams in a patient with known cirrhosis is primarily used to help assess:

- A. Progression of portal hypertension
- B. The patient's overall nutritional status directly
- C. Direct bilirubin level trending over time
- D. Hepatitis viral load trending over time

107. Median arcuate ligament syndrome, when evaluated with Doppler, classically shows which finding specifically related to respiration?

- A. A finding entirely unrelated to and unaffected by the respiratory cycle
- B. Complete, fixed occlusion of the celiac artery regardless of respiratory phase
- C. A finding limited exclusively to the superior mesenteric artery, never the celiac
- D. Increased celiac artery peak systolic velocity on expiration, improving somewhat on inspiration

108. A functioning uterine arteriovenous malformation (AVM), whether congenital or acquired after uterine instrumentation, is characterized on Doppler by which finding?

- A. Complete absence of any detectable vascularity within the myometrium

- B.** A single, simple, low-velocity feeding vessel with no turbulence
- C.** A tangle of vessels with high-velocity, low-resistance, turbulent flow and marked color aliasing
- D.** A finding indistinguishable from a normal postpartum uterus

109. Doppler evaluation of a testicular varicocele that fails to decompress with the patient upright and after Valsalva raises concern for which underlying issue?

- A.** A secondary varicocele from pelvic venous obstruction
- B.** A completely normal finding needing no workup
- C.** Definitive proof of malignancy needing no further imaging
- D.** A finding occurring only in prepubertal boys

110. On duplex evaluation of the great saphenous vein, retrograde (reversed) flow lasting longer than approximately 0.5 seconds after a distal augmentation maneuver is generally considered:

- A.** A normal, expected finding in every healthy adult leg
- B.** Diagnostic of an acute deep vein thrombosis instead
- C.** Unrelated to venous valve function of any kind
- D.** Diagnostic of venous reflux/incompetence at that segment

Answers

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- 1. D.** Laterality confirmation specifically guards against a wrong-site exam, a distinct and well-recognized preventable error category from wrong-patient errors. It does not address scan duration, transducer frequency choice, or consent documentation, each governed by separate safety processes.
 - 2. A.** Ultrasound uses non-ionizing mechanical (sound) energy, fundamentally different from the ionizing radiation used in x-ray and CT — not simply a lower dose of the same energy type. No ultrasound mode, including Doppler or 3D/4D, involves ionizing radiation.
 - 3. B.** Undocumented, uncleaned refilling of shared gel containers is a recognized infection-control concern, since the dispensing mechanism itself can become contaminated and transmit organisms between patients. It is not primarily an image-quality, transducer-hardware, or TGC-calibration issue.

- 4. B.** Encrypted, access-controlled networked systems protect patient health information from unauthorized access, a cybersecurity and data-privacy concern distinct from sterile technique, bioeffects/ALARA, or transducer QA.
- 5. D.** Expired supplies should be disposed of per established policy, since expiration reflects potential degradation in sterility, consistency, or efficacy, not merely remaining volume. Diluting an expired product does not restore its intended safety.
- 6. A.** Aspiration-risk positioning becomes specifically relevant when a patient's airway-protective reflexes are impaired, not a universal concern for every alert, cooperative patient. Transvaginal exams are not performed on pediatric patients, making that option inapplicable.
- 7. A.** Running a validated, known software state helps ensure the system behaves predictably and that measurement tools function as expected. It has no direct bearing on element burnout, disinfectant efficacy, or billing code assignment.
- 8. C.** RCA is triggered by a specific event and digs into that event's particular contributing factors, distinct from routine QA's broader performance review. RCA is typically conducted by an internal multidisciplinary team, and its purpose is patient-safety improvement, not billing compliance.
- 9. A.** Recognizing and clearly documenting a genuine technical limitation is the appropriate response. Fabricating measurements is a serious documentation violation, and discharging without documentation leaves a misleading record.
- 10. D.** Confirming the scheduled exam reasonably matches the stated clinical indication helps catch scheduling errors before they affect patient care. It does not guarantee insurance coverage, speed, or productivity.
- 11. D.** Briefly explaining the procedural aspects of the exam is within scope and helps reduce anxiety. Providing a clinical interpretation of findings crosses into diagnostic territory outside the sonographer's scope of practice.
- 12. C.** Duty factor = pulse duration x PRF, so pulse duration = $0.002/5000 = 0.4$ microseconds. Cycles = duration x frequency = $0.0000004 \times 4,000,000 \approx 1.6$ cycles. Distractors reflect factor-of-10 unit errors.
- 13. D.** A small impedance mismatch transmits the large majority of intensity; near-total reflection instead occurs at large-mismatch interfaces like soft tissue/air. There is no universal 50/50 split.
- 14. B.** Because intensity is proportional to amplitude squared, converting amplitude ratios to intensity-equivalent decibels effectively doubles the multiplier — a real mathematical relationship, not an outdated or arbitrary convention.
- 15. B.** Bone absorbs energy more readily than soft tissue, so equivalent displayed TI can still mean more significant bone heating — the basis for using TIB when bone is in the beam path. Fluid's low attenuation means minimal heating.

- 16. C.** Near-field complexity arises from interference among wavelets originating across the finite element width, smoothing into the simpler far-field pattern with distance. The beam actively propagates and attenuates throughout the near field.
- 17. B.** Divergence angle is approximately proportional to wavelength/aperture diameter — larger apertures and shorter wavelengths reduce divergence. Inverting the ratio misstates the relationship.
- 18. C.** Matched impedance means no mismatch to generate reflection, so nearly all energy transmits across the boundary. Complete reflection instead describes a large mismatch, and matching is unrelated to absorption.
- 19. D.** Rearranging the Doppler equation gives $v = (\text{shift} \times \text{speed}) / (2 \times \text{transmit frequency} \times \cos \text{angle})$. The distractors misplace terms in ways that test genuine algebraic understanding, not just recognition.
- 20. C.** Normalizing bandwidth to center frequency allows comparison across transducers of different center frequencies. It is not itself a penetration, footprint, or CW-exclusive measure.
- 21. B.** SPTA averages the spatial peak over the ENTIRE PRP including quiet time, giving a lower value than SPTP (peak during transmission only) — a distinct, separately named parameter.
- 22. A.** Intensity captures energy delivery rate, relevant to thermal bioeffects. Pressure absolutely can be measured (hydrophone) and relates to mechanical bioeffects (MI); the two quantities are related but not identical.
- 23. A.** Wavelength = $1580/4,000,000 \approx 0.40$ mm. 4.0 mm misplaces a decimal by 10x; 0.20 mm halves the value; 1.58 mm ignores frequency entirely.
- 24. B.** Power is total energy rate; intensity is power divided by area — related but distinct. Neither term is mode-restricted, and there is no fixed rule about relative magnitude.
- 25. C.** Axial resolution = SPL/2, so SPL = 1.0 mm. Wavelength = SPL/cycles = $1.0/3 \approx 0.33$ mm. Distractors reflect common misapplications of the formula.
- 26. D.** Because dispersion means speed depends on frequency, a minor timing/phase difference between fundamental and harmonic components is a real, if generally minor, physical nuance — not a barrier to harmonic imaging's routine clinical use.
- 27. B.** Amplitude oscillates positively and negatively as a wave quantity, while intensity represents a non-negative energy flow rate. The two are not numerically identical; decibels compare intensity RATIOS rather than being intensity's native unit, and amplitude applies generally to both B-mode and Doppler, not Doppler alone.
- 28. B.** Cumulative-use logs support asset lifecycle management, informing service or replacement timing based on real usage. They do not adjust frequency, perform disinfection, or affect billing.

- 29. D.** A grounded shield plane electrically isolates adjacent elements/channels, reducing cross-talk. It has no effect on lens wear, frame rate, or the thermal depoling threshold.
- 30. B.** Gel viscosity maintains continuous coupling, since even a thin air gap causes near-total reflection. It does not alter resonant frequency, the system's assumed propagation speed, or bandwidth.
- 31. A.** Reference-phantom recalibration catches gradual sensitivity/measurement drift, a subtler issue than abrupt single-element failure (which element-dropout testing targets). It does not detect housing damage or demographic data errors.
- 32. B.** A '1.75D' design adds further elevational rows beyond 1.5D, moving closer to (but short of) a full matrix array's independent elevational steering — specifically about elevational capability, not footprint shape or CW-vs-pulsed transmission.
- 33. D.** Battery/size constraints limit processing power for advanced optimization, though core imaging remains functional. Safety output limits are not relaxed for portable devices, and the physics of propagation is universal.
- 34. A.** Probe-system compatibility is tied to certified combinations and software versions, so a mismatch can prevent initialization on one specific system even when the probe works elsewhere — not a global model-wide failure or recall.
- 35. A.** Repeated chemical exposure can degrade the matching layer/lens material over many cycles, subtly affecting acoustic transmission — distinct from internal circuitry, the console, or patient skin exposure to gel.
- 36. D.** Embedded connector circuitry communicates probe identity automatically upon connection, distinct from an optical barcode requiring a scan, a manual dropdown, or a color-coded jacket requiring visual interpretation.
- 37. A.** Cumulative sub-threshold thermal cycling can gradually degrade performance, a slower mechanism distinct from the abrupt, complete depoling that occurs when the Curie point itself is exceeded in one event.
- 38. D.** A non-porous handle resists harboring contaminants, supporting cleaning/disinfection — an infection-control choice unrelated to acoustic coupling (the active face's role), manufacturing cost, or crystal frequency.
- 39. C.** Improperly cured bonding layers risk delamination, degrading acoustic transfer efficiency — a manufacturing-quality issue distinct from electrical grounding, software version, or informed consent.
- 40. B.** A lower noise floor allows weak signals to be distinguished from background noise, directly affecting sensitivity. It is unrelated to thermal safety limits, disinfection-cycle limits, or cable-length compatibility.

- 41. B.** Since shift is proportional to frequency, a lower frequency reduces shift for a given velocity, lowering aliasing risk while improving penetration. Dedicated Doppler probes are not B-mode devices at all, so B-mode production is not the relevant consideration.
- 42. D.** Awareness of subtle face-performance variation supports consistent probe-positioning technique for optimal image quality — unrelated to disinfectant selection, maximum safe depth, or fractional bandwidth calculation.
- 43. B.** The T/R switch isolates sensitive receive circuitry from the much higher-voltage transmit pulse, allowing the same element to transmit and receive. It does not select frequency, exam presets, or control depth markers.
- 44. B.** Per-element calibration corrects natural manufacturing variation across elements for uniform image quality — distinct from a completely dead element (an integrity-test finding, not a calibration target), operator gain, or patient habitus.
- 45. C.** A color-coded ring is a simple visual aid for quick probe-type recognition, distinct from electronic auto-ID. It does not electrically isolate the probe, calibrate output power, or serve as a sterilization indicator.
- 46. D.** Combining acquisition requires additional pulse sequences, generally reducing frame rate compared to either mode alone — a well-known real-time tradeoff, not an increase, and still requiring a defined color box.
- 47. A.** A saved preset speeds up reaching a reasonable starting image, but does not diagnose interval change, eliminate the value of fresh optimization, or apply as a permanent lock for unrelated future patients.
- 48. B.** An opacity slider is a purely display-side adjustment and does not alter the actual measured stiffness data, permanently switch modes, or affect acquisition-side push-pulse strength.
- 49. C.** A saturation warning flags a settings issue the operator can correct, not a hardware failure, mandatory exam cessation, or a demographic data error.
- 50. D.** A brightness histogram gives objective feedback on exposure balance. It has no role in fetal weight estimation, does not measure flow velocity, and does not replace caliper-based measurement.
- 51. C.** Auto-population reduces transcription errors; it does not generate a clinical impression, eliminate the underlying measurement step, or guarantee normalcy of any value.
- 52. D.** An exam-type default preset saves setup time but does not replace transducer selection, perform the exam autonomously, or standardize duration, which naturally varies by patient.

- 53. D.** Certain specialized views follow non-default orientation conventions, making configurable orientation relevant to those contexts specifically, not universal, pediatric-specific, or transducer-shape-specific.
- 54. C.** A surface-temperature alert is a direct patient-safety feature, unrelated to protecting the power supply, preserving saved images, or billing accuracy.
- 55. D.** A trend sparkline offers quick visual context; it does not diagnose the cause of change, eliminate current-exam documentation, or perform formal statistical significance testing.
- 56. C.** A frame-numbered scrub bar supports precise manual navigation; it does not auto-identify a best frame, delete other frames, or retroactively alter the original frame rate.
- 57. B.** Independent TGC is valuable specifically because two regions may have different attenuation profiles — the opposite of forcing identical settings — and both windows remain independently adjustable with TGC just as relevant as in a single window.
- 58. D.** Auto-freeze after inactivity supports ALARA by limiting idle live transmission. It does not auto-complete the worksheet, permanently prevent unfreezing, or guarantee diagnostic quality of captured frames.
- 59. D.** A prior-location overlay supports genuine remeasurement at the same site, still requiring a fresh measurement at the current visit — not reuse of the old value, elimination of documentation, or a 3D conversion.
- 60. B.** A statistical-outlier flag is a screening aid; it does not confirm pathology, alter the actual measured value, or substitute for the physician's independent clinical judgment.
- 61. B.** An exam-specific label library speeds up consistent annotation; it does not generate a clinical impression, prevent custom free-text entry, or enforce that every image be labeled.
- 62. A.** Consistent orientation prevents spatial confusion during interpretation. It has no bearing on Doppler angle math, maximum imaging depth, or automatic TGC application.
- 63. A.** A live SNR readout supports real-time technique adjustment; it does not diagnose pathology, eliminate the ongoing need for gain adjustment, or calculate a radiation dose that ultrasound does not involve.
- 64. B.** Customizable remapping supports individual/departmental workflow tailoring, the opposite of forcing identical layouts, and has no relationship to output power or replacing the console with voice-only control.
- 65. D.** A timestamped log creates an auditable compliance record; it does not itself judge pass/fail, eliminate the underlying test requirement, or automatically adjust transducer frequency.

- 66. D.** An overlay grid supports a quick informal impression, not the final documented measurement, is not restricted to a hypothetically missing caliper tool, and has no specific relationship to Doppler velocity measurement.
- 67. B.** Comparing two approaches helps confirm a finding is real rather than a view-specific artifact; it does not average the views, affect frame rate, or eliminate individual documentation.
- 68. C.** A missing-view flag prompts timely correction; it does not fabricate a substitute image, force a full cancellation, or replace the physician's own completeness review.
- 69. D.** A storage-capacity indicator proactively prevents a mid-exam interruption. It does not itself delete other images, affect frame rate, or change scheduling.
- 70. B.** Compression ratio trades detail preservation against storage space — a data-management tradeoff distinct from safety/billing, frequency/penetration, or angle/velocity relationships.
- 71. B.** A mode indicator supports situational awareness; it cannot retroactively convert 2D images to 3D data, does not eliminate manual mode selection, and active-mode display says nothing about resulting image quality.
- 72. A.** Remote mirroring supports supervision but does not itself correct technique (still requiring verbal guidance), replace hands-on training, or serve as the official medical record.
- 73. C.** An overdue-calibration flag prompts completing the calibration, since visually normal images do not guarantee measurement accuracy if calibration has genuinely drifted. It is a reminder, not an automatic shutdown or a reason to discard the system.
- 74. A.** A predicted trajectory overlay is a planning aid; it does not perform autonomous insertion, replace ongoing real-time visualization during the actual procedure, or guarantee a perfect outcome given biological variability.
- 75. B.** Configurable units support reporting-convention consistency; the underlying structure and measurement accuracy are unaffected, and the setting does not retroactively alter previously issued reports.
- 76. D.** A low-frame-rate warning flags a real-time temporal-resolution concern for the operator to address; it does not itself revert settings to default, permanently lock out line-density increases, or confirm overall protocol completeness.
- 77. C.** Correct rearrangement is $\text{velocity} = (\text{shift} \times \text{speed}) / (2 \times \text{transmit frequency} \times \cos \text{ angle})$. Distractors swap terms or invert the expression, testing genuine algebraic understanding.
- 78. C.** Power Doppler's amplitude-based display avoids the cosine term entirely, sidestepping steep near-90-degree velocity errors — unrelated to gel, functioning elements, or freezing the image.

- 79. D.** RI/PI are built around the arterial systolic-diastolic cycle; normal venous flow follows a continuous, respirophasic pattern instead. Venous velocity is absolutely measurable, and venous waveforms show genuine variation, not zero variation.
- 80. C.** Postpartum ovarian vein thrombosis classically presents right-sided with fever/pain after delivery, especially cesarean. It is a postpartum (not pre-delivery or exclusively-nulliparous) condition, and not typically an incidental years-later finding.
- 81. A.** Deep pelvic location increases rupture risk and delays detection. It is not cosmetic, does not convert into a fatty tumor, and is an adult (typically atherosclerotic-risk) condition.
- 82. B.** A visible periodic ureteral jet indicates active flow, useful for suspected unilateral obstruction. It does not assess renal RI, bladder muscular function, or cardiac stroke volume.
- 83. C.** Significant stenosis produces markedly elevated PSV with post-stenotic turbulence. A normal waveform would argue against, not support, stenosis; complete absent flow suggests occlusion instead.
- 84. D.** Distal to significant coarctation, the waveform dampens with prolonged diastolic runoff. A normal triphasic pattern argues against significant coarctation; collateral circulation typically maintains some distal flow, not complete absence.
- 85. B.** SVC obstruction reduces (not increases) flow and phasicity in draining veins. A normal waveform argues against significant syndrome, and the finding spans multiple draining veins, not just the internal jugular.
- 86. B.** Axillary pseudoaneurysm is typically an iatrogenic access-site complication, not spontaneous, congenital, or related to lower-extremity trauma (the axillary artery is an upper-extremity vessel).
- 87. C.** Surveillance monitors for thrombus extension, particularly proximal propagation. Thrombus does not convert to arterial tissue, the vein does not anatomically disappear, and follow-up correlation remains standard, not automatic assumption of resolution.
- 88. D.** An AV fistula produces turbulent high-velocity flow and venous arterialization. Absent flow instead suggests occlusion, a normal waveform would miss the abnormality, and by definition a fistula involves both arterial and venous components.
- 89. A.** Adrenal vein thrombosis is associated with hypercoagulable states or severe illness, not a routine healthy-adult finding, not pediatric-exclusive, and not caused by caffeine consumption.
- 90. D.** Dual blood supply and intermittent torsion can allow detectable flow despite genuine torsion — an important diagnostic pitfall. Doppler absolutely can assess ovarian flow, and preserved flow does NOT reliably exclude torsion.

- 91. A.** Reynolds number predicts laminar-vs-turbulent transition from velocity, diameter, density, and viscosity. It does not represent RI, is not simply a diameter measurement, and does not represent total volume flow.
- 92. A.** The continuity equation reflects conservation of volume flow rate ($\text{area}_1 \times \text{velocity}_1 = \text{area}_2 \times \text{velocity}_2$). It is not based on constant pressure (related instead to Bernoulli), wall thickness, or a fixed Doppler angle.
- 93. D.** Plug flow is a relatively flat profile near a vessel's origin, before parabolic profile develops. It is not highest-at-wall (neither plug nor parabolic show that), not identical to turbulence, and is described in arteries near branch points, not exclusively veins.
- 94. B.** Lower continuous metabolic demand underlies high-resistance physiology (minimal diastolic runoff); constant high-demand tissue is served by low-resistance beds with abundant diastolic flow — a physiologic, not diameter-based, distinction, and the two terms are genuinely different patterns.
- 95. C.** Unlike the SMA's postprandial diastolic increase, the splenic artery (non-digestive organ) shows minimal feeding-related change. It does not stop flowing after eating, and morphology does not shift categorically from arterial to venous.
- 96. D.** IVC diameter/collapsibility estimates central venous pressure/volume status. EF, PA pressure, and aortic valve area each require their own separate dedicated echocardiographic techniques.
- 97. C.** A mature fistula creates a low-resistance pathway with increased flow and prominent diastolic flow — distinctly different from a resting limb artery, absent diastolic flow (suggesting a problem), or the normal contralateral limb.
- 98. C.** Surveillance targets developing stenosis, classically at the venous anastomosis. Grafts do not convert into native tissue, are not replaced on a fixed schedule regardless of findings, and a developing stenosis requires action, not inaction.
- 99. D.** Both share low-resistance physiology when functioning normally, though maturation timelines differ. Grafts do not normally show high resistance, native fistulas absolutely achieve adequate flow once matured, and grafts require ongoing surveillance too.
- 100. A.** Surveillance monitors for restenosis at the surgical site over time, relying on baseline comparison, with detected restenosis having an established management pathway — not an unrelated aneurysm or an unmanageable finding.
- 101. D.** A duplicated segment shows normal flow/wall characteristics, distinguishing it from an occluding thrombus. The two are distinguishable with careful evaluation, a congenital variant does not require urgent anticoagulation, and is often incidental/asymptomatic.

- 102. C.** Raising the color scale (PRF) directly raises the Nyquist limit. Decreasing scale worsens aliasing; wall filter addresses clutter, not scale; and power Doppler's different display mode is not the standard direct correction within the mode being used.
- 103. A.** Doppler confirms the catheter tip's venous flow signal from the adrenal vein specifically. It is not used for cardiac output, adrenal volume calculation, or vertebral bone density.
- 104. D.** Flap Doppler surveillance targets early pedicle compromise (thrombosis/kinking), a time-critical monitoring application distinct from routine expected swelling, cosmetic concerns, or the original underlying condition.
- 105. D.** A niche is simply a structural scar defect without gestational tissue, unlike a scar ectopic where pregnancy has implanted there — very different management urgency. Both structural defects and pregnancies are, of course, visualizable with ultrasound.
- 106. A.** Splenic vein diameter trend helps assess portal hypertension progression, not nutritional status, bilirubin level, or viral load, each requiring separate clinical/laboratory assessment.
- 107. D.** MALS classically shows exaggerated celiac compression on expiration, improving on inspiration — a defining respiration-dependent, positional finding, not a fixed occlusion or an SMA-exclusive finding.
- 108. C.** Uterine AVM shows a chaotic tangle of vessels with high-velocity, low-resistance, turbulent flow and aliasing — very different from absent vascularity, a simple single low-velocity vessel, or a normal postpartum appearance.
- 109. A.** A non-decompressing varicocele raises concern for secondary obstruction elsewhere, warranting further evaluation — not a normal expected finding, not definitive proof of malignancy on its own, and not restricted to prepubertal boys.
- 110. D.** A reflux duration beyond the accepted threshold is considered diagnostic of venous incompetence at that segment — not a normal expected finding, not itself diagnostic of DVT (a distinct process), and directly tied to venous valve competence.