

COMPREHENSIVE MOCK EXAM 9

Supplemental to: Clinical Ultrasound Board Review 2026-2027

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ARDMS SPI (Sonography Principles and 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 assisting an elderly, unsteady patient onto the exam table, the sonographer raises the table's side rail once the patient is positioned and uses a gait belt to help the patient transfer safely. What does this practice primarily address?
 - A. Transducer disinfection classification
 - B. Patient fall-prevention/positioning safety
 - C. Electrical leakage-current safety
 - D. HIPAA-compliant image access control

2. Before beginning a paired-organ study such as a renal or testicular ultrasound, the sonographer explicitly confirms and documents which side (left or right) is being imaged before starting each portion of the exam. What does this verification step primarily prevent?
 - A. Wrong-side (laterality) documentation errors in a paired-organ study
 - B. Electrical leakage-current hazards during the exam
 - C. Contrast-agent allergic reactions during the exam
 - D. Disinfectant wet-contact-time violations on the transducer

3. Before administering an ultrasound contrast agent, the sonographer confirms the patient has no known allergy to the specific agent or its components. What does this verification step primarily address?
 - A. Contrast-agent allergy screening before administration
 - B. The transducer's disinfection classification
 - C. HIPAA-compliant image access control
 - D. Electrical leakage-current safety

4. Before scanning a patient on contact isolation precautions for a resistant organism, the sonographer dons a gown and gloves specific to that isolation status, beyond the standard precautions used for every patient. What does this additional PPE address?
 - A. The Spaulding classification of the transducer

- B. HIPAA-compliant image access control**
- C. Contact-isolation-specific personal protective equipment**
- D. Electrical leakage-current safety testing**

5. After wiping a transducer with a low-level disinfectant, the sonographer waits a specific number of minutes before the next patient use, allowing the product to remain visibly wet on the surface for its full labeled duration. What does this waiting period ensure?

- A. The transducer's Curie point being exceeded, unrelated here**
- B. The disinfectant's required wet-contact time for effective disinfection**
- C. The transducer's fractional bandwidth being preserved, unrelated here**
- D. HIPAA-compliant image access control, an unrelated privacy concept**

6. Before installing new ultrasound equipment near other sensitive hospital electronics, biomedical engineering tests whether the new device emits radiofrequency interference that could affect nearby equipment, and vice versa. What is this testing called?

- A. Electrical leakage-current testing, a distinct patient-shock safety check**
- B. Tissue-mimicking phantom QA, a distinct image-quality check**
- C. The Spaulding classification, a distinct disinfection-level system**
- D. Radiofrequency emissions/electromagnetic compatibility (EMC) testing**

7. Before administering a contrast agent, two staff members independently verify the medication, dose, and patient identity against the order before it is given. What does this practice represent?

- A. The Spaulding classification of the transducer**
- B. Electrical leakage-current safety testing**
- C. HIPAA-compliant image access control**
- D. Two-person verification for high-risk medication administration**

8. After an ultrasound-guided biopsy, the patient is given specific written instructions on when to seek medical attention, such as for worsening pain, swelling, or bleeding at the site. What is the primary purpose of these instructions?

- A.** Post-procedure discharge instructions covering bleeding/complication precautions
- B.** HIPAA-compliant image access control, an unrelated privacy concept
- C.** The Spaulding classification of the transducer used, an unrelated concept
- D.** Electrical leakage-current safety testing, an unrelated safety check

9. Before a newly hired sonographer begins independent scanning, the department requires her to complete and pass a structured checklist demonstrating competency across a defined set of exam types and equipment. What does this checklist represent?

- A.** An ongoing continuing medical education (CME) requirement
- B.** The Spaulding classification of the transducer
- C.** Electrical leakage-current safety testing
- D.** A new-hire competency assessment, distinct from ongoing CME

10. Once a year, all ultrasound department staff complete a drill practicing the facility's plan for evacuating patients and staff in the event of a fire or other emergency. What does this drill address?

- A.** The Spaulding classification of transducers
- B.** Facility disaster/emergency evacuation plan training
- C.** Electrical leakage-current safety testing
- D.** HIPAA-compliant image access control

11. A newer, battery-powered wireless transducer has no AC power cord connecting it directly to a wall outlet during scanning. How does this affect the applicability of standard electrical leakage-current testing designed for corded, AC-powered equipment?

- A.** Leakage-current testing is identical and fully unaffected by the missing cord
- B.** Wireless probes require no electrical safety testing of any kind at all

- C. Wireless probes are tested using the Spaulding classification system instead
- D. The cordless, battery-powered design changes which electrical safety tests apply

12. A longitudinal sound wave strikes a bone interface at an oblique angle. In addition to the expected reflected and transmitted longitudinal waves, a portion of the energy is converted into a different wave type (a shear wave) traveling within the bone. What is this energy-conversion phenomenon called?

- A. The piezoelectric effect, an unrelated material-conversion property
- B. Mode conversion (longitudinal-to-shear wave conversion at an oblique interface)
- C. The Doppler shift, an unrelated velocity-frequency phenomenon
- D. Specular reflection, an unrelated mirror-like echo phenomenon

13. Ignoring tissue attenuation entirely, a sound wave spreading outward from a small source in a uniform, non-attenuating medium still loses intensity simply because its energy is spread over an ever-larger area with increasing distance. What principle describes this purely geometric intensity loss?

- A. The half-value layer, an attenuation-depth measure
- B. Snell's Law, a refraction-angle relationship
- C. The inverse square law (geometric spreading loss)
- D. The piezoelectric effect, a material-conversion property

14. In a medium where propagation speed varies with frequency, the speed at which an individual wave crest travels can differ from the speed at which the overall envelope (or 'packet') of a pulse travels. What are these two distinct speeds called?

- A. Duty factor and PRF, an unrelated pair of transmit-timing terms
- B. Phase velocity versus group velocity in a dispersive medium
- C. Spatial pulse length and pulse duration, an unrelated pulse-timing pair
- D. Near-zone length and far-zone divergence, an unrelated beam-geometry pair

15. When intensity is expressed in decibels, the value is calculated as a ratio against a defined reference intensity level, below which the ratio is considered the 0 dB point. What does this reference value represent?

- A.** The Nyquist limit, a sampling-rate concept
- B.** The Curie point, a heat-induced depoling temperature
- C.** The defined reference intensity used as the 0 dB baseline
- D.** The duty factor, a transmit-timing ratio

16. Comparing the wavelength of a typical diagnostic ultrasound beam (roughly fractions of a millimeter) to the wavelength of a typical diagnostic X-ray (roughly a fraction of a nanometer), how do these two imaging modalities compare in wavelength scale?

- A.** Ultrasound wavelength and X-ray wavelength are essentially identical
- B.** X-ray wavelength is far longer than ultrasound wavelength
- C.** Wavelength scale has no relevance to either imaging modality
- D.** Ultrasound wavelength is many orders of magnitude longer than X-ray wavelength

17. When sound strikes an interface beyond the critical angle, it undergoes total internal reflection, but a non-propagating wave still briefly penetrates a short distance into the second medium before decaying rapidly. What is this brief, non-propagating penetration called?

- A.** The half-value layer, an unrelated attenuation-depth measure
- B.** An evanescent wave (a brief, rapidly decaying, non-propagating field beyond the critical angle)
- C.** The piezoelectric effect, an unrelated material-conversion property
- D.** Spatial compounding, an unrelated multi-angle imaging technique

18. A physicist relates a sound wave's local pressure to the medium's acoustic impedance and the particle velocity at that point, using the formula $p = Z \times u$. What does this formula describe?

- A.** Pressure equals impedance times particle velocity ($p = Z \times u$)
- B.** The Doppler shift equation, a velocity-frequency relationship

- C. The range (depth) equation, a distance-time relationship
- D. The reflection coefficient formula, an impedance-ratio relationship

19. A parameter called B/A is used to characterize how strongly a given tissue's acoustic behavior deviates from ideal linear propagation as sound amplitude increases. What does this parameter describe?

- A. The nonlinearity parameter B/A, characterizing nonlinear behavior
- B. The duty factor, a transmit-timing ratio
- C. The half-value layer, an attenuation-depth measure
- D. The Nyquist limit, a sampling-rate concept

20. Acoustic impedance can be expressed using a named physical unit equal to $\text{kg}/(\text{m}^2 \times \text{s})$, analogous to how resistance is measured in ohms. What is this named unit called?

- A. The Hertz
- B. The Rayl
- C. The Neper
- D. The Decibel

21. To characterize a transducer's usable bandwidth, engineers sometimes define its edges as the frequencies at which output power has dropped to half of its peak value, rather than using the -6 dB points sometimes used for beam-width characterization. What is this bandwidth-edge threshold called?

- A. The -6 dB beam-width points, a distinct beam-geometry measure
- B. The half-value layer, an attenuation-depth measure
- C. The -3 dB (half-power) bandwidth-edge threshold
- D. The Nyquist limit, a sampling-rate concept

22. A small, calibrated receiving device is placed directly within the beam to physically measure the actual acoustic pressure waveform at specific points, used to map a transducer's beam profile during calibration. What is this measurement device called?

- A.** A radiation-force balance, a total-power measurement tool
- B.** A hydrophone, a calibrated pressure-measuring device
- C.** An electrical leakage-current tester, an unrelated safety device
- D.** A tissue-mimicking phantom, an unrelated QA tool

23. In certain media, propagation speed varies measurably with the frequency of the transmitted wave, a phenomenon distinct from attenuation's well-known frequency dependence. What is this speed-versus-frequency phenomenon called?

- A.** Acoustic dispersion (propagation speed varying with frequency in some media)
- B.** The transducer's Curie point, an unrelated heat-induced depoling temperature
- C.** The transducer's fractional bandwidth, an unrelated frequency-range ratio
- D.** The Nyquist limit of the system, an unrelated sampling-rate concept

24. In the far zone, a beam's edge spreads outward at an angle that can be approximated using a formula relating wavelength to the transducer's aperture diameter. What does this angular formula estimate?

- A.** The Doppler shift angle, an unrelated velocity-measurement angle
- B.** The critical angle for total reflection, an unrelated refraction concept
- C.** The reflection coefficient, an unrelated impedance-ratio value
- D.** The far-zone beam divergence angle, related to wavelength and aperture

25. As particles in a medium oscillate to transmit a sound wave, their maximum displacement from rest and their maximum speed during that oscillation are two related but numerically distinct ways of describing the same motion. What are these two distinct measures called?

- A.** Wavelength and period, two unrelated wave-timing/distance terms
- B.** Particle displacement amplitude versus particle velocity amplitude
- C.** Duty factor and PRF, two unrelated transmit-timing terms
- D.** Spatial pulse length and pulse duration, two unrelated pulse terms

26. The fraction of a beam's energy reflected at a tissue interface, calculated from the impedance values on either side, does not itself change if the transmitted frequency is changed while the two tissues (and their impedances) stay the same. What does this illustrate about the reflection coefficient?

- A.** The reflection coefficient always increases with frequency
- B.** The reflection coefficient always decreases with frequency
- C.** The reflection coefficient cannot be calculated without knowing frequency
- D.** The reflection coefficient depends on the impedance values at the interface, not on frequency

27. A pulsed system has a pulse duration of 2 microseconds and a pulse repetition period of 500 microseconds. Using the standard formula, what is this system's duty factor?

- A.** 0.4% (duty factor = pulse duration divided by PRP)
- B.** 4% (pulse duration multiplied by PRP)
- C.** 40% (PRP divided by pulse duration)
- D.** 250% (PRP minus pulse duration)

28. A mechanical 3D/4D transducer physically tilts its internal 1D array back and forth through a defined maximum angle to sweep out a volume. What does this maximum angle specification determine?

- A.** The transducer's operating frequency, an unrelated spec
- B.** The width of the acquired volume dataset
- C.** The Curie point of the piezoelectric material, unrelated
- D.** The transducer's fractional bandwidth, unrelated here

29. An ultra-portable, pocket-sized probe uses a single element or a small sparse array rather than a full densely populated array, trading some image quality for size and cost. What is the main trade-off of this minimalist design approach?

- A.** Reduced beam steering/focusing capability, traded for smaller size and cost
- B.** Complete elimination of any image quality limitation whatsoever

- C. An automatic increase in operating frequency beyond any full array
- D. A guaranteed wider field of view than any full matrix array

30. A newer TEE probe design allows the imaging plane to be continuously rotated through a full range of angles under electronic control, rather than switching between only two fixed orthogonal planes. What is this newer design called?

- A. A biplane TEE probe, limited to two fixed planes only
- B. A multiplane TEE probe (continuous electronic rotation)
- C. A micro-convex TEE probe, an unrelated footprint design
- D. An intraoperative sterile TEE probe, an unrelated use case

31. A technique acquires several sequential transmissions using different small groups of elements, then combines the resulting data computationally to synthesize the effect of a much larger active aperture than was ever active at any single instant. What is this technique called?

- A. Multi-line acquisition (MLA), an unrelated receive-beam technique
- B. Row-column addressing (RCA), an unrelated element-addressing scheme
- C. Apodization, an unrelated aperture-weighting technique
- D. Synthetic aperture imaging (multi-transmit aperture synthesis)

32. A manufacturer's engineering team collects and examines transducers returned from the field due to failure, analyzing them to identify common failure patterns and inform improvements to future probe designs. What is this quality process called?

- A. Factory burn-in testing, an unrelated pre-shipment QA process
- B. Acoustic output drift monitoring, an unrelated lifetime calibration check
- C. Field-return failure analysis (examining returned failed probes to inform design improvements)
- D. The dead-element acceptability threshold, an unrelated in-use QA criterion

33. A newer transducer design places much of the beamforming electronics directly inside the probe handle itself, rather than relying entirely on the main system console, reducing the number of raw signal channels that must travel through the cable. What is this design approach called?

- A.** Row-column addressing (RCA), an unrelated element-addressing scheme
- B.** Chip-on-tip design (embedded beamforming electronics)
- C.** Multi-line acquisition (MLA), an unrelated receive-beam technique
- D.** Synthetic aperture imaging, an unrelated aperture-synthesis technique

34. A rigid plastic bracket attaches directly onto a transvaginal transducer, physically constraining an inserted biopsy needle to travel along a fixed, predictable path relative to the probe. What is this physical hardware component called?

- A.** The matching layer, an unrelated acoustic-transmission component
- B.** The acoustic lens, an unrelated elevational-focusing component
- C.** The biopsy-guide bracket (physical needle-guide attachment)
- D.** The kerf, an unrelated inter-element gap

35. Before a newly manufactured transducer batch is shipped, quality engineers run each unit continuously for an extended period to identify any units with early, infant-mortality-type failures before they ever reach a clinical customer. What is this pre-shipment testing called?

- A.** Acceptance testing performed by the purchasing facility
- B.** Factory burn-in testing before shipment
- C.** Acoustic output drift monitoring over the transducer's lifetime
- D.** The dead-element clinical QA threshold

36. During transducer manufacturing, quality control rejects a certain percentage of newly diced elements that fail initial electrical or acoustic testing before final assembly. What does this rejection rate represent?

- A.** The transducer's fractional bandwidth, an unrelated frequency ratio
- B.** The transducer's Curie point, an unrelated heat property

- C. The transducer's effective radiating area, an unrelated surface spec
- D. Element manufacturing yield (percentage passing initial QC)

37. A transducer's acoustic lens material is rated for how well it withstands repeated wiping with disinfectant and physical contact over its expected service life without cracking or clouding. What does this rating describe?

- A. The transducer's fractional bandwidth
- B. The transducer's Curie point
- C. Acoustic lens abrasion-resistance/durability rating
- D. The dead-element acceptability threshold

38. A system widens its active receive aperture as the received signal's focal depth increases, maintaining a roughly constant F-number (focal depth divided by aperture width) at each depth. If a target is at 8 cm and the system maintains an F-number of 2, what approximate aperture width is being used at that depth?

- A. Approximately 16 cm, an incorrect application of the formula
- B. Approximately 2 cm, an incorrect application of the formula
- C. Approximately 0.25 cm, an incorrect application of the formula
- D. Approximately 4 cm (aperture width = depth / F-number)

39. A technician inspects a transducer's housing and finds its model number and serial number printed directly on a small plate, allowing manual identification even if the automatic recognition chip inside the connector has failed. What does this printed marking represent?

- A. An embedded ID chip read automatically by the system, a different ID method
- B. A physical serial number/model marking on the probe housing (manual, non-electronic identification)
- C. The transducer's Curie point rating, an unrelated heat property
- D. The transducer's fractional bandwidth specification, an unrelated frequency ratio

40. A linear array has an element pitch (center-to-center element spacing) of 0.3 mm at a transmitted wavelength of 0.3 mm. Compared to an array with a much finer element pitch of 0.15 mm at the same wavelength, how does the coarser-pitch array's maximum usable electronic steering angle before problematic grating lobes appear generally compare?

- A.** The coarser-pitch (0.3 mm) array generally supports a smaller maximum steering angle before grating lobes appear
- B.** The coarser-pitch array always supports a larger maximum steering angle
- C.** Element pitch has no relationship to the maximum usable steering angle
- D.** Both arrays support an identical maximum steering angle regardless of pitch

41. A transducer with a large aperture and low operating frequency is compared to one with a small aperture and high operating frequency, both examined in their far zones. Which combination generally produces a more rapidly diverging (spreading) far-zone beam?

- A.** Large aperture, low frequency, generally reducing far-zone divergence
- B.** Neither aperture nor frequency affects far-zone divergence in any way
- C.** Both combinations diverge at an identical rate regardless of aperture
- D.** Small aperture, high frequency (smaller aperture generally increases divergence)

42. A transducer's connector is shaped with an asymmetric key/notch that physically fits only into the correctly matched port on the system, preventing the probe from being connected to an incompatible port. What is this design feature called?

- A.** Connector keying design (preventing connection to an incompatible or wrong port)
- B.** The matching layer, an unrelated acoustic-transmission component
- C.** The acoustic lens, an unrelated elevational-focusing component
- D.** The kerf, an unrelated inter-element gap

43. A manufacturer specifies that a particular 5 MHz curvilinear transducer is intended for imaging depths up to approximately 20 cm, beyond which image quality is expected to degrade substantially. What does this specification represent?

- A.** The manufacturer-specified maximum useful imaging depth for that probe
- B.** The transducer's Curie point specification, an unrelated concept here
- C.** The transducer's fractional bandwidth, an unrelated concept here
- D.** The dead-element acceptability threshold, an unrelated QA concept

44. Compared to manufacturing a standard polycrystalline PZT ceramic element, manufacturing a single-crystal PMN-PT element of equivalent size is generally more complex and costly, despite PMN-PT's sensitivity advantage. What does this trade-off represent?

- A.** PMN-PT eliminates all manufacturing cost considerations entirely
- B.** PZT is always more expensive to manufacture than PMN-PT
- C.** Manufacturing cost is identical between the two materials in every case
- D.** A cost/manufacturing-complexity trade-off weighed against PMN-PT's sensitivity benefit

45. An endocavity transducer's manufacturer specifies a maximum number of high-level disinfection cycles the probe can safely undergo before its materials are considered too degraded for continued clinical use. What does this specification represent?

- A.** A reprocessing (disinfection) cycle-count limit before replacement
- B.** The transducer's fractional bandwidth
- C.** The transducer's effective radiating area
- D.** The dead-element acceptability threshold for QA pass/fail

46. While reviewing a buffered cine loop, the sonographer marks one specific frame with a flag so it can be quickly located again later, without having to scroll through the entire buffer again. What is this feature called?

- A.** Freeze-frame, an unrelated live-halt feature
- B.** Cine-loop frame bookmarking (marking a frame for quick reference)
- C.** Persistence, an unrelated frame-averaging technique
- D.** Spatial compounding, an unrelated multi-angle technique

47. After completing an exam, the sonographer selects a single button that sends the finalized report and key images directly into the referring physician's electronic inbox, without a separate manual export step. What does this integration represent?

- A.** Modality worklist integration (pulling scheduling data in)
- B.** DICOM lossy compression
- C.** Direct EHR/referring-physician inbox delivery integration
- D.** A structured measurement worksheet

48. When generating a breast ultrasound report, the structured reporting software prompts the sonographer to select a finding category from a standardized list of terms recognized across the specialty, rather than free-text description. What does this represent?

- A.** Modality worklist integration, an unrelated scheduling feature
- B.** An ellipsoid volume formula, an unrelated organ-volume calculation
- C.** An automatic Doppler envelope trace, an unrelated spectral feature
- D.** Standardized reporting lexicon integration (a recognized terminology system)

49. When a sonographer marks a finding as urgent within the reporting system, the software automatically pages the on-call radiologist and flags the study at the top of the reading worklist. What does this feature address?

- A.** Automatic critical/urgent finding flagging for expedited notification
- B.** Modality worklist integration for routine scheduling
- C.** DICOM lossy compression for file-size reduction
- D.** An ellipsoid volume formula for organ measurement

50. During an ultrasound-guided procedure, a running number displayed on screen continuously shows the estimated current depth of the needle tip beneath the skin surface. What is this on-screen element called?

- A.** The color box boundary
- B.** The focal-zone position indicator

- C. The depth-scale (centimeter ruler) marker
- D. A real-time numeric needle-tip depth readout

51. When an operator selects an endocavity exam preset but an abdominal curvilinear probe is the one actually connected, the system displays an on-screen warning before allowing the exam to proceed. What does this warning address?

- A. Electrical leakage-current safety
- B. The Spaulding classification of the transducer
- C. Automatic detection of a probe-type/exam-preset mismatch
- D. HIPAA-compliant image access control

52. In the system settings menu, the operator can choose whether the cine-loop buffer retains the most recent 3 seconds, 5 seconds, or 10 seconds of imaging. What does this setting control?

- A. The persistence (frame-averaging) level
- B. The spatial compounding angle range
- C. The dynamic range value
- D. The configurable cine-loop buffer capture length

53. During a lengthy exam, the sonographer flags a handful of the most diagnostically important images to be saved and easily located, separate from the complete raw image set that is also archived. What does this flagging feature represent?

- A. Modality worklist integration, an unrelated scheduling feature
- B. Key-image flagging, distinct from the full archived raw dataset
- C. An ellipsoid volume formula, an unrelated organ-volume calculation
- D. DICOM lossy compression, an unrelated file-size technique

54. Before committing to a magnified zoom view, the operator sees a small preview box overlaid on the full image showing exactly which region will be enlarged. What is this preview feature called?

- A.** The biopsy guide-line, an unrelated needle-path overlay
- B.** The color box boundary, an unrelated Doppler region-of-interest tool
- C.** A zoom-region preview box shown before magnification is applied
- D.** The focal-zone position indicator, an unrelated focus-depth marker

55. After the sonographer places calipers on the gallbladder wall, the system automatically calculates the wall thickness and flags the value if it exceeds a predefined normal threshold. What software feature does this describe?

- A.** Automated ejection fraction calculation, an unrelated cardiac metric
- B.** Automated aortic-valve-area calculation, an unrelated cardiac metric
- C.** Automated carotid IMT measurement, an unrelated vascular metric
- D.** Automated gallbladder wall thickness measurement with threshold flag

56. After the sonographer places calipers along the long axis of the kidney, the system automatically calculates renal length and can compare it to a stored value from a prior exam. What software feature does this describe?

- A.** Automated ejection fraction calculation
- B.** Automated gallbladder wall thickness measurement
- C.** Automated carotid IMT measurement
- D.** Automated renal length measurement and tracking software

57. On a shear-wave elastography display, the operator can toggle the numeric stiffness output between kilopascals (kPa) and meters per second (m/s) shear-wave speed. What does this toggle change?

- A.** The underlying physics of the tissue being measured
- B.** Only the displayed unit changes, not the underlying measurement itself
- C.** The transducer's operating frequency
- D.** The Doppler angle correction applied to the measurement

58. The system automatically records every gain, TGC, and depth adjustment made during an exam, along with the exact time each change occurred, for later quality review. What is this record called?

- A.** A structured measurement worksheet
- B.** A modality worklist entry
- C.** A time-stamped settings-change audit trail
- D.** An ellipsoid volume calculation

59. During a live spectral Doppler scan, the sonographer presses a control that automatically freezes the display on the single frame containing the highest measured peak systolic velocity observed so far. What is this feature called?

- A.** Persistence, an unrelated frame-averaging technique
- B.** Automatic "freeze on peak value" capture during a live scan
- C.** Spatial compounding, an unrelated multi-angle technique
- D.** Cine-loop frame bookmarking, an unrelated manual-flagging feature

60. A system has two transducer ports and allows the operator to quickly toggle live scanning between two different connected probes without physically disconnecting either one. What does this capability describe?

- A.** A single-port wireless transducer connection, an unrelated feature
- B.** Dual-transducer connection with quick toggling between probes
- C.** A duplex probe with a dedicated CW crystal, an unrelated design
- D.** An automated breast volume scanner, an unrelated system

61. A small running clock displayed in the corner of the screen shows how much time has elapsed since the current exam was started. What is this on-screen element called?

- A.** The focal-zone position indicator
- B.** The depth-scale marker
- C.** The color box boundary

D. An on-screen exam-duration timer

62. After the operator enters a patient's height and weight, the system automatically adjusts default gain and frequency settings for that specific body habitus, beyond the fixed MI/TI output capping already applied for a pediatric preset. What does this additional adjustment represent?

- A.** The pediatric-preset MI/TI output cap itself
- B.** The Output Display Standard's basic requirement
- C.** The AIUM Statement on Prudent Use, applied manually
- D.** A general body-habitus-based preset adjustment beyond pediatric capping

63. Based on the measurements and images entered during a thyroid exam, the software suggests a ranked list of possible diagnoses for the interpreting physician to consider, distinct from simply flagging a standard anatomic view. What is this AI-based feature called?

- A.** An AI-generated differential-diagnosis prompt list
- B.** AI-assisted automatic view-recognition and measurement software
- C.** Automatic Doppler envelope tracing
- D.** A structured report-generation template

64. A wireless, battery-powered transducer displays a small icon on the system screen showing its remaining charge level during scanning. What is this on-screen element called?

- A.** The focal-zone position indicator, an unrelated focus-depth marker
- B.** The color box boundary, an unrelated Doppler region-of-interest tool
- C.** The depth-scale marker, an unrelated centimeter ruler
- D.** An on-screen wireless-transducer battery-level indicator

65. After the sonographer places calipers on the thyroid's length, width, and depth for each lobe, the system automatically applies the ellipsoid formula to calculate total thyroid volume. What software feature does this describe?

- A. Automated thyroid volume calculation software
- B. Automated ejection fraction calculation
- C. Automated aortic-valve-area calculation
- D. Automated carotid IMT measurement

66. Along one edge of the live scanning screen, small thumbnail versions of the most recently saved images from the current exam are displayed, letting the operator glance back at prior captures without leaving live imaging. What is this feature called?

- A. The biopsy guide-line, an unrelated needle-path overlay
- B. The color box boundary, an unrelated Doppler region-of-interest tool
- C. The focal-zone position indicator, an unrelated focus-depth marker
- D. An on-screen recent-image thumbnail strip

67. The system automatically plots a single measurement, such as liver span, across each of the patient's last several visits on a simple line graph, without the operator manually compiling the values. What is this feature called?

- A. An ellipsoid volume formula, an unrelated organ-volume calculation
- B. A trend graph plotting one value across multiple prior visits
- C. Automated ejection fraction calculation, an unrelated cardiac metric
- D. A modality worklist entry, an unrelated scheduling feature

68. After the sonographer measures splenic length, the system compares the value to a normal threshold and flags the study if the measurement suggests splenomegaly. What software feature does this describe?

- A. Automated ejection fraction calculation
- B. Automated gallbladder wall thickness measurement
- C. Automated spleen length measurement with a splenomegaly flag
- D. Automated carotid IMT measurement

69. A small percentage figure displayed on screen shows how many of the required images and measurements for a standardized protocol have been captured so far during the current exam. What is this on-screen element called?

- A.** An on-screen exam-completeness percentage indicator
- B.** The focal-zone position indicator, an unrelated focus-depth marker
- C.** The color box boundary, an unrelated Doppler region-of-interest tool
- D.** The depth-scale marker, an unrelated centimeter ruler

70. When a specific sonographer logs into the system, her own saved combination of preferred gain, depth, and preset settings for each exam type is automatically loaded, distinct from a generic factory default. What does this represent?

- A.** Modality worklist integration
- B.** A structured report-generation template
- C.** The pediatric-preset MI/TI output cap
- D.** A personalized, per-sonographer default preset profile

71. Regardless of the physical angle at which the sonographer holds the transducer, the displayed image is automatically rotated so a standardized anatomic landmark always appears in the same position on screen. What does this automatic correction represent?

- A.** Cine-loop frame bookmarking, an unrelated manual-flagging feature
- B.** An ellipsoid volume formula, an unrelated organ-volume calculation
- C.** Automatic image-orientation correction to a standardized anatomic display
- D.** A structured measurement worksheet, an unrelated data-entry feature

72. After the sonographer measures a structure, the system automatically displays the numeric difference between today's value and the same structure's value from the patient's last stored exam. What does this display feature provide?

- A.** An ellipsoid volume formula, an unrelated organ-volume calculation
- B.** A structured report-generation template, an unrelated documentation feature

- C. Automated ejection fraction calculation, an unrelated cardiac metric
- D. An automatic prior-exam measurement delta (change) display

73. At the start of a follow-up exam, the measurement worksheet automatically pre-populates each field with the corresponding value from the patient's prior visit, which the sonographer then updates with new measurements. What does this pre-population represent?

- A. A worksheet auto-populated with prior-exam values as a reference
- B. Modality worklist integration, an unrelated scheduling feature
- C. DICOM lossy compression, an unrelated file-size technique
- D. The pediatric-preset MI/TI output cap, an unrelated safety interlock

74. After each image is captured, an algorithm automatically scores it for focus, gain, and probe contact quality, flagging suboptimal images for the sonographer to reacquire before moving on. What is this feature called?

- A. Automatic Doppler envelope tracing, an unrelated spectral feature
- B. Modality worklist integration, an unrelated scheduling feature
- C. A structured measurement worksheet, an unrelated data-entry feature
- D. An AI-based image-quality score/grading feedback feature

75. Partway through a standardized exam protocol, the system displays a prompt suggesting which specific view or measurement the sonographer should acquire next, based on which required items remain outstanding. What is this feature called?

- A. Modality worklist integration, an unrelated scheduling feature
- B. An ellipsoid volume formula, an unrelated organ-volume calculation
- C. A structured report-generation template, an unrelated documentation feature
- D. An on-screen "next recommended view" protocol-guidance prompt

76. A sonographer customizes which physical footswitch pedal and which keyboard keys trigger her most commonly used functions, such as freeze, save, and caliper activation. What does this customization represent?

- A.** Configurable footswitch/keyboard shortcut mapping for common functions
- B.** Modality worklist integration, an unrelated scheduling feature
- C.** An ellipsoid volume formula, an unrelated organ-volume calculation
- D.** DICOM lossy compression, an unrelated file-size technique

77. Several weeks after a liver transplant, Doppler of the portal vein anastomosis shows markedly elevated peak velocity at a focal narrowing, with a lower, dampened waveform beyond it. What complication does this suggest?

- A.** Portal vein anastomotic stenosis, a recognized transplant complication
- B.** Normal expected anastomotic flow, without abnormality
- C.** Hepatic artery thrombosis, an unrelated arterial complication
- D.** Normal hepatopetal flow, without any abnormality

78. A scrotal ultrasound shows a fluid collection around the testicle. Grayscale and Doppler help distinguish whether the collection is a simple avascular hydrocele, a dilated, compressible venous plexus with reflux (varicocele), or blood products from trauma (hematocele). What does this Doppler-aided differentiation primarily rely on?

- A.** Measuring the testicle's resistive index alone, an incomplete approach
- B.** Assessing only the epididymis, without evaluating the collection itself
- C.** The internal flow character: simple fluid, refluxing venous flow, or complex content
- D.** Measuring only the unaffected contralateral side, ignoring the collection

79. A renal transplant patient develops new hydronephrosis on grayscale imaging. Doppler of the transplant kidney shows an elevated resistive index compared to prior exams. What does this elevated RI most likely reflect in this specific clinical context?

- A.** Normal expected transplant RI, unrelated to the new hydronephrosis

- B.** Confirmed rejection, to the exclusion of any other possible cause
- C.** A technically inadequate Doppler angle throughout the entire kidney
- D.** Increased resistance from obstruction, a distinct cause of RI elevation

80. A pediatric abdominal ultrasound identifies a large, solid renal mass. Color Doppler shows prominent internal vascularity within the mass. In a child of this age, what does this vascular solid renal mass most classically suggest?

- A.** A simple renal cyst, an avascular unrelated finding
- B.** Wilms tumor, a vascular pediatric renal malignancy
- C.** A normal renal pyramid, an unrelated anatomic structure
- D.** Renal artery stenosis, an unrelated vascular finding

81. An infant is found to have a hepatic mass with intense internal color Doppler flow and is also noted to have signs of high-output cardiac failure. What congenital hepatic lesion does this combination suggest?

- A.** A simple hepatic cyst, an avascular unrelated finding
- B.** Normal neonatal liver, an unrelated baseline finding
- C.** Hepatic adenoma, a distinct and less vascular lesion type
- D.** Infantile hepatic hemangioma with high-flow shunting

82. An incidental finding on abdominal ultrasound shows a focal, rounded, anechoic-appearing structure adjacent to the splenic hilum. Color Doppler reveals swirling arterial flow within it, connecting to the splenic artery. What does this represent?

- A.** A splenic artery aneurysm
- B.** A normal splenic vein
- C.** A splenic infarct
- D.** A simple splenic cyst

83. A patient with cirrhosis and known portal hypertension undergoes ultrasound, which shows dilated, tortuous vessels near the gastroesophageal junction with hepatofugal flow on Doppler, connecting the portal venous system to the systemic venous system via the coronary (left gastric) vein. What does this represent?

- A.** A splenorenal shunt, a distinct collateral pathway
- B.** Normal portal vein hepatopetal flow, the opposite direction
- C.** Gastric/esophageal varices via coronary vein portosystemic shunting
- D.** Nutcracker syndrome, an unrelated renal-vein finding

84. A patient with a mediastinal mass presents with facial swelling and distended neck veins. Doppler of the superior vena cava shows markedly diminished or absent flow with prominent collateral venous channels in the chest wall. What does this suggest?

- A.** Normal superior vena cava flow, without abnormality
- B.** Superior vena cava syndrome with collateral flow
- C.** Budd-Chiari syndrome, an unrelated hepatic-vein finding
- D.** May-Thurner syndrome, an unrelated iliac-vein finding

85. A dialysis patient with a history of multiple prior central venous catheters develops ipsilateral arm swelling. Doppler of the subclavian vein shows a focal area of elevated velocity and loss of normal respiratory phasicity proximal to the swelling. What does this suggest?

- A.** A normal subclavian vein waveform
- B.** Central venous stenosis from prior catheter-related scarring
- C.** A normal arteriovenous fistula waveform, an unrelated structure
- D.** Testicular torsion, an entirely unrelated organ system

86. A critically ill patient on high-dose vasopressors develops abdominal pain. Mesenteric duplex shows patent, non-stenotic mesenteric arteries but diffusely diminished flow velocities throughout, without a focal stenosis. What mechanism does this suggest?

- A.** Focal atherosclerotic stenosis of a single mesenteric vessel

- B. Median arcuate ligament compression**
- C. Mesenteric venous thrombosis**
- D. Non-occlusive mesenteric ischemia from a systemic low-flow state**

87. In a patient on anticoagulation therapy with a new, enlarging soft-tissue hematoma, color Doppler identifies a focal jet of flow extending from an adjacent artery directly into the hematoma itself, rather than remaining contained within a discrete sac. What does this specific finding suggest?

- A. A contained pseudoaneurysm with flow confined to a discrete sac**
- B. Active arterial extravasation (a color jet extending into the hematoma)**
- C. A simple, uninfected hematoma, without any vascular connection**
- D. Normal arterial flow, without any abnormality present**

88. A focal liver lesion shows a distinctive color Doppler pattern of vessels radiating outward from a central feeding artery, resembling the spokes of a wheel. What benign liver lesion is classically associated with this specific vascular pattern?

- A. A simple hepatic cyst, an avascular unrelated finding**
- B. Focal nodular hyperplasia, classically showing this spoke-wheel pattern**
- C. A hepatic hemangioma, a distinct vascular lesion type**
- D. Hepatic artery thrombosis, an unrelated vascular complication**

89. A pregnant patient presents with vaginal bleeding and abdominal pain. Ultrasound shows a collection between the placenta and uterine wall with no internal color Doppler flow, distinct from the surrounding vascularized placental tissue. What does this finding suggest?

- A. Placental abruption, an avascular retroplacental hematoma**
- B. Normal placental implantation, without abnormality**
- C. A vein of Galen malformation, an unrelated intracranial entity**
- D. An umbilical vein varix, a distinct fetal finding**

90. In a monochorionic twin pregnancy, Doppler shows markedly discordant umbilical artery waveforms between the two fetuses, with one showing absent end-diastolic flow and the other showing an abnormally low-resistance pattern. What condition does this discordance help identify?

- A.** A normal dichorionic twin pregnancy
- B.** Twin-to-twin transfusion syndrome
- C.** A single normal singleton pregnancy
- D.** Uterine artery notching alone

91. Transrectal Doppler of the prostate in a patient with suspected acute prostatitis shows diffusely increased glandular vascularity compared to a typical asymptomatic gland. What does this increased vascularity primarily reflect?

- A.** A normal, expected finding in every adult prostate
- B.** Complete absence of prostatic blood flow
- C.** Benign prostatic hypertrophy exclusively, unrelated to inflammation
- D.** Inflammatory hyperemia consistent with acute prostatitis

92. A patient with known Crohn's disease undergoes bowel ultrasound, which shows a thickened segment of small bowel wall with increased color Doppler flow within the wall itself. What does this increased bowel-wall vascularity suggest?

- A.** A normal, uninflamed bowel segment
- B.** Complete bowel obstruction with no inflammatory component
- C.** Active inflammation within that segment of bowel
- D.** A simple mesenteric lymph node, unrelated to the bowel wall

93. A soft-tissue hematoma is followed with serial ultrasound over several weeks. The early exam shows a heterogeneous collection with internal septations and some internal echoes, while a later exam shows the same collection appearing more uniformly anechoic with no internal septations. What process does this evolving appearance reflect?

- A.** Organization/liquefaction over time, from heterogeneous to anechoic

- B.** Active new arterial bleeding, a distinct acute finding
- C.** A congenital vascular malformation, present since birth
- D.** A normal, unchanged muscle appearance throughout

94. Following a stab wound to the thigh, Doppler identifies an abnormal direct connection between the femoral artery and femoral vein, with turbulent, high-velocity flow and arterialization of the venous waveform. What does this represent?

- A.** A normal postoperative finding requiring no further workup
- B.** A surgically created dialysis fistula
- C.** An iatrogenic post-biopsy fistula
- D.** A traumatic arteriovenous fistula from penetrating injury

95. An elderly patient with new headache, jaw claudication, and visual symptoms undergoes temporal artery ultrasound, which shows a dark, hypoechoic, concentric thickening surrounding the vessel lumen. What is this sonographic finding called, and what does it suggest?

- A.** The macaroni sign, suggesting Takayasu arteritis
- B.** The halo sign, suggesting giant cell (temporal) arteritis
- C.** The lyre sign, suggesting a carotid body tumor
- D.** The whirlpool sign, suggesting ovarian torsion

96. A patient with a history of intravenous drug use presents with neck swelling. Ultrasound shows a non-compressible internal jugular vein filled with echogenic material and no Doppler flow. What does this describe?

- A.** Normal internal jugular vein flow
- B.** Internal jugular vein thrombosis
- C.** A normal finding used for central-line guidance
- D.** Subclavian steal physiology

97. A young, athletic patient develops sudden arm swelling after vigorous overhead activity. Doppler of the axillary/subclavian vein shows a non-compressible segment filled with echogenic material and absent flow. What condition does this describe?

- A.** A normal axillary vein waveform
- B.** Popliteal artery entrapment, an unrelated lower-extremity condition
- C.** Axillary/subclavian vein thrombosis (effort thrombosis)
- D.** Subclavian steal physiology

98. Following a cardiac catheterization via the brachial artery, the patient develops a pulsatile mass at the access site. Doppler shows swirling, to-and-fro flow within the mass, connecting to the brachial artery through a narrow neck. What does this describe?

- A.** A normal postprocedural hematoma with no vascular connection
- B.** A surgically created dialysis fistula
- C.** Normal brachial artery flow with no complication
- D.** A brachial artery pseudoaneurysm at the catheterization site

99. A patient with a remote history of deep vein thrombosis undergoes follow-up ultrasound, which shows the main portal vein replaced by a tangle of small, tortuous collateral venous channels rather than a single patent vessel. What chronic finding does this represent?

- A.** Acute portal vein thrombosis, a distinct earlier-stage finding
- B.** Portal vein cavernous transformation, a chronic collateral network
- C.** A normal main portal vein, without abnormality
- D.** Nutcracker syndrome, an unrelated renal-vein finding

100. A patient has a palpable mass behind the knee. Ultrasound shows a focally dilated, thin-walled popliteal VEIN segment (not artery) with slow, swirling venous flow within the dilation. What does this describe?

- A.** A true popliteal artery aneurysm, an arterial rather than venous finding
- B.** Popliteal artery entrapment, an unrelated arterial-compression condition

- C. A Baker's cyst, an entirely avascular cystic structure
- D. A popliteal vein aneurysm, a venous rather than arterial dilation

101. A young woman presents with a transient ischemic attack. Carotid ultrasound shows a thin, shelf-like intraluminal projection arising from the posterior wall of the internal carotid artery, distinct from typical atherosclerotic plaque. What entity does this suggest?

- A. A typical atherosclerotic plaque, a different focal wall finding
- B. A carotid body tumor, an unrelated hypervascular mass
- C. A carotid web, a fibromuscular-dysplasia-related intraluminal shelf
- D. A pseudoaneurysm, an unrelated focal wall-defect finding

102. During evaluation of a potential living kidney donor, renal Doppler and CT angiography identify a second, smaller renal artery supplying the same kidney in addition to the main renal artery. What does this additional vessel represent?

- A. Renal artery stenosis, a pathologic narrowing of the main vessel
- B. Renal vein thrombosis, an unrelated venous finding
- C. Nutcracker syndrome, an unrelated renal-vein finding
- D. An accessory (duplicated) renal artery, a normal donor-evaluation variant

103. A febrile patient with a history of endocarditis is found to have a rapidly enlarging, irregularly walled arterial aneurysm with surrounding inflammatory changes on Doppler. What type of aneurysm does this clinical context suggest?

- A. A mycotic (infected) aneurysm
- B. A simple, chronic atherosclerotic aneurysm
- C. A congenital berry aneurysm
- D. A pseudoaneurysm from a prior biopsy

104. On a routine third-trimester obstetric ultrasound, a focal, saccular dilation is identified within the intra-abdominal portion of the fetal umbilical vein. What is this finding called?

- A.** A ductus venosus a-wave reversal, an unrelated venous waveform
- B.** Umbilical artery absent end-diastolic flow, an unrelated arterial finding
- C.** A vein of Galen malformation, an unrelated intracranial entity
- D.** An umbilical vein varix, a focal dilation of the vein itself

105. A patient with a history of neck radiation therapy several years earlier for head and neck cancer develops new arm symptoms. Doppler of the subclavian artery shows a focal, smooth, concentric narrowing with elevated velocity at that segment. What does this suggest?

- A.** Radiation-induced subclavian stenosis, a delayed radiotherapy complication
- B.** A normal subclavian artery waveform, without abnormality
- C.** May-Thurner syndrome, an unrelated iliac-vein finding
- D.** Popliteal artery entrapment, an unrelated lower-extremity condition

106. Following placement of a synthetic vascular bypass graft, a patient develops fever and Doppler shows an abnormal fluid collection surrounding the graft with disorganized, low-level internal echoes and no clear internal flow. What complication does this raise concern for?

- A.** An endoleak, a distinct finding within an aneurysm sac
- B.** Normal expected postoperative graft healing, without complication
- C.** Vascular graft infection, a perigraft fluid collection
- D.** In-stent restenosis, a distinct intraluminal velocity finding

107. A pediatric neck mass shows multiple large, thin-walled, fluid-filled cystic spaces on grayscale imaging, with no internal flow detected on color Doppler within the cystic spaces themselves. What type of vascular anomaly does this suggest?

- A.** A macrocystic lymphatic malformation, without internal flow
- B.** An arteriovenous malformation, showing prominent internal flow

- C. A carotid body tumor, an unrelated hypervascular solid mass
- D. A venous malformation, typically showing some slow internal flow

108. Before creating a radiocephalic dialysis fistula, the surgeon requests a Doppler assessment of the radial artery's caliber, waveform, and patency at the wrist. What is the primary purpose of this preoperative Doppler evaluation?

- A. To assess for testicular torsion, an unrelated organ system
- B. To measure the ankle-brachial index, an unrelated lower-extremity metric
- C. To confirm adequate radial artery inflow before planning fistula creation
- D. To screen for renal artery stenosis, an unrelated vessel

109. During a lower-extremity venous duplex exam, the sonographer notes the popliteal vein splits into two parallel channels for a short segment before rejoining into a single vessel, a normal anatomic variant. What is the main practical significance of recognizing this variant during a DVT scan?

- A. It confirms the patient has deep vein thrombosis
- B. Both channels need individual compressibility checks, or thrombus could be missed
- C. It means the patient cannot have a DVT at that level
- D. It requires switching to a completely different transducer frequency

110. A patient with back pain and fever undergoes ultrasound, which shows an elongated fluid collection within the psoas muscle with a rim of increased color Doppler flow surrounding a central area with no flow. What does this finding suggest?

- A. A normal psoas muscle, without any abnormality present
- B. A simple, uninfected hematoma, without this hyperemic rim
- C. A psoas abscess, with rim hyperemia around an avascular center
- D. A normal iliopsoas tendon, an unrelated structure entirely

Answers

- 1. B.** Raising the side rail and using a gait belt for an unsteady patient during table transfer addresses patient fall-prevention and positioning safety, a basic patient-safety practice. This is unrelated to transducer disinfection classification, electrical safety testing, or HIPAA image access controls.
- 2. A.** Explicitly confirming and documenting laterality before each portion of a paired-organ exam prevents wrong-side documentation errors, a recognized patient-safety and medical-record-accuracy concern distinct from electrical safety, allergy screening, or disinfectant contact-time requirements.
- 3. A.** Confirming the absence of a known allergy to the specific contrast agent or its components before administration is a contrast-agent allergy screening step, a distinct safety verification from the agent's underlying microbubble mechanism. This is unrelated to disinfection classification, HIPAA access control, or electrical safety testing.
- 4. C.** Donning isolation-specific gown and gloves beyond standard precautions addresses contact-isolation-specific PPE requirements for a patient with a known resistant organism, an additional layer beyond the baseline precautions used for every patient. This is unrelated to disinfection classification, HIPAA access control, or electrical safety testing.
- 5. B.** Waiting for the disinfectant's full labeled wet-contact time ensures the product remains on the surface long enough to achieve its intended disinfection level, a requirement specific to that product's labeling. This is unrelated to the Curie point, fractional bandwidth, or HIPAA access control.
- 6. D.** Radiofrequency emissions/electromagnetic compatibility (EMC) testing verifies new equipment does not emit interference affecting nearby devices and is not itself affected by interference from other equipment, a distinct engineering safety concern from electrical leakage current, phantom QA, or the Spaulding classification.
- 7. D.** Two-person independent verification of medication, dose, and patient identity before administering a high-risk medication such as a contrast agent is a recognized safety practice reducing administration errors. This is unrelated to the Spaulding classification, electrical safety testing, or HIPAA access control.
- 8. A.** Post-procedure discharge instructions covering bleeding, swelling, or other complication precautions ensure the patient knows when to seek care after an invasive procedure such as a biopsy. This is unrelated to HIPAA access control, the Spaulding classification, or electrical safety testing.
- 9. D.** A structured new-hire competency checklist verifies a new sonographer's skills across defined exam types and equipment before independent practice, a onetime onboarding assessment distinct from the ongoing periodic CME credits required to maintain an existing registry credential. This is unrelated to the Spaulding classification or electrical safety testing.

- 10. B.** An annual evacuation drill addresses facility disaster/emergency preparedness training, ensuring staff know the facility's plan for safely evacuating patients and staff during a fire or other emergency. This is unrelated to the Spaulding classification, electrical safety testing, or HIPAA access control.
- 11. D.** A battery-powered, cordless transducer's electrical safety profile differs meaningfully from corded, AC-powered equipment, so the specific electrical safety testing considerations that apply are not simply identical to standard corded-equipment leakage-current testing. Wireless probes are not exempt from all electrical safety testing, and the Spaulding classification concerns disinfection level, not electrical safety.
- 12. B.** Mode conversion describes a portion of an obliquely incident longitudinal wave's energy converting into a different wave type, such as a shear wave, upon striking certain interfaces (notably bone), a phenomenon distinct from the piezoelectric effect (an unrelated material property), the Doppler shift (a velocity-related frequency change), or simple specular reflection (which does not involve a wave-type change).
- 13. C.** The inverse square law describes the purely geometric loss of intensity as a wave's energy spreads over an increasingly large area with distance from a point source, independent of any tissue attenuation. The half-value layer, Snell's Law, and the piezoelectric effect are unrelated concepts, not this geometric spreading principle.
- 14. B.** In a dispersive medium (where speed varies with frequency), phase velocity (the speed of an individual wave crest) and group velocity (the speed of the overall pulse envelope) are two distinct, related quantities describing wave propagation. Duty factor/PRF, SPL/pulse duration, and near-zone/far-zone are unrelated pairs of terms.
- 15. C.** The decibel scale requires a defined reference intensity level as its baseline (the 0 dB point), against which all other intensity values are expressed as a ratio. The Nyquist limit, Curie point, and duty factor are unrelated concepts, not this reference-value baseline.
- 16. D.** Diagnostic ultrasound wavelengths (roughly fractions of a millimeter) are many orders of magnitude longer than diagnostic X-ray wavelengths (roughly fractions of a nanometer), reflecting the fundamentally different physical nature of mechanical sound waves versus electromagnetic X-rays. The two are not remotely similar in scale, and wavelength scale is highly relevant to both modalities' imaging physics.
- 17. B.** An evanescent wave is the brief, rapidly decaying, non-propagating field that penetrates a short distance into the second medium beyond the critical angle during total internal reflection, distinct from the half-value layer (an attenuation-depth measure), the piezoelectric effect (a material property), or spatial compounding (an imaging technique).
- 18. A.** The formula $p = Z \times u$ relates a sound wave's local acoustic pressure (p) to the medium's acoustic impedance (Z) and the particle velocity (u) at that point, a fundamental acoustic wave relationship. The

Doppler shift equation, range equation, and reflection coefficient formula are distinct formulas relating different variables.

19. A. The nonlinearity parameter B/A characterizes how strongly a given tissue's acoustic behavior deviates from ideal linear propagation as amplitude increases, an advanced parameter relevant to nonlinear propagation phenomena. Duty factor, half-value layer, and Nyquist limit are unrelated parameters, not this nonlinearity characterization.

20. B. The Rayl is the named unit of acoustic impedance, equal to $\text{kg}/(\text{m}^2 \times \text{s})$, analogous to how electrical resistance is measured in ohms. The Hertz measures frequency, the Neper is an alternative logarithmic attenuation unit, and the Decibel is a logarithmic ratio unit -- none of which is the named unit for acoustic impedance.

21. C. The -3 dB (half-power) bandwidth-edge threshold defines a transducer's usable bandwidth as the frequencies at which output power has dropped to half its peak value, a distinct application of decibel thresholds from the -6 dB points sometimes used to characterize beam width. The half-value layer and Nyquist limit are unrelated concepts.

22. B. A hydrophone is a small, calibrated receiving device placed within the beam to directly measure the actual acoustic pressure waveform at specific points, used for detailed beam-profile mapping during calibration -- distinct from a radiation-force balance (which measures total power via force, not detailed pressure mapping), an electrical leakage-current tester, or a tissue-mimicking phantom.

23. A. Acoustic dispersion describes propagation speed varying with frequency in certain media, a distinct phenomenon from attenuation's frequency dependence, and generally negligible (though not exactly zero) in soft tissue. The Curie point, fractional bandwidth, and Nyquist limit are unrelated concepts, not this speed-frequency phenomenon.

24. D. The far-zone beam divergence angle can be estimated using a formula relating wavelength to the transducer's aperture diameter, describing how quickly the beam spreads once it enters the far zone. The Doppler shift angle, critical angle, and reflection coefficient are unrelated concepts, not this beam-divergence estimate.

25. B. Particle displacement amplitude (how far a particle moves from rest) and particle velocity amplitude (how fast it moves during that oscillation) are two related but numerically distinct ways of describing the same underlying particle motion in a sound wave. Wavelength/period, duty factor/PRF, and SPL/pulse duration are unrelated pairs of terms.

26. D. The reflection coefficient at a given interface depends only on the acoustic impedance values of the two tissues involved, not on the transmitted frequency -- unlike attenuation, which is frequency-dependent. The reflection coefficient does not simply increase or decrease with frequency, and it can, in fact, be calculated from impedance values alone without needing to know frequency.

- 27. A.** Duty factor equals pulse duration divided by pulse repetition period: 2 microseconds / 500 microseconds = 0.004, or 0.4%, consistent with the very low duty factor typical of pulsed B-mode imaging. The other calculations misapply the formula, using multiplication, an inverted ratio, or subtraction instead of the correct division.
- 28. B.** The maximum mechanical sweep angle of a 3D/4D probe's internal tilting array directly determines the width of the acquired volume dataset -- a wider sweep angle captures a wider volume. This specification does not determine operating frequency, the Curie point, or fractional bandwidth, which are unrelated transducer characteristics.
- 29. A.** Ultra-portable pocket-sized probes using a single element or sparse array trade reduced beam steering/focusing capability and overall image quality for the benefits of smaller size and lower cost, a fundamental engineering trade-off. This design does not eliminate image-quality limitations, does not automatically increase frequency, and does not guarantee a wider field of view than a full matrix array.
- 30. B.** A multiplane TEE probe allows continuous electronic rotation of the imaging plane through a full range of angles, offering more flexible imaging than a biplane probe's two fixed orthogonal planes. Micro-convex and intraoperative probes are unrelated transducer types used in different clinical contexts.
- 31. D.** Synthetic aperture imaging acquires several sequential transmissions from different small element groups, then computationally combines the resulting data to synthesize the effect of a much larger effective aperture than was ever physically active at one instant. MLA (multiple receive beams per single transmit), RCA (row/column element addressing), and apodization (aperture amplitude tapering) are distinct, unrelated techniques.
- 32. C.** Field-return failure analysis examines transducers that have already failed in clinical use after being returned, identifying common failure patterns to inform future design improvements -- a distinct quality process from pre-shipment burn-in testing (which occurs before any clinical use), ongoing lifetime output-drift monitoring (a calibration check), or the clinical dead-element threshold (an in-use QA pass/fail criterion).
- 33. B.** Chip-on-tip transducer design embeds significant beamforming electronics directly within the probe handle, reducing the number of raw signal channels that must travel through the cable to the console. RCA, MLA, and synthetic aperture imaging are distinct techniques addressing element addressing, receive-beam density, and aperture synthesis, respectively, not electronics placement within the probe itself.
- 34. C.** The biopsy-guide bracket is the rigid physical hardware attachment on a transvaginal (or similar) transducer that constrains an inserted needle to a fixed, predictable path, distinct from the acoustic lens (elevational focusing), matching layer (acoustic transmission), or kerf (inter-element gap), which are internal transducer components unrelated to needle guidance.

35. B. Factory burn-in testing runs each newly manufactured transducer continuously for an extended period before shipment, specifically to catch early, infant-mortality-type failures before the unit ever reaches a clinical customer -- distinct from acceptance testing (performed by the purchasing facility after delivery), the clinical dead-element threshold (an in-use QA criterion), or lifetime output-drift monitoring (ongoing periodic testing after clinical deployment).

36. D. Element manufacturing yield describes the percentage of newly diced elements that pass initial electrical/acoustic QC testing before final assembly, a factory-level metric distinct from fractional bandwidth, the Curie point, or effective radiating area, which describe finished-transducer specifications rather than a manufacturing rejection rate.

37. C. Acoustic lens abrasion-resistance/durability rating describes how well the lens material withstands repeated disinfectant wiping and physical contact over its service life without cracking or clouding, a materials-durability specification distinct from the Curie point, fractional bandwidth, or the dead-element acceptability threshold, which address unrelated transducer properties.

38. D. Aperture width equals depth divided by F-number: $8 \text{ cm} / 2 = 4 \text{ cm}$, the standard relationship maintaining a constant F-number as receive focus depth increases. The other values do not correctly apply this formula to the given depth and F-number.

39. B. A physical, printed serial number/model marking on the housing provides a manual, non-electronic way to identify a specific transducer, serving as a backup to the automatic identification chip read by the system on connection. The Curie point and fractional bandwidth are unrelated transducer specifications, not an identification marking.

40. A. A coarser element pitch (larger center-to-center spacing relative to wavelength) generally supports a smaller maximum usable electronic steering angle before problematic grating lobes appear, compared to a finer-pitch array, since grating lobes become significant at smaller steering angles as element spacing increases relative to wavelength. Pitch does meaningfully affect maximum steering angle, and the two arrays would not support an identical maximum angle.

41. D. A smaller aperture combined with a higher frequency generally produces more rapid far-zone beam divergence, since near-zone length (which delays the onset of divergence) is proportional to aperture squared, favoring a larger aperture to extend the near zone and reduce far-zone spread; frequency's relationship is more complex but a small-aperture, high-frequency combination tends toward greater far-zone divergence relative to a large-aperture, low-frequency probe. Aperture and frequency do meaningfully affect far-zone divergence, so the two combinations do not diverge identically.

42. A. Connector keying design uses an asymmetric physical shape so the connector fits only into its correctly matched port, preventing accidental connection to an incompatible system port. The matching layer, acoustic lens, and kerf are unrelated internal transducer components, not this external connector-shape safeguard.

- 43. A.** A manufacturer-specified maximum useful imaging depth for a specific probe/frequency combination tells the operator the practical depth limit beyond which image quality is expected to degrade substantially for that probe. This specification is unrelated to the Curie point, fractional bandwidth, or the dead-element acceptability threshold, which describe different transducer properties.
- 44. D.** Manufacturing a single-crystal PMN-PT element is generally more complex and costly than manufacturing an equivalent polycrystalline PZT element, representing a cost/manufacturing-complexity trade-off that must be weighed against PMN-PT's sensitivity advantage when selecting transducer materials. PMN-PT does not eliminate cost considerations, PZT is not universally more expensive, and manufacturing cost is not identical between the two material types.
- 45. A.** A reprocessing cycle-count limit specifies the maximum number of high-level disinfection cycles an endocavity probe can safely undergo before its materials are considered too degraded for continued safe clinical use, prompting replacement. This is distinct from fractional bandwidth, effective radiating area, or the dead-element acceptability threshold, which address unrelated transducer specifications.
- 46. B.** Cine-loop frame bookmarking lets the operator flag a specific frame within the buffer for quick later retrieval, without needing to scroll back through the entire buffer. Freeze-frame simply halts on the current live frame, persistence averages across frames, and spatial compounding blends multiple beam angles -- none of which describe marking a specific buffered frame for later reference.
- 47. C.** Direct EHR/referring-physician inbox delivery integration sends the finalized report and key images directly into the physician's electronic inbox with a single action, distinct from modality worklist integration (which pulls scheduling data in before the exam), DICOM compression (a file-size technique), or a structured measurement worksheet (a data-entry feature).
- 48. D.** Standardized reporting lexicon integration prompts the sonographer to select from a recognized, specialty-standard categorical terminology system rather than free text, improving consistency and comparability across reports. Modality worklist integration, the ellipsoid volume formula, and automatic Doppler envelope tracing are unrelated features.
- 49. A.** Automatic critical/urgent finding flagging pages the on-call radiologist and elevates the study's priority on the reading worklist the moment a finding is marked urgent, supporting timely notification. This is distinct from routine modality worklist scheduling, DICOM compression, or the ellipsoid volume formula.
- 50. D.** A real-time numeric needle-tip depth readout continuously displays the estimated current depth of the needle tip during a guided procedure, a distinct on-screen element from the color box, focal-zone indicator, or general depth-scale ruler, which serve different purposes.
- 51. C.** An automatic probe-type/exam-preset mismatch warning alerts the operator when the connected transducer does not match the selected exam preset (such as an abdominal probe with an endocavity

preset selected), helping prevent an inappropriate exam setup. This is unrelated to electrical safety, the Spaulding classification, or HIPAA access control.

52. D. The configurable cine-loop buffer capture length setting lets the operator choose how many seconds of recent imaging the buffer retains, a distinct setting from persistence level, spatial compounding angle range, or dynamic range, which control different image-processing parameters.

53. B. Key-image flagging lets the sonographer mark a small subset of the most diagnostically important images for easy retrieval, distinct from and in addition to the complete raw image set that is also fully archived. This is unrelated to modality worklist integration, the ellipsoid volume formula, or DICOM compression.

54. C. A zoom-region preview box overlays the full image to show exactly which area will be magnified before the operator commits to the zoom, distinct from the biopsy guide-line, color box boundary, or focal-zone indicator, which serve different on-screen purposes.

55. D. Automated gallbladder wall thickness measurement with threshold flagging calculates wall thickness from placed calipers and flags values exceeding a normal threshold, a specific clinical auto-measurement distinct from ejection fraction, aortic valve area, or carotid IMT calculations, which apply to entirely different structures.

56. D. Automated renal length measurement and tracking software calculates kidney length from placed calipers and can compare it to a prior stored value, a specific clinical auto-measurement distinct from ejection fraction, gallbladder wall thickness, or carotid IMT calculations.

57. B. Toggling the elastography display between kPa and m/s changes only the displayed unit of the same underlying stiffness measurement, not the actual tissue property, transducer frequency, or any Doppler angle correction, none of which are affected by this display-unit choice.

58. C. A time-stamped settings-change audit trail automatically records every gain, TGC, and depth adjustment along with the exact time it occurred, supporting later quality review of scanning technique. This is distinct from a structured measurement worksheet, a modality worklist entry, or an ellipsoid volume calculation.

59. B. Automatic "freeze on peak value" capture halts the display on the single frame containing the highest measured value observed during live scanning, such as peak systolic velocity, distinct from persistence (frame averaging), spatial compounding (multi-angle blending), or cine-loop bookmarking (manual frame flagging).

60. B. Dual-transducer simultaneous connection allows the operator to quickly toggle live scanning between two connected probes without physically disconnecting either, a distinct hardware/workflow capability from a single wireless connection, a duplex probe's dedicated CW crystal, or an automated breast volume scanner.

- 61. D.** An on-screen exam-duration timer displays elapsed time since the exam began, a distinct on-screen element from the focal-zone indicator, depth-scale marker, or color box boundary, which convey different information entirely.
- 62. D.** A general body-habitus-based automatic preset adjustment uses entered patient height/weight to adjust default gain and frequency settings, an additional layer of automatic adjustment beyond (and distinct from) the fixed MI/TI output capping specifically applied when a pediatric preset is selected. This is not the pediatric cap itself, the basic Output Display Standard, or the manually-applied AIUM statement.
- 63. A.** An AI-generated differential-diagnosis prompt list suggests a ranked set of possible diagnoses based on entered measurements and images, a distinct diagnostic decision-support feature from AI-assisted view-recognition/measurement software, which instead automates standard-view identification and caliper placement rather than suggesting diagnoses.
- 64. D.** An on-screen wireless-transducer battery-level indicator displays the remaining charge of a battery-powered probe during scanning, a distinct on-screen element from the focal-zone indicator, color box boundary, or depth-scale marker, which convey unrelated information.
- 65. A.** Automated thyroid volume calculation software applies the ellipsoid formula to placed length/width/depth calipers on each lobe to calculate total thyroid volume, a specific clinical auto-measurement distinct from ejection fraction, aortic valve area, or carotid IMT calculations.
- 66. D.** An on-screen recent-image thumbnail strip displays small versions of the most recently saved images along the screen edge, letting the operator glance back at prior captures without leaving live imaging, distinct from the biopsy guide-line, color box boundary, or focal-zone indicator.
- 67. B.** A structured measurement trend graph automatically plots a single value, such as liver span, across multiple prior visits on a simple graph without manual compilation, a distinct longitudinal-tracking feature from the ellipsoid volume formula, ejection fraction calculation, or a modality worklist entry.
- 68. C.** Automated spleen length measurement with a splenomegaly flag compares the measured splenic length to a normal threshold and flags the study if splenomegaly is suggested, a specific clinical auto-measurement distinct from ejection fraction, gallbladder wall thickness, or carotid IMT calculations.
- 69. A.** An on-screen exam-completeness percentage indicator shows how many of a standardized protocol's required images and measurements have been captured so far, a distinct on-screen element from the focal-zone indicator, color box boundary, or depth-scale marker.
- 70. D.** A personalized, per-sonographer default preset profile automatically loads that individual's own saved preferred settings upon login, distinct from a generic factory default, modality worklist integration, a structured report template, or the pediatric-preset MI/TI output cap.

- 71. C.** Automatic image-orientation correction rotates the displayed image so a standardized anatomic landmark consistently appears in the same on-screen position, regardless of the transducer's physical holding angle, distinct from cine-loop bookmarking, the ellipsoid volume formula, or a structured measurement worksheet, which serve unrelated purposes.
- 72. D.** An automatic prior-exam measurement delta display calculates and shows the numeric change between today's measurement and the same structure's value from the patient's last stored exam, distinct from the ellipsoid volume formula, a structured report template, or ejection fraction calculation.
- 73. A.** A worksheet auto-populated with prior-exam values gives the sonographer a starting reference point at a follow-up exam, which is then updated with new measurements, distinct from modality worklist integration, DICOM compression, or the pediatric-preset MI/TI output cap.
- 74. D.** An AI-based image-quality score/grading feedback feature automatically scores each captured image for focus, gain, and probe contact quality, flagging suboptimal images for reacquisition, distinct from automatic Doppler envelope tracing, modality worklist integration, or a structured measurement worksheet.
- 75. D.** An on-screen "next recommended view" protocol-guidance prompt suggests which specific view or measurement remains outstanding partway through a standardized exam protocol, distinct from modality worklist integration, the ellipsoid volume formula, or a structured report-generation template.
- 76. A.** Configurable footswitch/keyboard shortcut mapping lets an individual sonographer customize which physical controls trigger her most commonly used functions, such as freeze, save, and caliper activation, distinct from modality worklist integration, the ellipsoid volume formula, or DICOM compression.
- 77. A.** Markedly elevated peak velocity at a focal narrowing of the portal vein anastomosis, with a dampened waveform beyond it, suggests portal vein stenosis, a recognized post-liver-transplant vascular complication requiring further evaluation. This is not normal anastomotic flow, is unrelated to hepatic artery thrombosis (a distinct arterial complication), and is not simply normal hepatopetal flow given the abnormal velocity pattern described.
- 78. C.** Differentiating a hydrocele, varicocele, and hematocele relies on assessing the collection's internal flow characteristics: simple anechoic avascular fluid (hydrocele), a dilated venous plexus with venous flow and reflux (varicocele), or complex, heterogeneous, avascular content (hematocele from blood products). This differentiation is not based on RI alone, does not exclude evaluating the collection itself in favor of the epididymis, and does not rely solely on the contralateral side.
- 79. D.** New hydronephrosis combined with a rising resistive index in a transplant kidney suggests increased intrarenal vascular resistance from obstructive hydronephrosis, a distinct cause of RI elevation separate from rejection, which can produce a similar RI rise through a different mechanism. This is not necessarily a normal expected RI, does not confirm rejection to the exclusion of the more likely

obstructive cause given the new hydronephrosis, and a genuine, reproducible RI trend is not explained by a technical angle problem throughout the kidney.

80. B. A large, vascular solid renal mass in a young child is classically concerning for Wilms tumor (nephroblastoma), the most common pediatric renal malignancy, which typically shows prominent internal vascularity on Doppler. A simple cyst would be avascular and anechoic, a normal renal pyramid would not present as a mass, and renal artery stenosis does not produce a solid renal mass.

81. D. An infantile hepatic hemangioma with high-flow arteriovenous shunting is a recognized cause of neonatal high-output cardiac failure, presenting as a hepatic mass with intense internal Doppler vascularity. A simple cyst and normal liver parenchyma would not show this vascularity or cause high-output failure, and a hepatic adenoma is a distinct, typically less vascular lesion type and an unusual finding in this age group.

82. A. A focal, rounded structure near the splenic hilum with swirling arterial Doppler flow connecting to the splenic artery describes a splenic artery aneurysm, a recognized vascular finding in that location. A normal splenic vein would show venous, not swirling arterial, flow, a splenic infarct would be avascular, and a simple cyst would show no internal flow at all.

83. C. Dilated, tortuous vessels near the gastroesophageal junction with hepatofugal flow connecting the portal system to systemic veins via the coronary (left gastric) vein describes gastric/esophageal varices from portosystemic shunting, a recognized portal hypertension complication distinct from a splenorenal shunt (a different collateral pathway), normal hepatopetal portal flow (the opposite direction), or nutcracker syndrome (a renal vein compression, unrelated vessel).

84. B. Markedly diminished or absent SVC flow with prominent chest-wall collateral venous channels, in a patient with facial swelling and a mediastinal mass, describes superior vena cava syndrome, in which SVC obstruction forces blood through collateral pathways. This is not normal SVC flow, and is distinct from Budd-Chiari syndrome (hepatic vein/IVC obstruction) or May-Thurner syndrome (iliac vein compression), which involve entirely different vessels.

85. B. Focal elevated velocity and loss of respiratory phasicity in the subclavian vein, in a patient with multiple prior central catheters and new ipsilateral arm swelling, suggests central venous stenosis from catheter-related scarring, a recognized complication in dialysis patients with extensive central line history. This is not a normal waveform, is not describing an arteriovenous fistula (a different vascular structure), and testicular torsion is an unrelated organ system entirely.

86. D. Diffusely diminished mesenteric flow velocities without a focal stenosis, in a critically ill patient on vasopressors, suggests non-occlusive mesenteric ischemia (NOMI), caused by a systemic low-flow state rather than a fixed arterial blockage. This is distinct from focal atherosclerotic stenosis (a fixed lesion), median arcuate ligament compression (a focal celiac artery finding), or mesenteric venous thrombosis (a venous, not diffuse arterial low-flow, process).

87. B. A color Doppler jet extending directly from an artery into an enlarging hematoma, rather than remaining confined to a discrete sac, suggests active arterial extravasation (ongoing bleeding), a more urgent finding than a contained pseudoaneurysm, which shows flow limited to a defined sac connected by a narrow neck. This is not a simple avascular hematoma, and clearly does not represent normal arterial flow given the active bleeding pattern described.

88. B. Focal nodular hyperplasia (FNH) classically shows a central feeding artery with vessels radiating outward in a "spoke-wheel" pattern on color Doppler, a helpful distinguishing feature from other liver lesions. A simple cyst and hepatic hemangioma show different characteristic patterns (avascular, and peripheral nodular enhancement on contrast, respectively), and hepatic artery thrombosis is an unrelated vascular complication, not a distinct focal liver lesion.

89. A. An avascular collection between the placenta and uterine wall, in a pregnant patient with bleeding and pain, suggests placental abruption (a retroplacental hematoma), which characteristically lacks internal Doppler flow, distinguishing it from vascularized placental tissue. This is not a normal implantation finding, and is unrelated to a vein of Galen malformation (an intracranial fetal entity) or an umbilical vein varix (a different fetal vascular finding).

90. B. Markedly discordant umbilical artery waveforms between monochorionic twins, with one showing absent end-diastolic flow and the other a low-resistance pattern, helps identify twin-to-twin transfusion syndrome, in which unequal placental blood-sharing causes divergent hemodynamics between the twins. This discordant pattern is not seen in a normal dichorionic (separate placenta) pregnancy, does not describe a singleton pregnancy, and is a distinct finding from isolated uterine artery notching.

91. D. Diffusely increased prostatic vascularity compared to a typical gland, in a patient with suspected acute prostatitis, reflects inflammatory hyperemia consistent with that diagnosis. This is not a normal finding in every adult prostate, does not represent complete absence of flow (the opposite of what is described), and is not attributable to benign prostatic hypertrophy alone without an inflammatory component in this clinical context.

92. C. Increased color Doppler flow within a thickened bowel wall segment, in a patient with known Crohn's disease, suggests active inflammation within that segment, a recognized sonographic correlate of disease activity. This is not a normal, uninflamed bowel appearance, does not indicate complete obstruction without an inflammatory component, and is not describing a separate lymph node rather than the bowel wall itself.

93. A. Hematomas characteristically evolve sonographically over time as they organize and liquefy, progressing from an early heterogeneous, septated appearance to a later more uniformly anechoic, avascular appearance -- a recognized serial-imaging pattern. This evolving pattern does not indicate active new bleeding (a different, acute finding), is not a congenital process (hematomas are acquired), and clearly does not represent a normal, unchanged muscle appearance given the described change over time.

94. D. An abnormal direct connection between the femoral artery and vein with turbulent, high-velocity, arterialized flow, following a penetrating stab wound, describes a traumatic arteriovenous fistula from the injury. This is not a normal postoperative finding, is distinct from a surgically created dialysis fistula (an intentional, planned connection) or an iatrogenic post-biopsy fistula (a different causative mechanism).

95. B. The halo sign -- a dark, hypoechoic, concentric wall thickening around the temporal artery lumen -- suggests giant cell (temporal) arteritis in a patient with headache, jaw claudication, and visual symptoms. The macaroni sign is a distinct finding associated with Takayasu arteritis in larger vessels, the lyre sign describes carotid body tumor splaying, and the whirlpool sign describes ovarian torsion -- all different signs in different clinical contexts.

96. B. A non-compressible internal jugular vein filled with echogenic material and no Doppler flow, in a patient with a history of IV drug use and neck swelling, describes internal jugular vein thrombosis, a recognized complication in this population. This is not normal IJ flow, and while the IJ vein is also used for central-line guidance in other contexts, this describes pathologic thrombosis, not a procedural-guidance use; it is unrelated to subclavian steal physiology, which involves a different vessel and mechanism.

97. C. A non-compressible axillary/subclavian vein filled with echogenic material and absent flow, following vigorous overhead activity in a young athletic patient, describes axillary/subclavian vein thrombosis, also known as effort thrombosis or Paget-Schroetter syndrome. This is not a normal waveform, is unrelated to popliteal artery entrapment (a different, lower-extremity arterial condition), and is distinct from subclavian steal physiology (a different vessel and mechanism).

98. D. Swirling, to-and-fro flow within a pulsatile mass connecting to the brachial artery through a narrow neck, following a catheterization via that artery, describes a brachial artery pseudoaneurysm at the access site, a recognized post-catheterization complication. This is not a simple hematoma with no vascular connection, is not a surgically created dialysis fistula, and clearly represents an abnormal finding rather than normal flow.

99. B. Replacement of the main portal vein by a tangle of small, tortuous collateral venous channels describes portal vein cavernous transformation, the chronic sequela of longstanding portal vein thrombosis in which collaterals develop around the occluded segment. This is distinct from acute portal vein thrombosis (which would show a filled, non-compressible vein rather than collaterals), a normal main portal vein, or nutcracker syndrome (an unrelated vessel and mechanism).

100. D. A focally dilated popliteal VEIN (not artery) with slow, swirling venous flow describes a popliteal vein aneurysm, a venous counterpart to the more commonly recognized popliteal artery aneurysm, distinguished by its venous flow characteristics and vessel identity. A Baker's cyst is entirely avascular, and popliteal artery entrapment and true arterial aneurysm involve the artery, not the vein.

101. C. A thin, shelf-like intraluminal projection from the posterior wall of the internal carotid artery, distinct from typical atherosclerotic plaque, describes a carotid web, a fibromuscular dysplasia-related entity increasingly recognized as a stroke risk factor in younger patients. This differs from typical atherosclerotic plaque in appearance and patient demographic, and is unrelated to a carotid body tumor or pseudoaneurysm, which have distinct sonographic appearances.

102. D. An accessory (duplicated) renal artery is a normal anatomic variant in which a kidney is supplied by more than one renal artery, an important finding to identify during living-donor evaluation since it can affect surgical planning. This is not renal artery stenosis (a pathologic narrowing), renal vein thrombosis, or nutcracker syndrome, which are distinct pathologic findings rather than a normal arterial-supply variant.

103. A. A rapidly enlarging, irregularly walled aneurysm with surrounding inflammatory changes, in a febrile patient with a history of endocarditis, suggests a mycotic (infected) aneurysm, in which septic emboli seed and weaken the arterial wall. This clinical picture is not typical of a simple chronic atherosclerotic aneurysm (which develops gradually without this inflammatory/infectious context), a congenital berry aneurysm (an intracranial entity), or a biopsy-related pseudoaneurysm (a different causative mechanism).

104. D. A focal, saccular dilation within the intra-abdominal umbilical vein on a third-trimester scan is called an umbilical vein varix, a distinct fetal finding from ductus venosus a-wave reversal, umbilical artery absent end-diastolic flow, or a vein of Galen malformation, all of which involve different vessels or findings entirely.

105. A. A focal, smooth, concentric arterial narrowing developing years after radiation therapy to the involved field is a recognized pattern of radiation-induced vasculopathy, a delayed complication distinct from typical atherosclerotic stenosis. This is not a normal waveform, and is unrelated to May-Thurner syndrome (an iliac vein finding) or popliteal entrapment (a distinct lower-extremity arterial condition).

106. C. An abnormal perigraft fluid collection with disorganized internal echoes and no clear internal flow, developing with fever after graft placement, raises concern for vascular graft infection, a serious postoperative complication requiring prompt evaluation. This is distinct from an endoleak (flow within an aneurysm sac outside a stent graft, a different clinical scenario), normal expected healing (which would not show this abnormal collection), or in-stent restenosis (a flow/velocity finding within the graft lumen, not a perigraft fluid collection).

107. A. Multiple large, thin-walled cystic spaces without internal Doppler flow, in a pediatric neck mass, describes a macrocystic lymphatic malformation, distinguished from an arteriovenous malformation (which shows prominent internal arterial flow) or a venous malformation (which typically shows slow internal flow rather than none at all); a carotid body tumor would show a hypervascular solid mass, not cystic spaces.

108. C. Preoperative Doppler assessment of the radial artery's caliber, waveform, and patency confirms adequate arterial inflow is present before planning creation of a radiocephalic dialysis fistula, helping predict fistula maturation success. This evaluation is unrelated to testicular torsion, the ankle-brachial index, or renal artery stenosis screening, which involve entirely different vessels and clinical questions.

109. B. When a duplicated popliteal vein segment is present, both parallel channels must be individually assessed for compressibility during a DVT scan, since thrombus confined to just one of the two channels could be missed if only one is examined -- an important technical pitfall this normal anatomic variant creates. Recognizing the variant does not itself confirm or exclude DVT, and does not require switching to a different transducer frequency.

110. C. An elongated fluid collection within the psoas muscle with a rim of increased Doppler flow surrounding a central avascular area, in a febrile patient with back pain, describes a psoas abscess, showing the classic peripheral inflammatory hyperemia surrounding a central necrotic, non-perfused core seen in abscesses generally. This is not a normal muscle appearance, a simple uninfected hematoma would not typically show this hyperemic rim pattern, and this does not describe a normal tendon structure.