COMPREHENSIVE MOCK EXAM 6

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 scanning, the sonographer applies a generous layer of gel to the transducer face and skin. What is the primary acoustic purpose of this coupling gel?

A. It eliminates the air gap between transducer and skin, preventing near-total beam reflection

B. It cools the transducer face specifically to prevent thermal tissue bioeffects

C. It increases the transducer's operating frequency for better spatial resolution

D. It sterilizes the skin surface completely before the scan begins

2. A patient discloses a known latex allergy just before an endocavity exam. What equipment adjustment should the sonographer make?

A. Use extra coupling gel instead of a probe cover

B. Use a non-latex (e.g., polyurethane) probe cover instead of a standard latex sheath

C. Cancel the endocavity exam entirely regardless of clinical need

D. Proceed with a standard latex cover, since surface contact is brief

3. As part of biomedical equipment safety checks, a technician measures the small amount of current that could potentially flow from the transducer housing to the patient under fault conditions. What is this safety check called?

A. Output Display Standard verification

B. Electrical leakage-current testing

C. Tissue-mimicking phantom QA

D. Curie point verification

4. A professional organization publishes formal guidance encouraging sonographers to use the lowest acoustic output and shortest exposure time consistent with obtaining diagnostic information. What is this specific published guidance document called?

A. The AIUM Statement on Prudent Use

B. The Output Display Standard

C. The Spaulding classification

D. The ARDMS Code of Ethics

5. How do the acoustic output intensities used in diagnostic (imaging) ultrasound compare to those used in therapeutic applications such as high-intensity focused ultrasound (HIFU)?

A. Diagnostic and therapeutic ultrasound use essentially identical acoustic intensities

B. Diagnostic ultrasound uses substantially higher intensities than therapeutic HIFU does

C. Diagnostic ultrasound uses intensities orders of magnitude lower than therapeutic HIFU, which is intended to heat/ablate tissue

D. Therapeutic ultrasound uses no acoustic energy at all, only direct applied heat

6. A working sonographer maintains individual professional certification through a national registry body, distinct from her employer's facility-level accreditation. Which organization most commonly provides this individual credential in the United States?

A. The AIUM (American Institute of Ultrasound in Medicine), a professional society

B. The ACR (American College of Radiology), a facility-accrediting body

C. ARDMS (American Registry for Diagnostic Medical Sonography)

D. The FDA (Food and Drug Administration), a device regulator, not a credentialing body

7. To keep her individual sonography registry credential active, a sonographer must periodically complete additional coursework. What is this ongoing education requirement called?

A. Continuing medical education (CME) credit requirement

B. Output Display Standard renewal, a display-indicator requirement

C. Spaulding recertification, an infection-control classification term

D. AIUM facility accreditation renewal, a facility-level process

8. During a third-trimester obstetric ultrasound, the sonographer notices the patient becoming lightheaded while lying flat on her back. Which repositioning is recommended to relieve this?

A. Trendelenburg (head-down) positioning of the patient

B. Prone (face-down) positioning of the patient

C. Left lateral decubitus positioning, relieving vena cava compression

D. Reverse Trendelenburg (head-up) positioning of the patient

9. After completing a diagnostic exam, the sonographer saves the full image set to the facility's archive rather than discarding it once the report is dictated. What is the primary reason for this retention practice?

A. To free up storage space on the local hard drive after the exam is dictated

B. Because raw images otherwise cannot legally be viewed by the interpreting physician

C. To satisfy an unrelated transducer maintenance logging requirement instead

D. Because the images are part of the patient's permanent medical-legal record

10. An ultrasound suite that occasionally performs sedated procedures is required to have which of the following readily available, per general patient-safety standards?

A. A tissue-mimicking QA phantom

B. A backup transducer of every frequency

C. Emergency equipment such as oxygen and a crash cart

D. A dedicated Doppler-only workstation

11. A patient asks whether an ultrasound exam will expose her to the same type of radiation as an X-ray. What is the correct response?

A. Yes, ultrasound uses a lower dose of the same ionizing radiation as X-ray

B. Yes, but only during Doppler modes, not B-mode

C. No, diagnostic ultrasound uses non-ionizing sound waves, not ionizing radiation

D. No, ultrasound uses ionizing radiation but at a wavelength too long to affect tissue

12. A beam travels from soft tissue (average speed ~1540 m/s) into a region of fatty tissue (average speed ~1450 m/s), at the same transmitted frequency. What happens to the propagation speed and the frequency as the beam crosses into fat?

A. Propagation speed changes with the new medium, but frequency stays fixed (a source property)

B. Both propagation speed and frequency change together, staying proportional to each other

C. Frequency changes with the new medium, while propagation speed stays exactly fixed

D. Neither propagation speed nor frequency ever changes crossing into a new medium

13. A system calculates depth by measuring the round-trip travel time of a pulse and assuming a fixed propagation speed. Which formula describes this fundamental relationship?

A. Depth equals frequency multiplied by wavelength, divided by two

B. Depth equals propagation speed multiplied by round-trip time, divided by two

C. Depth equals PRF multiplied by the number of scan lines

D. Depth equals amplitude divided by intensity, multiplied by two

14. A safety report distinguishes between the intensity measured at the single hottest point of the beam versus the intensity averaged over the entire beam area, and separately between the intensity at the instant of peak output versus averaged over the full pulse cycle. What pair of terms describes these two distinctions?

A. Axial versus lateral versus elevational resolution definitions

B. Near zone length versus far zone divergence properties

C. Duty factor definition versus pulse repetition period definition

D. Spatial peak versus spatial average, and temporal peak versus temporal average

15. A beam traveling in soft tissue (1540 m/s) strikes an interface with bone (4080 m/s) at a 20-degree angle of incidence. Using Snell's Law, what happens to the beam's angle as it enters the bone?

A. The beam bends away from the perpendicular (refracts to a larger angle), since it is entering a medium with a higher propagation speed

B. The beam bends toward the perpendicular (refracts to a smaller angle), since it is entering a medium with a higher propagation speed

C. The beam does not bend at all, since Snell's Law only applies to visible light

D. The beam reverses direction entirely and travels back into the soft tissue

16. Using the standard soft-tissue rule of thumb (approximately 0.5 dB/cm/MHz), what is the approximate total attenuation of a 5 MHz beam after traveling 4 cm through soft tissue (one-way)?

A. Approximately 2 dB of total attenuation

B. Approximately 4.5 dB of total attenuation

C. Approximately 10 dB of total attenuation

D. Approximately 20 dB of total attenuation

17. How does the fraction of acoustic energy that scatters directly back toward the transducer (forming the displayed echo) compare to the total energy lost to attenuation as the beam travels through tissue?

A. They are exactly equal; all attenuated energy fully returns as backscatter from every tissue interface

B. Only a small portion of attenuated energy returns to the transducer as backscatter; most is lost to absorption and forward/side scatter

C. Backscatter always exceeds total attenuation, generated fully independently of it

D. Attenuation only begins after backscatter has already returned all the way to the probe

18. A stiffer, less compressible tissue and a softer, more easily compressed tissue are compared. In terms of the physical property that most directly governs propagation speed, how are compressibility and stiffness related?

A. Compressibility is the inverse of stiffness; a stiffer (less compressible) tissue transmits sound faster

B. Compressibility and stiffness are unrelated physical properties

C. Compressibility and stiffness both increase together in the same tissue

D. Compressibility depends only on tissue density, not on stiffness at all

19. Sound traveling through soft tissue causes particles to vibrate back and forth along the same direction the wave itself is traveling, rather than perpendicular to it. What type of wave does this describe?

A. A transverse wave

B. A longitudinal wave

C. An electromagnetic wave

D. A standing wave only

20. A continuous, single-frequency sound wave is modeled mathematically as a smooth, repeating oscillation between a maximum and minimum pressure value over time. What is the basic mathematical model used to describe this kind of wave?

A. A sinusoidal (simple harmonic) wave

B. A square (rectangular) waveform, alternating abruptly

C. A sawtooth waveform, ramping and dropping sharply

D. A random-noise waveform, with no repeating pattern

21. Comparing the spatial-peak temporal-average intensity (ISPTA) typically produced by pulsed Doppler modes to that produced by conventional B-mode imaging at similar settings, which statement is generally true?

A. B-mode ISPTA is always substantially higher than pulsed Doppler ISPTA

B. The two imaging modes always produce exactly identical ISPTA values

C. ISPTA never differs meaningfully between any two operating modes

D. Pulsed Doppler modes typically produce a higher ISPTA than B-mode, due to their higher duty factor

22. How does the frequency range used in diagnostic medical ultrasound imaging compare to the range of sound audible to the human ear?

A. Diagnostic ultrasound uses frequencies lower than the audible range (below 20 Hz)

B. Diagnostic ultrasound uses exactly the same frequency range as human hearing (20 Hz-20 kHz)

C. Diagnostic ultrasound uses frequencies (roughly 2-15 MHz) far above the upper limit of human hearing (about 20 kHz)

D. Diagnostic ultrasound frequency depends entirely on patient age, not on any fixed range

23. Within a single cycle of a sound wave, the medium is alternately squeezed together and then stretched apart as the wave passes. What are these two halves of the cycle called?

A. Amplitude and wavelength

B. Reflection and refraction

C. Near zone and far zone

D. Compression and rarefaction

24. A decibel value on its own, without any accompanying reference value, cannot be interpreted as an absolute quantity. What does this indicate about the nature of the decibel as a unit?

A. The decibel expresses a relative ratio, so it always requires a stated or implied reference value

B. The decibel is an absolute unit, exactly like the watt, needing no reference value at all

C. The decibel measures distance directly and needs no reference intensity value at all

D. The decibel is meaningful only for frequency measurements, never for intensity or power

25. Unlike light (an electromagnetic wave), which can travel through the vacuum of space, what does sound require in order to propagate at all?

A. A true vacuum, exactly the same requirement as light

B. A minimum frequency of at least 20 kHz, below which sound cannot travel

C. A physical medium (solid, liquid, or gas) whose particles can be set into motion

D. A minimum intensity above the ALARA threshold, below which sound cannot travel

26. To characterize a transducer's beam width at a given depth, engineers commonly measure the width of the beam at the points where intensity has fallen to a specific fraction of its peak value at the center. What is this common beam-width specification called?

A. The half-value layer width, an attenuation-depth measurement, not a beam-width term

B. The dead-zone width, a near-field imaging limitation, not a beam-width term

C. The -6 dB beam width (the width at which intensity has dropped to roughly a quarter of peak)

D. The Nyquist beam width, an unrelated sampling-rate term entirely

27. Attenuation can be expressed in decibels (dB), a logarithmic ratio commonly used clinically, or alternatively in Nepers (Np), a different logarithmic unit sometimes used in engineering contexts. What does the existence of these two systems illustrate?

A. Attenuation cannot be expressed logarithmically in any unit system at all, ever

B. Attenuation, like other quantities, can be expressed in more than one unit system, dB being standard

C. Nepers are used exclusively for measuring frequency shift, never attenuation values

D. Decibels and Nepers measure two entirely unrelated physical quantities altogether

28. A linear array transducer's software electronically steers the outer scan lines outward at increasing angles, widening the displayed field of view beyond the probe's physical footprint into a trapezoidal shape. What is this feature called?

A. Harmonic imaging, a nonlinear-propagation contrast technique

B. Spatial compounding, a multi-angle border-definition technique

C. Trapezoidal (electronically widened, extended-view) imaging technique

D. Coded excitation, a penetration/signal-to-noise technique

29. Two curvilinear (convex) array transducers have different radii of curvature: one is more sharply curved, the other more gently curved. All else equal, how does a sharper radius of curvature affect the resulting field of view?

A. A sharper (smaller) radius of curvature produces a wider field of view at a given depth

B. A sharper (smaller) radius of curvature produces a narrower field of view at every depth

C. Radius of curvature has no effect on field of view width, only on frequency

D. A sharper radius of curvature converts the probe into a linear array

30. To avoid grating lobe artifacts in an electronically steered phased array, element spacing (pitch) must generally be kept below approximately what threshold?

A. Below one full wavelength of the transmitted frequency

B. Below ten wavelengths of the transmitted frequency

C. Element spacing has no relationship to grating lobes

D. Below approximately half a wavelength of the transmitted frequency

31. A 3D acquisition method uses a conventional handheld 1D transducer fitted with an external position-sensing device, allowing the operator to freely sweep the probe while the system tracks its position to reconstruct a volume. What is this acquisition method called?

A. Matrix array volume acquisition, fully electronic in both planes

B. Mechanical (motorized) volume acquisition inside the probe

C. Freehand (position-sensor-tracked) 3D acquisition

D. Biplane acquisition, two simultaneous orthogonal planes

32. A small, sterile, high-frequency transducer is designed to be placed directly onto an organ's surface during an open surgical procedure. What best describes this transducer's design purpose?

A. To maximize penetration depth for whole-abdomen survey scanning

B. To provide very high-resolution, high-frequency imaging via direct sterile organ contact

C. To fully replace the need for any preoperative imaging at all

D. To function exclusively as a CW Doppler probe, without B-mode

33. A specialized transducer is mounted at the tip of a flexible, steerable endoscope-like shaft and passed into the esophagus to image the heart from behind, avoiding lung and rib interference. What is this transducer/exam type called?

A. An endocavity transvaginal transducer

B. A micro-convex intercostal transducer

C. A transesophageal echocardiography (TEE) probe

D. An intraoperative sterile probe

34. Transducer manufacturers specify a maximum allowable surface temperature rise for the probe housing itself, separate from patient tissue Thermal Index values. What does this specification address?

A. Preventing the transducer face from becoming hot enough to cause a contact burn, apart from TI

B. The Curie point of the piezoelectric ceramic material exclusively

C. The matching layer's acoustic impedance rating specifically

D. The maximum PRF value the transducer electronics can support

35. A transducer cable is manufactured with a braided metal shield surrounding the internal conductors. What is the primary purpose of this shielding?

A. To increase the transducer's operating frequency range

B. To provide the elevational focusing normally supplied by the acoustic lens

C. To reduce electromagnetic interference (EMI) affecting the signal traveling through the cable

D. To allow the cable to be gas-sterilized regardless of the probe's rating

36. A single transducer housing is designed so its elements can be driven at one center frequency optimized for B-mode imaging and a different frequency within its bandwidth optimized for spectral Doppler, selected automatically by the system depending on the active mode. What best describes this capability?

A. A duplex probe design with a dedicated, separate CW Doppler crystal

B. An annular array design with concentric ring elements

C. A micro-convex array design with a small curved footprint

D. A frequency-agile transducer shifting operating frequency within its bandwidth by mode

37. When a transducer is connected to the system, the machine automatically identifies the exact probe model and loads its corresponding preset frequency range and calibration data, without the operator manually specifying the probe type. What enables this automatic recognition?

A. The transducer's Curie point temperature rating alone

B. An embedded identification chip or connector-encoded ID read by the system on connection

C. The transducer's backing (damping) material composition alone

D. The transducer's matching layer thickness specification alone

38. Instead of a single solid slab of piezoelectric ceramic, some transducer elements are manufactured as small ceramic rods embedded within a softer polymer matrix. What is this composite element design called, and what is its main benefit?

A. Piezocomposite design; it improves bandwidth and sensitivity compared to a solid ceramic element

B. CMUT design, eliminating the need for piezoelectric material entirely

C. Annular design, enabling mechanical steering capability only

D. Matrix design, requiring no backing material whatsoever

39. A newer class of piezoelectric material, such as PMN-PT, is used as a single continuous crystal structure rather than the polycrystalline ceramic structure of standard PZT. What is the typical advantage of this single-crystal material?

A. It eliminates the Curie point temperature limitation entirely

B. It removes the need for any matching layer at all

C. It functions only in continuous-wave transmission mode

D. It offers higher piezoelectric sensitivity than standard polycrystalline PZT ceramic

40. An emerging transducer technology uses tiny vibrating membrane structures manufactured with semiconductor (MEMS) fabrication techniques to generate and detect ultrasound, rather than a piezoelectric ceramic crystal. What is this technology called?

A. Piezocomposite technology, still a piezoelectric-ceramic-based design

B. Capacitive micromachined ultrasonic transducer (CMUT) technology

C. Annular array technology, a concentric-ring piezoelectric design

D. Single-crystal PMN-PT technology, still a piezoelectric material

41. Manufacturer guidance for a particular transducer recommends allowing the probe several minutes of active operation after power-on before relying on its output for critical quantitative measurements. What is this recommendation addressing?

A. The Curie point of the piezoelectric material being permanently exceeded during use

B. The need to reformat the transducer's internal identification memory chip

C. A required manual recalibration of the TGC curve settings

D. Allowing the transducer to reach thermal/output equilibrium (warm-up) for consistent performance

42. A full 2D matrix array transducer, capable of electronic steering and focusing in both azimuth and elevation, requires driving and receiving from many thousands of individual elements. What major engineering challenge does this create compared to a standard 1D array?

A. Managing the much larger number of transmit/receive channels needed to drive every element

B. There is no added engineering challenge; matrix arrays reuse identical 1D electronics

C. Matrix arrays eliminate the need for any beamforming electronics whatsoever entirely

D. Matrix arrays require a lower operating frequency than any 1D array design uses

43. During transducer QA testing, a technician notices the outer layer bonded to the transducer face has begun to separate from the underlying element structure, distinct from a simple element dropout. What is this specific failure mode called?

A. Curie point failure, a heat-induced loss of piezoelectric properties

B. Element crystal dropout, loss of function in one array element

C. Grating lobe failure, an off-axis artifact from element spacing

D. Delamination (separation) of the matching layer or acoustic lens from the element structure

44. A large-element-count array uses a fast electronic switch to connect small groups of elements to a limited number of receive channels in rapid succession, rather than dedicating one channel to every single element. What is this switching technique called?

A. Apodization, tapering drive amplitude across the aperture edges

B. Dynamic aperture, widening active elements with increasing depth

C. Harmonic filtering, isolating harmonic frequencies from fundamental

D. Multiplexing (element-group switching to reduce required receive channels)

45. Achieving a low, near-parallel Doppler angle can be especially difficult with a very small-footprint intraoperative or endocavity transducer. What is the main reason for this added difficulty?

A. Small-footprint probes cannot perform Doppler imaging under any circumstance at all

B. Small-footprint probes always operate at frequencies far too low for any Doppler use

C. Limited physical space constrains how close to parallel the beam can align with flow

D. Small-footprint probes lack a Nyquist limit entirely, unlike every other probe type

46. On a standard B-mode grayscale display, a strongly reflective interface such as a bone surface appears bright white, while fluid within a simple cyst appears black. What display convention does this reflect?

A. Higher echo amplitude is displayed as brighter (whiter); little or no returning echo is displayed as darker (black)

B. Higher echo amplitude is displayed as darker; little or no returning echo is displayed as brighter

C. Brightness on screen is assigned randomly and has no relationship to echo amplitude

D. Brightness reflects only the depth of the structure, not its echo amplitude

47. On a spectral Doppler display, flow moving toward the transducer is plotted above the baseline by convention, while flow moving away is plotted below it. What governs whether this default display can be flipped top-to-bottom?

A. It cannot be changed at all once the exam itself has started

B. The operator can invert the spectral display convention using a dedicated control

C. Only the manufacturer can permanently fix this setting at the factory

D. It automatically inverts every time the probe is physically repositioned

48. A biplane endocavity transducer displays two real-time images simultaneously, one from each of two array elements oriented at 90 degrees to each other within the same probe, showing two orthogonal anatomic planes at once. What is this display called?

A. Panoramic (extended field of view) stitched display

B. Biplane display (two simultaneous orthogonal real-time planes from one probe)

C. M-mode single-line-over-time display, showing motion at one point

D. Color M-mode single-line-over-time display, with velocity added

49. After a period of no operator interaction with the controls, some systems automatically freeze the live image rather than continuing to scan indefinitely. What is the primary purpose of this feature?

A. To permanently disable the transducer after just one single use ever

B. To automatically and permanently delete the entire exam from system memory

C. To increase the transducer's acoustic output level automatically

D. To limit unnecessary continued patient exposure and conserve system resources during operator inactivity

50. A 3D dataset is rendered so that only the outermost boundary of a structure, such as a fetal face, is displayed as a solid, shaded surface. What is this rendering mode called?

A. Surface-mode 3D rendering

B. Glass-body (transparent) 3D rendering

C. M-mode rendering

D. Panoramic rendering

51. A different 3D rendering mode displays the entire volume as translucent, allowing internal structures such as vessels or skeletal elements to be seen through the surrounding tissue, rather than showing only a solid outer surface. What is this rendering mode called?

A. Surface-mode rendering, a solid outer-boundary display

B. M-mode rendering, a single-line-over-time display

C. Biplane rendering, two simultaneous orthogonal planes

D. Glass-body (transparent) 3D rendering

52. During an extended field-of-view (panoramic) acquisition, the patient shifts slightly partway through the sweep. What effect does this have on the resulting stitched image?

A. Misregistration artifact: structures appear duplicated or distorted at the motion point

B. No effect at all; panoramic stitching fully self-corrects for any patient motion

C. The system simply halts acquisition and displays a blank image

D. The image frame rate permanently doubles for the exam's remainder

53. After acquiring a spectral Doppler waveform, the sonographer presses a control and the system automatically outlines the peak systolic and end-diastolic points across several cardiac cycles, rather than the operator placing each point by hand. What is this feature called?

A. Automatic Doppler envelope tracing of the peak and end-diastolic points

B. Manual caliper placement, done by hand for every single point

C. Spatial compounding, a multi-angle border-definition technique

D. Cine loop review, playback of previously buffered frames

54. An ultrasound system is integrated with software that automatically pulls saved measurements and images into a formatted report template for the interpreting physician to review and sign. What is this integration called?

A. PACS long-term image archival, a storage-only function

B. Structured/integrated report-generation software

C. DICOM compression, a file-size reduction technique

D. Modality worklist integration, a scheduling-data function

55. On a frozen image, the sonographer types a text label and draws an arrow pointing to a specific finding before saving the image to the record. What system feature is being used?

A. Cine loop review, playback of previously buffered frames

B. Elevational compounding, averaging adjacent out-of-plane slices

C. On-screen image annotation tools (text labels and arrows)

D. Automatic image-optimization algorithm, a gain-adjustment feature

56. Before saving an image, the sonographer selects a small icon of a body outline and places a probe-position marker on it to indicate exactly where and in what orientation the transducer was held. What is this feature called?

A. Body marker/pictogram with a probe-position icon

B. Modality worklist integration

C. Region of interest (color box)

D. Automatic image-optimization algorithm

57. A system transmits and receives at two different center frequencies during the same exam and blends the resulting images together, aiming to balance the better resolution of the higher frequency with the better penetration of the lower frequency. What is this technique called?

A. Spatial (multi-angle) compounding, blending several beam angles

B. Dual-frequency (frequency) compounding imaging

C. Elevational compounding, averaging adjacent out-of-plane slices

D. Coded excitation, a penetration/signal-to-noise technique

58. An ultrasound system can acquire image data at a very fine spatial resolution, but the number of physical pixels on the display monitor itself may ultimately limit how much of that detail the viewer can actually see. What distinction does this illustrate?

A. Acquisition resolution is separate from monitor pixel resolution; either can be limiting

B. Acquisition resolution and monitor resolution are always exactly identical

C. Monitor resolution has no possible effect on the perceived image quality at all

D. Acquisition resolution is set entirely by the monitor, not the transducer or system

59. A sonographer toggles a display setting so that structures that normally appear bright (white) on the image now appear dark, and vice versa, purely as a viewing preference. What is this feature called?

A. Dynamic range adjustment, a contrast-compression control setting

B. Edge enhancement, a border-sharpening postprocessing feature

C. Grayscale inversion (black/white swap) display feature

D. Persistence (frame averaging), a temporal-smoothing feature

60. Along the side of the displayed image, a ruled scale marked in centimeters allows the viewer to visually estimate depth and structure size without placing electronic calipers. What is this display element called?

A. The focal-zone indicator, marking transmit focus depth specifically

B. The on-screen depth-scale marker (centimeter ruler)

C. The region of interest box, defining the color-processing area

D. The biopsy guide-line, marking the expected needle path

61. A small arrow or bracket displayed along the depth-scale marker shows the operator exactly which depth the system's transmit focus is currently set to. What is this on-screen element called?

A. The dead-zone marker

B. The focal-zone position indicator

C. The biopsy guide-line

D. The color box boundary

62. After the sonographer places calipers on fetal biometry measurements (such as head circumference and femur length), the system automatically calculates an estimated gestational age and plots it on a percentile growth curve. What software feature does this describe?

A. Modality worklist integration, a scheduling-data function

B. Automatic Doppler envelope tracing, a spectral waveform feature

C. Automated OB growth-chart/gestational-age percentile calculation software

D. Structured report-generation software, a documentation feature

63. Before scanning, the operator selects a preset labeled for a specific exam type (such as "abdomen" versus "small parts"), which among other settings applies a slightly different assumed average propagation speed appropriate to that region. What does this preset selection affect?

A. The transducer's Curie point, an unrelated material-heat property

B. The patient's Thermal Index display value only, not depth calculation

C. The tissue-specific propagation-speed assumption used for depth/distance calculations in that preset

D. The transducer's physical footprint size, an unrelated hardware trait

64. A postprocessing technique averages several adjacent, closely spaced imaging slices in the elevational (out-of-plane) direction to reduce the granular speckle pattern, distinct from blending multiple azimuthal beam angles within a single plane. What is this technique called?

A. Elevational compounding (averaging adjacent slices in the out-of-plane direction)

B. Spatial (azimuthal) compounding, blending beam angles in-plane

C. Harmonic imaging, a nonlinear-propagation contrast technique

D. Coded excitation, a penetration/signal-to-noise technique

65. After the sonographer places calipers on fetal head, abdomen, and femur measurements, the system automatically applies a published formula (such as Hadlock's) to calculate an estimated fetal weight. What best describes this software capability?

A. Automatic Doppler envelope tracing, a spectral waveform feature

B. Modality worklist integration, a scheduling-data function

C. Structured measurement worksheet with an automatic formula-based clinical calculation

D. Body marker/pictogram placement, a documentation feature

66. To estimate the volume of an ellipsoid-shaped organ or fluid collection, such as the urinary bladder, the system multiplies its three orthogonal diameters together and applies a fixed geometric constant. What is this standard formula?

A. Length multiplied by width only, with no constant applied

B. Length plus width plus height, divided by three

C. Length multiplied by width multiplied by height, with no correction constant

D. Length x width x height x 0.523 (the ellipsoid volume formula)

67. To measure the area of an irregularly shaped structure, the sonographer traces its outline on the frozen image using a trackball-controlled cursor, and the system calculates the enclosed area automatically. What is this measurement technique called?

A. Automatic Doppler envelope tracing, a spectral waveform feature

B. Ellipsoid volume calculation, using three fixed diameters instead

C. Manual border-tracing (planimetry) for automatic area calculation

D. Body marker placement, an unrelated documentation feature

68. A workstation is set up with two separate monitors: one displaying the live scanning image, and a second displaying reference images, prior studies, or the worklist. What is this setup called?

A. Multi-monitor (dual-display) configuration

B. Biplane display, two live orthogonal planes from one probe

C. Split-screen dual-image display, two images on one monitor

D. Cine loop review, playback of previously buffered frames

69. A newer transducer design contains an internal battery and transmits its image data wirelessly to a tablet or console, eliminating the traditional cable connecting probe to system. What is this technology called?

A. Duplex probe technology, combining imaging with a CW element

B. CMUT technology, a MEMS-based non-piezoelectric design

C. Micro-convex array technology, a small curved-footprint design

D. Wireless (tetherless) transducer technology

70. During a rural exam, a remote specialist views the live ultrasound feed over a network connection and can annotate or guide the on-site sonographer's technique in real time. What capability does this describe?

A. Modality worklist integration

B. Remote/tele-ultrasound guidance

C. Automatic image-optimization algorithm

D. Structured report-generation software

71. A system's software automatically recognizes when the operator has obtained a standard anatomic view and offers to place measurement calipers in the expected locations without manual guidance. What general capability does this describe?

A. Modality worklist integration, a scheduling-data function

B. Elevational compounding, averaging adjacent out-of-plane slices

C. AI-assisted automatic view-recognition and measurement software

D. Multiplexing, switching element groups onto limited channels

72. An on-screen checklist guides the sonographer step by step through each required image and measurement for a standardized exam protocol, marking each item complete as it is captured. What is this feature called?

A. Body marker/pictogram placement

B. On-screen exam protocol/worksheet checklist

C. Automatic Doppler envelope tracing

D. Grayscale inversion

73. A sonographer displays a live image from the current exam on one half of the screen and, simultaneously, a previously saved image from the patient's prior exam on the other half, for direct side-by-side comparison. What does this describe?

A. Dual live/split real-time comparison against a stored prior image or exam

B. Biplane display of two orthogonal planes from one probe

C. Cine loop review of the current exam only

D. Panoramic (extended field of view) display

74. When an ultrasound system is powered on, it automatically runs a series of internal checks on its electronics before allowing the operator to begin scanning. What is this process called?

A. Modality worklist integration

B. Automatic Doppler envelope tracing

C. Structured report generation

D. System self-test/power-on diagnostic check

75. A facility purchases an ultrasound system, then separately pays to unlock its elastography and 3D imaging capabilities, which were present in the hardware but inactive until purchased. What controls this kind of feature activation?

A. The transducer's Curie point rating, an unrelated material property

B. The system's electrical leakage-current safety rating

C. The Spaulding classification of the transducer, an infection-control term

D. A software license/feature-key activation controlling which advanced modes are enabled

76. A researcher requests the full, uncompressed original DICOM dataset from an exam for quantitative analysis, rather than a simple screenshot-style image saved for the medical record. What distinguishes these two file types?

A. Raw DICOM keeps full original pixel data; a secondary-capture image is a flattened copy

B. They are functionally identical file formats with no real difference

C. Secondary-capture images always contain more original data than raw DICOM does

D. Raw DICOM data cannot be opened by any software besides the scanner itself

77. The Doppler equation includes a factor of 2 in the numerator (shift = 2 x f0 x v x cos(theta) / c). What physical reason accounts for this factor of 2?

A. It corrects for the Doppler angle exceeding the standard 60-degree limit

B. It accounts for attenuation losses occurring during the round-trip pulse

C. It compensates specifically for the Nyquist limit at a high PRF setting

D. The shift occurs twice: once as the moving cell receives the wave, again as it re-transmits it back

78. When measuring arterial diameter on a duplex ultrasound image for a diameter-based calculation, which measurement convention is standard?

A. Outer-wall-to-outer-wall, including both vessel wall thicknesses

B. Measuring only one wall thickness and doubling it

C. Inner-wall-to-inner-wall (leading-edge-to-leading-edge of the lumen), excluding wall thickness

D. The convention is arbitrary and varies with no accepted standard

79. During a carotid duplex exam, the sonographer measures the distance between two distinct echogenic layers within the common carotid artery wall, a value used to help assess cardiovascular risk. What is this specific measurement called?

A. Resistive index (RI)

B. Pulsatility index (PI)

C. Intima-media thickness (IMT)

D. Acceleration time

80. A vascular lab uses Doppler-derived systolic blood pressures measured at the ankle and at the arm to calculate a ratio used to screen for peripheral arterial disease. What is this ratio called?

A. Resistive index (RI)

B. Ankle-brachial index (ABI)

C. Pulsatility index (PI)

D. Velocity ratio

81. To localize the level of peripheral arterial disease in a symptomatic leg, blood pressure cuffs are placed at several levels (thigh, calf, ankle) along the limb, and continuous-wave Doppler is used to detect a pressure drop between segments. What is this exam called?

A. Ankle-brachial index (ABI) alone

B. Segmental limb pressure Doppler examination

C. Intima-media thickness measurement

D. Transcranial Doppler examination

82. During a lower-extremity venous duplex exam, the sonographer presses the transducer directly onto the vein at each level along its course, observing whether the vein walls fully coapt (flatten together). What is the primary diagnostic significance of this B-mode maneuver?

A. It measures the vein's own resistive index value at that specific level

B. It assesses arterial flow characteristics only, not venous flow at all

C. It fully replaces the need for any Doppler interrogation of that vein

D. A vein failing to fully compress under gentle pressure suggests thrombus, a primary B-mode DVT sign

83. Doppler interrogation across a stenotic prosthetic heart valve shows a markedly elevated peak velocity compared to a normally functioning valve of the same type. What does this elevated transvalvular velocity indicate?

A. Valve stenosis: elevated velocity reflects increased resistance across the narrowed orifice

B. Normal valve function, since a higher velocity always indicates health

C. Valve regurgitation exclusively, with absolutely no stenotic component

D. A technically inadequate Doppler angle, unrelated to the valve itself

84. To screen for renal artery stenosis, some protocols compare the peak systolic velocity in the renal artery to the peak systolic velocity in the adjacent aorta, rather than relying on the renal artery's absolute velocity alone. What is this comparison called?

A. Resistive index (RI)

B. Acceleration time

C. Renal-aortic ratio (RAR)

D. Pulsatility index (PI)

85. Following a liver transplant, serial Doppler exams of the hepatic artery are performed, with a rising resistive index or a very low/absent diastolic flow raising concern for a specific vascular complication. What complication is this monitoring intended to detect?

A. Hepatic artery thrombosis or significant stenosis, a serious transplant complication

B. Normal expected postoperative healing, requiring no further workup

C. Portal vein hepatofugal flow exclusively

D. A technically inadequate Doppler angle during the exam

86. On a lower-extremity venous duplex exam, B-mode imaging directly visualizes echogenic material filling and expanding the lumen of a vein that fails to compress. What is the most direct diagnostic significance of this specific B-mode finding?

A. Direct visualization of an intraluminal thrombus, a primary B-mode sign of DVT

B. Confirmation of normal venous respiratory phasicity

C. Confirmation of normal augmentation with distal compression

D. A sign of arterial, not venous, disease

87. Doppler interrogation of a neonate's ductus arteriosus, before it has closed, typically shows which flow pattern?

A. Absent flow entirely, since the ductus has not yet become patent

B. A normal triphasic arterial waveform, identical to any peripheral artery

C. Simple venous-type continuous flow, at a low, steady velocity

D. Continuous, often turbulent flow reflecting the pressure gradient between the aorta and pulmonary artery

88. In a pregnancy complicated by suspected fetal anemia, Doppler is used to measure the peak systolic velocity in a specific fetal cerebral vessel, since anemia increases blood flow velocity there. Which vessel is this?

A. The umbilical artery, assessed for absent or reversed diastolic flow

B. The ductus venosus, assessed for a-wave reversal

C. The fetal middle cerebral artery (MCA)

D. The uterine artery, assessed for diastolic notching

89. In a fetus with cardiac compromise, Doppler of a specific fetal venous vessel may show reversal of the normally forward-flowing component that occurs during atrial contraction, an ominous finding. What is this abnormal waveform component called, and in which vessel is it assessed?

A. Reversed S-wave in the umbilical vein

B. Reversed a-wave in the ductus venosus

C. Reversed diastolic flow in the umbilical artery

D. Reversed E-wave in the hepatic vein

90. In a patient with portal hypertension, Doppler evaluation may extend beyond the main portal vein to assess a vessel connecting the splenic and left renal venous systems, which can enlarge and carry flow as a spontaneous shunt. What is this vessel/pathway called?

A. A splenorenal shunt (via the splenic vein)

B. The ductus venosus, a distinct fetal venous structure

C. The hepatic artery, assessed instead for transplant complications

D. The umbilical vein, a distinct fetal/neonatal structure

91. To screen for vasospasm following a subarachnoid hemorrhage, Doppler is used to insonate vessels of the circle of Willis through a specific acoustic window in the skull. What is this specialized exam and window called?

A. Renal-aortic ratio Doppler through an intercostal window

B. Transcranial Doppler (TCD) through the temporal bone window

C. Segmental pressure Doppler through the popliteal window

D. Ankle-brachial index Doppler through the pedal window

92. In echocardiography, cardiac output can be estimated by multiplying the velocity-time integral (VTI) of flow across the left ventricular outflow tract (LVOT) by the LVOT's cross-sectional area and the heart rate. What does this calculation represent?

A. The resistive index of the aorta, an unrelated waveform-shape parameter

B. The pulsatility index of the left ventricle, an unrelated parameter

C. The Doppler angle correction factor applied specifically to the LVOT

D. Doppler-derived cardiac output (LVOT VTI x cross-sectional area x heart rate)

93. To assess the severity of mitral valve stenosis, a Doppler-derived measurement evaluates how quickly the diastolic inflow velocity across the valve decelerates, since a more severely narrowed valve empties more slowly. What is this measurement called?

A. Pressure half-time (PHT)

B. Resistive index (RI)

C. Pulsatility index (PI)

D. Acceleration time

94. Diastolic function of the left ventricle can be assessed by comparing the velocity of early, passive mitral inflow to the velocity of inflow generated by atrial contraction, expressed as a ratio. What is this ratio called?

A. The E/A ratio, comparing early versus atrial mitral inflow velocity

B. The renal-aortic ratio, an unrelated renal-vessel calculation

C. The velocity ratio used in grading arterial stenosis severity

D. The systolic/diastolic (S/D) ratio, a different waveform index

95. Doppler evaluation of a transjugular intrahepatic portosystemic shunt (TIPS) tracks flow velocity within the shunt over time, since a significant rise or fall outside the expected range can indicate shunt narrowing or occlusion. What is being monitored in this surveillance protocol?

A. The Curie point of the stent material, an unrelated property

B. TIPS shunt velocity criteria, tracked to detect stenosis or malfunction

C. The resistive index of the hepatic artery, an unrelated vessel

D. The renal-aortic ratio, an unrelated renal-vessel calculation

96. To evaluate chronic mesenteric ischemia, duplex Doppler of the celiac and superior mesenteric arteries (SMA) is performed both fasting and after a meal, since velocities normally change with digestion. What is this comparison assessing?

A. Renal artery stenosis severity, assessed by a different ratio entirely

B. Hepatic artery transplant complications, assessed by a different vessel

C. Fasting-versus-postprandial mesenteric artery velocity criteria for chronic mesenteric ischemia

D. Portal vein hepatopetal flow direction, an unrelated portal finding

97. A congenital vascular anomaly shows a tangled network of abnormal vessels on color Doppler, with low-resistance, high-velocity flow directly connecting arteries to veins without an intervening capillary bed, distinct from a surgically created dialysis access. What is this entity called?

A. An arteriovenous malformation (AVM)

B. A surgically created arteriovenous (AV) fistula

C. A pseudoaneurysm

D. A venous varix

98. After endovascular aneurysm repair (EVAR), color Doppler surveillance is performed to detect ongoing blood flow within the aneurysm sac but outside the stent graft itself, a complication requiring monitoring or reintervention. What is this finding called?

A. Normal expected postoperative graft flow

B. A pseudoaneurysm at the graft's proximal end only

C. An endoleak (flow within the sac but outside the stent graft)

D. Graft thrombosis/occlusion

99. Uterine artery Doppler performed in the second trimester may show a persistent notch in early diastole, associated with increased downstream placental resistance and used to help screen for a specific pregnancy complication. What complication does this notching pattern help screen for?

A. Pre-eclampsia, linked to rising uterine artery resistance

B. Fetal anemia, assessed by a different vessel

C. Ductus arteriosus closure timing

D. Umbilical cord entanglement risk

100. Doppler interrogation of a dialysis arteriovenous fistula reveals a focal area of markedly elevated peak velocity at one specific point along its course, compared to normal velocities elsewhere in the fistula. What does this specific finding suggest?

A. Normal, uniformly patent fistula flow throughout its length

B. A focal stenosis at that specific point within the fistula or graft

C. Complete fistula thrombosis at that point

D. A technically inadequate Doppler angle at that specific point only

101. During contrast-enhanced ultrasound (CEUS) of a focal liver lesion, the lesion's enhancement pattern is assessed across the arterial phase, the portal venous phase, and the delayed phase after microbubble contrast injection. What is the clinical purpose of tracking enhancement across these specific timing phases?

A. To measure the transducer's Curie point during contrast administration

B. To calculate the patient's ankle-brachial index during the same exam

C. To characterize the lesion based on its distinct enhancement/washout pattern across each vascular phase

D. To calculate the fetal middle cerebral artery peak systolic velocity

102. In a patient with a severe ipsilateral internal carotid artery stenosis, Doppler of the ophthalmic artery may show flow reversed in direction, away from the eye. What does this finding suggest?

A. Normal ophthalmic artery flow, entirely unrelated to carotid disease

B. A primary ophthalmic artery aneurysm, unrelated to carotid stenosis

C. Subclavian steal physiology specifically, a different vessel entirely

D. Collateral flow reversal, an indirect sign of severe ipsilateral carotid stenosis/occlusion

103. A young athlete reports calf pain with exercise. Doppler of the popliteal artery performed at rest is normal, but with active plantarflexion of the foot, flow becomes markedly diminished or absent. What condition does this dynamic finding suggest?

A. Chronic mesenteric ischemia

B. Popliteal artery entrapment syndrome

C. Subclavian steal syndrome

D. Renal artery stenosis

104. When anatomy makes it unclear whether a small, unlabeled vessel on ultrasound is an artery or a vein, which basic Doppler waveform characteristic most reliably distinguishes the two?

A. Vessel color seen on grayscale B-mode imaging alone, with no Doppler

B. Vessel depth measured from the skin surface alone, with no Doppler

C. Vessel diameter alone, since arteries are assumed always larger

D. Pulsatile, cyclical flow suggests an artery, while continuous, non-pulsatile flow suggests a vein

105. A patient with intermittent claudication has normal resting ankle-brachial index values. To unmask the suspected peripheral arterial disease, the vascular lab has the patient walk on a treadmill and repeats the Doppler pressure measurements immediately afterward. What is the purpose of this provocative testing?

A. To measure intima-media thickness specifically under exercise conditions

B. To calculate the renal-aortic ratio specifically after exercise testing

C. To reveal a pressure drop only apparent after exercise raises limb blood-flow demand

D. To assess fetal middle cerebral artery velocity specifically under stress

106. Comparing the audible and visual Doppler signal of a synthetic (PTFE) dialysis graft to that of a native arteriovenous fistula, what difference is often noted?

A. The synthetic graft always shows a completely silent, flow-absent signal

B. The native fistula always sounds identical to arterial flow, with no diastolic component

C. There is never any perceptible difference between a fistula and a graft

D. The synthetic graft's flow is often more turbulent/higher-pitched than a native fistula's

107. A carotid duplex exam identifies a hypervascular mass splaying apart the internal and external carotid arteries at the carotid bifurcation, with marked flow on color Doppler. What entity does this description most strongly suggest?

A. A simple reactive lymph node

B. A thrombosed pseudoaneurysm

C. A carotid body tumor (paraganglioma)

D. A normal anatomic variant requiring no further workup

108. In a patient presenting with a prolonged, painful erection, Doppler of the cavernosal arteries is used to help distinguish two different underlying mechanisms requiring very different management. What does cavernosal artery Doppler help differentiate in this setting?

A. Testicular torsion versus epididymitis

B. Renal artery stenosis versus renal vein thrombosis

C. Subclavian steal versus vertebrobasilar insufficiency

D. High-flow (arterial) priapism versus low-flow (venous occlusive) priapism

109. To help estimate right atrial pressure noninvasively, Doppler/B-mode assessment of the inferior vena cava (IVC) evaluates how much its diameter collapses during a brisk inspiratory sniff. What does a poorly collapsing ("plethoric") IVC suggest?

A. Normal, low right atrial pressure, requiring no further workup at all

B. Severe left ventricular outflow tract obstruction, specifically and only

C. Elevated right atrial pressure, since a poorly collapsing IVC reflects reduced respiratory variation

D. A technically inadequate Doppler angle used during this particular exam

110. In a limb affected by rising compartment pressure after a crush injury, Doppler assessment of the distal arteries over time may show progressively diminishing flow signals. What does this trend most directly suggest?

A. Progressively compromised perfusion as compartment pressure nears arterial pressure

B. Normal, fully expected flow given the injury, needing no further monitoring

C. Isolated venous thrombosis, entirely unrelated to the compartment pressure

D. A technically inadequate Doppler angle, unrelated to compartment pressure

Answers

1. A. Coupling gel eliminates the air gap between the transducer face and skin; because the acoustic impedance mismatch between air and tissue is enormous, any air gap would cause near-total reflection of the beam at the skin surface, preventing meaningful imaging. Gel does not meaningfully cool the transducer, does not change its frequency, and is not a sterilizing agent.

2. B. For a patient with a known latex allergy, a non-latex (e.g., polyurethane) probe cover should be substituted for a standard latex sheath to avoid triggering an allergic reaction during an endocavity exam. Extra gel does not address the allergy, canceling a clinically indicated exam is not the appropriate first response, and using a standard latex cover would risk an allergic reaction regardless of contact duration.

3. B. Electrical leakage-current testing measures the small fault-condition current that could potentially reach the patient through the transducer housing or cable, and is a standard biomedical equipment electrical-safety check. Output Display Standard verification concerns acoustic output indicators, phantom QA concerns image-quality testing, and Curie point verification is unrelated to electrical safety.

4. A. The AIUM Statement on Prudent Use is the specific published guidance encouraging minimal acoustic output and exposure time consistent with diagnostic need, distinct from the Output Display Standard (which governs the on-screen TI/MI indicators themselves), the Spaulding classification (disinfection levels), and the ARDMS Code of Ethics (professional conduct).

5. C. Diagnostic ultrasound intensities are deliberately kept orders of magnitude below those used in therapeutic applications such as HIFU, which intentionally uses much higher, focused acoustic energy to heat or ablate tissue -- a fundamentally different clinical goal from diagnostic imaging. The two are not equivalent in intensity, and therapeutic HIFU is itself an acoustic-energy-based modality, not simply direct heat application.

6. C. ARDMS (American Registry for Diagnostic Medical Sonography) is the primary individual credentialing body for sonographers in the U.S., distinct from AIUM/ACR facility-level practice accreditation and unrelated to the FDA's regulatory role over device manufacturing.

7. A. Continuing medical education (CME) credits are the standard mechanism registry bodies require sonographers to accumulate periodically in order to maintain an active individual credential. The Output Display Standard, Spaulding classification, and AIUM facility accreditation are unrelated to an individual's ongoing credentialing requirement.

8. C. Left lateral decubitus positioning relieves compression of the inferior vena cava by the gravid uterus, correcting supine hypotensive syndrome, which is the likely cause of a pregnant patient's lightheadedness while lying flat. Trendelenburg, prone, and reverse Trendelenburg positioning do not address vena cava compression in this way.

9. D. Diagnostic images are retained as part of the patient's permanent medical-legal record, supporting future comparison, review, and potential legal or quality-assurance needs -- not simply to manage local storage space, and image access by the interpreting physician does not depend on long-term archival in this way. Transducer maintenance logging is an unrelated, separate recordkeeping process.

10. C. Facilities performing sedated or higher-risk procedures are expected to have emergency equipment such as oxygen and a crash cart readily available to respond to an adverse event. A QA phantom, backup transducers, and a dedicated Doppler workstation are useful resources but are not emergency-preparedness requirements.

11. C. Diagnostic ultrasound uses non-ionizing sound waves, fundamentally different from the ionizing electromagnetic radiation used in X-ray imaging, and this distinction holds true across all ultrasound modes, including Doppler. Ultrasound does not use ionizing radiation at any wavelength.

12. A. Frequency is set by the transmitting source (the transducer) and does not change as the beam crosses into a new medium; propagation speed, by contrast, is a property of the medium itself and does change. Wavelength (not frequency) is what changes correspondingly to keep the wave equation consistent, but frequency itself stays fixed.

13. B. The range (depth) equation states depth equals propagation speed multiplied by round-trip travel time, divided by two (to account for the round trip). Frequency-wavelength, PRF-scan-line, and amplitude-intensity relationships are unrelated formulas that do not calculate depth.

14. D. Spatial peak versus spatial average describes intensity at the single hottest point of the beam versus averaged across the beam's cross-sectional area, while temporal peak versus temporal average describes intensity at the instant of peak output versus averaged over the full pulse cycle -- together forming the basis for reported intensity metrics such as ISPTA. Axial/lateral resolution, near/far zone, and duty factor/PRP are unrelated pairs of terms.

15. A. Per Snell's Law, when sound enters a medium with a higher propagation speed (bone, 4080 m/s, compared to soft tissue, 1540 m/s), the transmitted angle is larger than the incident angle -- the beam bends away from the perpendicular (normal). Snell's Law applies to any wave type experiencing a speed change at an interface, not only visible light, and the beam does not simply reverse direction at an oblique, non-critical angle.

16. C. Using the 0.5 dB/cm/MHz rule of thumb: 0.5 x 5 MHz x 4 cm = 10 dB of one-way attenuation. The other values do not correctly apply this standard approximation to the given frequency and depth.

17. B. Only a small fraction of the total energy attenuated as the beam travels through tissue actually returns to the transducer as backscatter; the majority of attenuated energy is lost to absorption (converted to heat) and to scatter/reflection in directions other than straight back to the transducer. Backscatter and total attenuation are not equal, backscatter does not exceed attenuation, and attenuation is not sequentially dependent on backscatter first occurring.

18. A. Compressibility is the inverse of stiffness (bulk modulus): a stiffer, less compressible tissue resists compression more and transmits sound faster, which is why propagation speed rises with increasing stiffness. Compressibility and stiffness are directly related (inversely), not unrelated, do not both increase together, and compressibility is not determined by density alone.

19. B. In a longitudinal wave, particle motion is parallel to (along the same axis as) the direction of wave propagation, which is how sound travels through soft tissue. A transverse wave has particle motion perpendicular to propagation (as in light), and this description does not describe an electromagnetic wave or a standing wave specifically.

20. A. A continuous, single-frequency sound wave is modeled as a sinusoidal (simple harmonic) wave, a smooth, repeating oscillation between maximum and minimum values. Square, sawtooth, and random-noise waveforms are different, non-sinusoidal waveform shapes that do not describe a basic continuous sound wave.

21. D. Pulsed Doppler modes typically have a higher duty factor than B-mode imaging, which generally results in a higher ISPTA (spatial-peak temporal-average intensity) for Doppler modes compared to B-mode at similar settings -- part of the physical basis for extra caution with Doppler exposure time. The two modes are not equal, and ISPTA does meaningfully differ across modes based on duty factor and other transmission parameters.

22. C. Diagnostic ultrasound uses frequencies roughly in the 2-15 MHz range, far above the upper limit of human hearing (approximately 20 kHz), which is why the sound itself is inaudible to patients. It is not below the audible range, does not match the audible range, and while transducer frequency selection may vary with patient size, it is not solely age-dependent with no fixed range.

23. D. Compression (particles pushed together, higher pressure) and rarefaction (particles pulled apart, lower pressure) are the two alternating halves of a single sound wave cycle. Amplitude/wavelength, reflection/refraction, and near zone/far zone are unrelated pairs of terms that do not describe the two phases of a wave cycle.

24. A. The decibel is inherently a relative, logarithmic ratio between two values (such as output versus reference intensity), so a dB figure is only meaningful with a stated or implied reference point -- unlike an absolute unit such as the watt. It is not an absolute unit itself, is not a distance measure, and applies to intensity/power/amplitude ratios, not exclusively to frequency.

25. C. Sound is a mechanical wave and therefore requires a physical medium (solid, liquid, or gas) whose particles can be set into motion to propagate; it cannot travel through a vacuum, unlike electromagnetic waves such as light. There is no minimum frequency or intensity threshold required simply for sound to propagate at all.

26. C. The -6 dB beam width defines the beam's width at the depth where intensity has fallen to about one-quarter of its peak central value, a standard way to characterize beam width. The half-value layer

describes attenuation depth (not beam width), the dead zone describes a near-field imaging limitation, and the Nyquist limit is unrelated to beam-width specification.

27. B. Like other logarithmic quantities, attenuation can be validly expressed in more than one logarithmic unit system; decibels (dB) are the standard clinical unit, while Nepers (Np) are an alternative logarithmic unit sometimes used in engineering contexts, with a fixed conversion factor between them. Attenuation can be expressed logarithmically (that is the whole point of both units), Nepers are not exclusively a frequency unit, and dB and Np both describe the same underlying quantity (attenuation/ratio), not unrelated quantities.

28. C. Trapezoidal (extended-view) imaging electronically steers a linear array's outer scan lines outward, widening the displayed field of view into a trapezoid beyond the probe's physical footprint. Harmonic imaging, spatial compounding, and coded excitation address image quality/penetration, not field-of-view widening for a linear array.

29. A. A sharper (smaller) radius of curvature causes the curvilinear array's scan lines to fan out more quickly, producing a wider field of view at a given depth than a more gently curved (larger-radius) probe. Radius of curvature does affect field of view, does not narrow it with a sharper curve, and does not convert a curvilinear probe into a linear array.

30. D. Element spacing (pitch) must generally be kept below roughly half a wavelength of the transmitted frequency to avoid grating lobe artifacts in an electronically steered array; wider spacing allows constructive interference to create off-axis grating lobes. Spacing well above one wavelength would worsen, not prevent, grating lobes, and spacing is directly related to grating lobe formation, not unrelated to it.

31. C. Freehand 3D acquisition uses an external position-sensing device attached to a conventional handheld transducer, tracking the probe's position and orientation as the operator freely sweeps it, allowing the system to reconstruct a 3D volume from the tracked 2D images. This differs from matrix array (fully electronic) and mechanical (motorized sweep within the probe) methods, and is unrelated to biplane (simultaneous two-plane) imaging.

32. B. Intraoperative transducers are designed as small, sterile, high-frequency probes for direct contact with an organ's surface during surgery, providing very high-resolution imaging not achievable transcutaneously. They are not designed to maximize whole-abdomen penetration depth, do not replace preoperative imaging, and are not limited to CW-Doppler-only function.

33. C. A transesophageal echocardiography (TEE) probe is mounted at the tip of a steerable endoscope-like shaft and passed into the esophagus to image the heart from behind, avoiding lung and rib interference that limits transthoracic imaging. This is distinct from a transvaginal endocavity probe, a micro-convex intercostal probe, and an intraoperative sterile probe, each used in different anatomic contexts.

34. A. Transducer surface temperature-rise specifications address preventing the probe housing itself from becoming hot enough to cause a contact burn on skin, a distinct safety concern from the Thermal Index, which estimates internal tissue heating from the acoustic beam. This specification is not the Curie point (an internal material property), the matching layer's impedance rating, or a PRF limit.

35. C. Braided cable shielding reduces electromagnetic interference (EMI) that could otherwise corrupt the weak analog signal traveling from the transducer elements to the system. It does not affect operating frequency, does not provide elevational focusing (that is the acoustic lens's role), and does not by itself change the probe's sterilization rating.

36. D. A frequency-agile transducer can shift its operating frequency within its available bandwidth depending on the active imaging mode, using a higher frequency optimized for B-mode resolution and a different frequency better suited for Doppler penetration/sensitivity, without requiring a separate dedicated element set. This differs from a duplex probe's separate CW crystal, an annular array's concentric-ring design, and a micro-convex array's footprint-based design.

37. B. An embedded identification chip or connector-encoded ID allows the system to automatically recognize the exact connected probe model and load its corresponding presets and calibration data without manual operator entry. The Curie point, backing material, and matching layer thickness are physical/material properties unrelated to automatic probe identification.

38. A. Piezocomposite elements embed small piezoelectric ceramic rods within a softer polymer matrix, which improves bandwidth and sensitivity compared to a solid ceramic element by better matching acoustic impedance and damping unwanted vibration modes. CMUT is an entirely different (non-piezoelectric, MEMS-based) technology, annular design concerns element geometry rather than composite material, and matrix design does not eliminate the need for backing material.

39. D. Single-crystal piezoelectric materials such as PMN-PT offer higher piezoelectric sensitivity and electromechanical conversion efficiency than standard polycrystalline PZT ceramic, translating to improved signal sensitivity. Single-crystal materials still have a Curie point, still require a matching layer, and are not restricted to continuous-wave-only operation.

40. B. Capacitive micromachined ultrasonic transducers (CMUTs) use tiny MEMS-fabricated vibrating membranes over a cavity, generating and detecting ultrasound electrostatically rather than via a piezoelectric ceramic crystal, an entirely different transducer technology. Piezocomposite, annular array, and single-crystal PMN-PT designs are all still piezoelectric-based technologies, unlike CMUT.

41. D. Allowing a transducer a warm-up period after power-on lets it reach thermal and output equilibrium, so its acoustic output and performance are stable and consistent before relying on it for critical quantitative measurements. This is unrelated to the Curie point being exceeded, memory chip reformatting, or manual TGC recalibration.

42. A. A full 2D matrix array's thousands of independent elements require correspondingly vast numbers of transmit/receive channels, cabling, and processing capability, a major engineering and cost challenge compared to a standard 1D array's much smaller channel count. Matrix arrays do not use identical, simpler electronics to 1D arrays, still require beamforming electronics, and are not restricted to a lower operating frequency by this challenge.

43. D. Delamination describes the outer bonded layer (matching layer or acoustic lens) separating from the underlying element structure, a distinct physical failure mode from element crystal dropout (loss of an individual element's function). Curie point failure concerns heat-induced depoling, and grating lobe failure is an artifact phenomenon, not a bonding failure.

44. D. Multiplexing rapidly switches small groups of elements onto a limited number of receive channels in sequence, allowing a large-element-count array to be driven without requiring one dedicated channel per element. Apodization tapers aperture amplitude, dynamic aperture changes active element count with depth, and harmonic filtering isolates harmonic frequencies -- none address reducing the required channel count.

45. C. The limited physical space and constrained positioning options available with a very small-footprint intraoperative or endocavity probe make it harder to align the beam close to parallel with vessel flow, limiting how low a Doppler angle can practically be achieved. Small-footprint probes can perform Doppler, are not restricted to low frequencies, and still have a Nyquist limit like any pulsed system.

46. A. By display convention, higher-amplitude returning echoes are shown brighter (whiter), while little or no returning echo (as from simple fluid) is shown darker (black), the basis for interpreting grayscale B-mode images. Brightness is not randomly assigned, and while depth affects TGC compensation, the final displayed brightness represents amplitude, not depth itself.

47. B. Operators can invert the default spectral display convention (which plots flow toward the transducer above baseline and away below) using a dedicated control, which can help match a preferred or more intuitive waveform orientation for a given vessel. This setting can be changed by the operator during a live exam, is not permanently factory-fixed, and does not automatically flip with probe repositioning.

48. B. A biplane probe contains two array elements oriented 90 degrees apart, allowing simultaneous real-time display of two orthogonal anatomic planes from a single probe position, distinct from panoramic (single stitched wide image), M-mode (single-line-over-time), and color M-mode (color-encoded single-line-over-time) displays.

49. D. Auto-freeze after inactivity helps limit unnecessary continued patient acoustic exposure and conserves system processing resources when the operator is not actively using the live image, consistent with prudent-use principles. It does not permanently disable the transducer, delete the exam, or increase acoustic output.

50. A. Surface-mode 3D rendering displays only the outermost boundary of a structure as a solid, shaded surface, commonly used for fetal face rendering. Glass-body rendering instead shows the volume as translucent; M-mode and panoramic rendering are unrelated, non-volumetric display modes.

51. D. Glass-body (transparent) rendering displays the entire acquired volume as translucent, allowing internal structures such as vessels or bone to be seen through overlying tissue, in contrast to surface-mode rendering, which shows only a solid outer boundary. M-mode and biplane rendering are unrelated single-plane/single-line display concepts.

52. A. Patient or probe motion during a panoramic sweep causes misregistration artifact, where the stitched image shows duplicated, distorted, or discontinuous structures at the point of motion, since the stitching algorithm assumes a smooth, motion-free sweep. The system does not automatically correct for this, does not simply stop acquiring, and frame rate is not affected by this artifact.

53. A. Automatic Doppler envelope tracing outlines the peak systolic and end-diastolic points of the spectral waveform across multiple cycles without requiring the operator to manually place each point, speeding up calculation of indices such as RI or PI. Manual caliper placement is the alternative, non-automatic approach; spatial compounding and cine loop review are unrelated features.

54. B. Structured/integrated report-generation software automatically pulls saved measurements and images into a formatted report template for physician review and sign-off, streamlining documentation. PACS archival, DICOM compression, and modality worklist integration are related but distinct digital-imaging functions that do not themselves generate the report content.

55. C. On-screen image annotation tools allow the operator to add text labels and arrows directly onto a frozen image before saving it, highlighting specific findings for the record. Cine loop review, elevational compounding, and automatic image optimization are unrelated features that do not add operator-placed text/arrow annotations.

56. A. The body marker/pictogram feature lets the operator place a probe-position icon on a small body-outline diagram, documenting exactly where and how the transducer was held for that image. Modality worklist integration, the color box, and automatic optimization are unrelated features.

57. B. Dual-frequency (frequency) compounding transmits and receives at two different center frequencies and blends the resulting images, balancing the higher frequency's better resolution against the lower frequency's better penetration. Spatial and elevational compounding blend multiple beam angles or adjacent slices rather than multiple frequencies, and coded excitation is an unrelated pulse-encoding technique.

58. A. Acquisition (image) resolution, determined by the transducer and system settings, is conceptually separate from the display monitor's own fixed pixel resolution; either one can become the limiting factor for how much true detail the viewer perceives. The two are not always identical, monitor resolution can meaningfully affect perceived quality, and acquisition resolution is not determined by the monitor itself.

59. C. Grayscale inversion simply swaps which end of the gray scale (black or white) represents higher versus lower echo amplitude, purely as a viewing preference, without altering the underlying acquired data. Dynamic range, edge enhancement, and persistence are distinct postprocessing/acquisition features that do not describe this black/white swap.

60. B. The on-screen depth-scale marker is a ruled centimeter scale along the image's side, letting the viewer visually estimate depth and size without placing electronic calipers. The focal-zone indicator marks focus depth specifically, the region of interest box defines the color-processing area, and the biopsy guide-line marks a needle path, none of which is a general depth ruler.

61. B. The focal-zone position indicator is a small arrow or bracket along the depth scale showing exactly where the system's transmit focus is currently set. The dead-zone marker, biopsy guide-line, and color box boundary are distinct on-screen elements unrelated to focus-depth indication.

62. C. Automated OB growth-chart/gestational-age percentile software takes placed fetal biometry calipers and automatically calculates estimated gestational age, plotting it against a percentile growth curve. Modality worklist integration, automatic Doppler envelope tracing, and structured report-generation software are related but distinct capabilities that do not perform this specific OB calculation.

63. C. An exam-type preset (such as "abdomen" versus "small parts") applies a tissue-specific assumed average propagation speed appropriate to that region, among other preset parameters, affecting the accuracy of depth/distance calculations for that exam type. It does not affect the Curie point, is not limited to the TI display alone, and does not change the transducer's physical footprint.

64. A. Elevational compounding averages several adjacent, closely spaced slices in the out-of-plane (elevational) direction to reduce speckle, distinct from spatial (azimuthal) compounding, which blends multiple beam angles within a single scan plane. Harmonic imaging and coded excitation address different image-quality goals (contrast/near-field clutter and penetration/signal-to-noise, respectively), not elevational-direction speckle averaging.

65. C. This describes a structured measurement worksheet with an automatic formula-based clinical calculation: placed biometry calipers feed directly into a published formula (such as Hadlock's) to calculate estimated fetal weight without manual computation. Automatic Doppler envelope tracing, modality worklist integration, and body marker placement are unrelated features that do not perform this fetal-weight calculation.

66. D. The standard ellipsoid volume formula multiplies the three orthogonal diameters (length, width, height) together and applies the geometric constant 0.523 (pi/6) to estimate the volume of an ellipsoid-shaped structure such as the bladder. Simple multiplication or averaging without this constant does not correctly estimate ellipsoid volume.

67. C. Manual border-tracing (planimetry) lets the operator trace an irregular structure's outline with a trackball-controlled cursor, after which the system automatically calculates the enclosed area. Automatic

Doppler envelope tracing addresses spectral waveforms, ellipsoid volume calculation uses three fixed diameters rather than a traced outline, and body marker placement is an unrelated documentation feature.

68. A. A multi-monitor (dual-display) configuration uses two separate physical monitors, one for the live scanning image and another for reference material such as prior studies or the worklist, distinct from a biplane display (two live planes from one probe) or a split-screen display (two live images sharing a single monitor).

69. D. Wireless (tetherless) transducer technology uses an internal battery and wireless data transmission to a tablet or console, eliminating the traditional physical cable. Duplex probe, CMUT, and micro-convex array technologies describe unrelated transducer design characteristics, not cable elimination.

70. B. Remote/tele-ultrasound guidance allows a remote specialist to view the live exam feed over a network connection and provide real-time annotation or coaching to an on-site operator, useful in settings with limited local expertise. Modality worklist integration, automatic image optimization, and structured reporting are unrelated system capabilities.

71. C. AI-assisted automatic view-recognition and measurement software identifies when a standard anatomic view has been obtained and can suggest or automatically place calipers in expected locations, reducing manual measurement time. Modality worklist integration, elevational compounding, and multiplexing are unrelated capabilities.

72. B. An on-screen exam protocol/worksheet checklist walks the operator step by step through each required image and measurement for a standardized protocol, marking items complete as they are captured, helping ensure a thorough, standardized exam. Body marker placement, automatic Doppler tracing, and grayscale inversion are unrelated features.

73. A. Dual live/split real-time comparison displays a current live image alongside a stored prior image or exam for direct side-by-side comparison, useful for interval-change assessment -- distinct from a biplane display (two live orthogonal planes from one probe), cine loop review (playback of the current exam's own buffered frames), or panoramic display (a single stitched wide image).

74. D. A system self-test/power-on diagnostic check automatically verifies internal electronics function correctly before allowing scanning to begin, catching hardware faults early. Modality worklist integration, automatic Doppler tracing, and structured report generation are unrelated system functions performed after power-on, not as part of the diagnostic check itself.

75. D. Advanced imaging modes present in the hardware but requiring separate purchase to activate are controlled by a software license/feature-key mechanism, allowing a manufacturer to sell the same hardware platform with different enabled capabilities. The Curie point, leakage-current rating, and Spaulding classification are unrelated physical/safety specifications, not licensing mechanisms.

76. A. Raw DICOM data preserves the full original pixel data and any embedded measurement information, while a secondary-capture (screenshot-style) image is a simplified, flattened copy intended for the medical record rather than quantitative reanalysis. The two are not functionally identical, secondary-capture images do not contain more original data than raw DICOM, and raw DICOM can be viewed by many DICOM-compatible viewers, not only the original scanner.

77. D. The factor of 2 accounts for the shift occurring twice in the pulse-echo Doppler process: once as the moving red blood cell effectively 'receives' the incoming wave at a shifted frequency (due to its own motion), and again as it re-transmits (reflects) that wave back toward the transducer, which also experiences a shift from the cell's continued motion. It is unrelated to angle threshold, attenuation, or Nyquist limit considerations.

78. C. Standard convention measures arterial diameter inner-wall-to-inner-wall (leading-edge-to-leading-edge of the lumen), excluding the vessel wall thickness itself, for consistency in area and flow calculations. Outer-wall-to-outer-wall measurement would include wall thickness inappropriately, doubling a single wall measurement is not the standard technique, and a consistent convention is in fact used, not an arbitrary one.

79. C. Intima-media thickness (IMT) is the measured distance between the lumen-intima and media-adventitia echogenic interfaces of the carotid artery wall, used as a marker of cardiovascular risk. Resistive index, pulsatility index, and acceleration time are waveform-shape or timing measurements, not a wall-thickness measurement.

80. B. The ankle-brachial index (ABI) is the ratio of Doppler-derived systolic pressure at the ankle to that at the arm, used to screen for peripheral arterial disease; a reduced ratio suggests arterial insufficiency in the leg. Resistive index, pulsatility index, and velocity ratio are distinct waveform- or velocity-based calculations, not a pressure ratio between limbs.

81. B. A segmental limb pressure Doppler exam places cuffs at multiple levels along the leg and uses CW Doppler to detect a pressure drop between segments, helping localize the level of arterial disease -- distinct from the single-ratio ABI, the wall-thickness IMT measurement, and transcranial Doppler (an intracranial exam).

82. D. Failure of a vein to fully compress (coapt) under gentle transducer pressure is a primary B-mode sign of intraluminal thrombus and deep vein thrombosis, independent of the flow-based Doppler signs (phasicity, augmentation) also used in a complete venous exam. This maneuver does not measure resistive index, does not assess arterial flow, and complements rather than replaces Doppler interrogation.

83. A. An elevated peak velocity across a prosthetic valve reflects increased resistance to flow through a narrowed orifice, indicating valve stenosis, analogous to the velocity elevation seen across a stenotic native vessel. Elevated velocity does not indicate normal function, does not exclusively indicate

regurgitation (a different, though sometimes coexisting, abnormality), and a properly angle-corrected measurement reflects a true hemodynamic finding, not simply a technical error.

84. C. The renal-aortic ratio (RAR) compares renal artery peak systolic velocity to aortic peak systolic velocity, providing an alternative screening criterion for renal artery stenosis that helps account for variability in absolute renal artery velocity between patients. Resistive index, acceleration time, and pulsatility index are distinct waveform parameters, not this specific ratio.

85. A. Serial hepatic artery Doppler after liver transplant screens for hepatic artery thrombosis or significant stenosis, a serious complication that can threaten graft viability; a rising resistive index or diminished/absent diastolic flow raises concern for this. This is not expected normal postoperative healing requiring no workup, is unrelated to portal vein flow direction, and a genuine rising-RI trend is a clinical finding, not simply a technical angle artifact.

86. A. Directly visualizing echogenic material filling and expanding a non-compressible vein's lumen is a primary B-mode sign of intraluminal thrombus (DVT), distinct from and complementary to the flow-based Doppler signs of phasicity and augmentation. This finding does not confirm normal phasicity or augmentation (the opposite is implied) and is a venous, not arterial, finding.

87. D. A patent ductus arteriosus typically shows continuous, often turbulent flow reflecting the pressure gradient between the higher-pressure aorta and lower-pressure pulmonary artery throughout the cardiac cycle. It is not absent flow (the vessel is patent), does not resemble a normal peripheral arterial triphasic waveform, and is not simple low-velocity venous-type flow.

88. C. Fetal middle cerebral artery (MCA) peak systolic velocity rises in fetal anemia due to decreased blood viscosity and a compensatory increase in cerebral blood flow (the 'brain-sparing' effect), making it the standard vessel used for this specific screening application. The umbilical artery, ductus venosus, and uterine artery are used for other distinct assessments (placental resistance, fetal cardiac compromise, and maternal-side resistance/pre-eclampsia risk, respectively).

89. B. Reversal of the a-wave (the component reflecting forward flow during atrial contraction) in the ductus venosus is an ominous Doppler finding suggesting fetal cardiac compromise or significantly increased cardiac afterload. This is distinct from umbilical artery/vein findings and hepatic vein waveform terminology, which use different vessel-specific patterns.

90. A. A splenorenal shunt is a spontaneous portosystemic collateral pathway connecting the splenic vein to the left renal vein, which can enlarge and carry significant flow in portal hypertension, distinct from the ductus venosus (a fetal vessel), the hepatic artery, or the umbilical vein (a fetal/neonatal structure).

91. B. Transcranial Doppler (TCD) insonates vessels of the circle of Willis through the temporal bone acoustic window (among others), commonly used to screen for vasospasm after subarachnoid

hemorrhage by detecting elevated velocities. The renal-aortic ratio, segmental pressure Doppler, and ABI are unrelated exams performed through different windows/vessels entirely.

92. D. Multiplying LVOT VTI (velocity-time integral, representing stroke distance) by the LVOT cross-sectional area yields stroke volume, and multiplying that by heart rate yields Doppler-derived cardiac output -- a standard echocardiographic calculation. Resistive index, pulsatility index, and angle-correction factors are unrelated Doppler parameters that do not represent a cardiac output calculation.

93. A. Pressure half-time (PHT) measures how quickly the diastolic mitral inflow velocity decelerates; a more severely stenotic valve empties more slowly, prolonging the PHT, making it a standard severity marker for mitral stenosis. Resistive index, pulsatility index, and acceleration time are distinct parameters used in other vascular/waveform contexts, not this specific valve-severity measurement.

94. A. The E/A ratio compares the velocity of early (E), passive mitral inflow to the velocity of late, atrial-contraction-driven (A) inflow, serving as a standard echocardiographic marker of left ventricular diastolic function. The renal-aortic ratio, arterial stenosis velocity ratio, and S/D ratio are distinct calculations used in different vascular contexts.

95. B. TIPS surveillance tracks shunt velocity over serial exams, since a significant rise or fall outside the expected range can indicate stenosis or impending shunt malfunction, prompting further evaluation or intervention. The Curie point, hepatic artery resistive index alone, and renal-aortic ratio are unrelated to this specific shunt-velocity surveillance protocol.

96. C. Comparing fasting and postprandial celiac and SMA velocities assesses for chronic mesenteric ischemia, since a normal mesenteric vascular bed shows an expected postprandial velocity increase that may be blunted or exaggerated in significant stenosis. This protocol is specific to the mesenteric vessels, not renal artery stenosis, hepatic transplant complications, or portal vein flow direction.

97. A. An arteriovenous malformation (AVM) is a congenital tangle of abnormal vessels connecting arteries directly to veins without an intervening capillary bed, showing low-resistance, high-velocity, disorganized nidus flow -- a distinct pathologic entity from a surgically created AV fistula, a pseudoaneurysm (a contained arterial wall defect), or a simple venous varix (dilated vein).

98. C. An endoleak is persistent blood flow within the aneurysm sac but outside the stent graft after EVAR, a complication requiring surveillance since it indicates the sac is not fully excluded from arterial pressure. This is distinct from normal expected graft flow (which stays within the graft), a pseudoaneurysm (a different structural complication), and graft thrombosis (absent, not persistent, flow).

99. A. A persistent early-diastolic uterine artery notch reflects increased downstream placental vascular resistance and is used, particularly in combination with other markers, to help screen for pre-eclampsia risk. It is not used to screen for fetal anemia, ductus arteriosus closure, or cord entanglement, which are assessed by different vessels/methods.

100. B. A focal area of markedly elevated peak velocity at one specific point along an otherwise normal-velocity fistula or graft suggests a focal stenosis at that location, analogous to velocity elevation at an arterial stenosis. This is not simply normal uniform patency, does not indicate complete thrombosis (which would show absent, not elevated, flow), and a focal, reproducible velocity elevation is a genuine finding, not a technical angle artifact limited to one point.

101. C. Tracking a liver lesion's enhancement and washout pattern across the arterial, portal venous, and delayed phases after microbubble contrast injection is the basis for CEUS lesion characterization (for example, distinguishing a hemangioma's peripheral nodular enhancement from a malignant lesion's arterial hyperenhancement with washout). This protocol is unrelated to Curie point, ankle-brachial index, or fetal MCA velocity measurements.

102. D. Reversed ophthalmic artery flow (away from the eye) can occur when severe ipsilateral internal carotid stenosis or occlusion causes the ophthalmic artery to instead receive collateral flow from the external carotid system, reversing its normal direction -- an indirect sign of severe carotid disease. It is not a normal finding, is not primarily an aneurysm, and is a distinct phenomenon from subclavian steal, which involves the vertebral artery and subclavian circulation.

103. B. Popliteal artery entrapment syndrome is suggested when normal resting popliteal flow becomes markedly diminished or absent specifically with active plantarflexion, reflecting dynamic compression of the artery by an abnormally positioned muscle/tendon -- a distinct dynamic vascular compression syndrome from mesenteric ischemia, subclavian steal, or renal artery stenosis.

104. D. Pulsatile, cyclical Doppler flow corresponding to the cardiac cycle is characteristic of arteries, while continuous, non-pulsatile (though often respiratory-phasic) flow is characteristic of veins, making waveform pattern the most reliable basic differentiator when anatomy alone is ambiguous. Grayscale color, depth, and diameter alone are not reliable ways to distinguish artery from vein.

105. C. Exercise (treadmill) testing increases limb blood flow demand, which can reveal a pressure drop and reproduce symptoms in patients with a significant but resting-compensated arterial stenosis that produces normal resting ABI values -- unmasking disease that resting testing alone would miss. It does not test intima-media thickness, the renal-aortic ratio, or fetal MCA velocity, which are unrelated measurements.

106. D. A synthetic (PTFE) dialysis graft's flow character is often more turbulent and higher-pitched than a native arteriovenous fistula's typically smoother, lower-resistance signal, reflecting differences in the conduit's compliance and wall characteristics. A functioning graft does not produce a silent, flow-absent signal, native fistulas characteristically show elevated diastolic flow rather than sounding like a normal resistive artery, and there is a real, describable, perceptible difference between the two conduit types.

107. C. A hypervascular mass splaying the internal and external carotid arteries apart at the bifurcation, with marked color Doppler flow, is the classic description of a carotid body tumor (paraganglioma), a

vascular neuroendocrine tumor arising at that specific location. A simple reactive lymph node, a thrombosed pseudoaneurysm (which would typically show absent, not increased, flow), and a normal variant would not produce this specific hypervascular splaying appearance.

108. D. Cavernosal artery Doppler helps distinguish high-flow (arterial, often traumatic) priapism, which shows elevated arterial inflow, from low-flow (venous occlusive) priapism, which shows absent or minimal cavernosal arterial flow with trapped, stagnant blood -- a distinction that changes management significantly. This is unrelated to testicular torsion/epididymitis, renal vascular disease, or subclavian/vertebrobasilar pathology.

109. C. A poorly collapsing (plethoric) IVC with a sniff maneuver reflects reduced respiratory variation in IVC diameter, which correlates with elevated right atrial pressure, a noninvasive echocardiographic estimation technique. This is not a sign of normal low right atrial pressure, is not specific to left ventricular outflow obstruction, and a consistently poor collapse response across repeated attempts reflects a genuine physiologic finding, not simply a technical angle issue (IVC collapsibility assessment does not rely on a Doppler angle in the same way velocity measurements do).

110. A. As compartment pressure rises toward and eventually exceeds capillary and then arterial perfusion pressure, distal arterial Doppler signals progressively diminish and can eventually become undetectable, reflecting worsening compromise of limb perfusion -- a surgical emergency indicator. This is not a normal or expected finding, is not explained by an isolated venous process, and a progressive, reproducible trend reflects genuine physiologic compromise rather than a technical angle artifact.