

SIMULATION EXAM 20 — QUESTIONS 1-100

1. A CTS holder is evaluating a room for a new AV installation. Which action should occur first?

- A. Order the specified equipment immediately
- B. Determine the final cost of the project
- C. Conduct a site survey with the client
- D. Train the end users on operation

2. The 4H rule applies to which type of display content?

- A. Analytical decision-making
- B. Passive entertainment
- C. General wayfinding
- D. Ambient background

3. Two 4-ohm loudspeakers wired in series produce:

- A. 2 ohms
- B. 4 ohms
- C. 6 ohms
- D. 8 ohms

4. The standard for audio coverage uniformity is:

- A. NFPA 70
- B. ANSI/AVIXA A102.01
- C. ISO 27001
- D. IEEE 802.3

5. HDBaseT supports cable runs up to:

- A. 100 meters
- B. 75 meters
- C. 55 meters
- D. 30 meters

6. A conference room exhibits excessive echo. The best response is:

- A. Add more microphones
- B. Increase amplifier power
- C. Address room absorption
- D. Replace the loudspeakers

7. HDMI 2.0 maximum bandwidth is:

- A. 10.2 Gbps
- B. 18 Gbps
- C. 48 Gbps
- D. 80 Gbps

8. The CTS Code of Ethics requires members to:

- A. Always recommend the cheapest solution
- B. Match competitor pricing exactly
- C. Prioritize employer profits above clients
- D. Disclose conflicts of interest

9. Which cable category supports 10 Gbps at 100 meters?

- A. Cat 6A
- B. Cat 5e
- C. Cat 3
- D. Cat 6

10. A 16:9 display with a 70" diagonal has an image height of approximately:

- A. 40 inches
- B. 45 inches
- C. 34 inches
- D. 50 inches

11. Which protocol manages multicast group membership?

- A. ARP
- B. IGMP
- C. DHCP
- D. DNS

12. 1 watt equals how many BTU/hr?

- A. 1.0
- B. 2.0
- C. 5.5
- D. 3.412

13. An omnidirectional microphone:

- A. Has equal sensitivity in all directions
- B. Rejects sound from the rear
- C. Picks up only high frequencies
- D. Works only underwater

14. A projector throw ratio of 1.5 with a 10-foot image requires what distance?

- A. 10 feet
- B. 12 feet
- C. 15 feet
- D. 20 feet

15. Which standard addresses display image size for 2D content?

- A. ANSI/AVIXA A102.01
- B. ANSI/AVIXA V202.01
- C. ISO 9001
- D. NFPA 72

16. A 10-bit color depth provides per channel:

- A. 256 shades
- B. 512 shades
- C. 2048 shades
- D. 1024 shades

17. A far-end participant reports muffled audio during a video call. First action is:

- A. Check microphone and DSP gain structure
- B. Replace the network switch
- C. Increase display brightness
- D. Upgrade the codec firmware

18. The speed of sound in air at 20°C is approximately:

- A. 300 m/s
- B. 500 m/s
- C. 343 m/s
- D. 1000 m/s

19. Which OSI layer handles IP routing?

- A. Layer 1
- B. Layer 3
- C. Layer 5
- D. Layer 7

20. A 70V loudspeaker tapped at 15 watts draws:

- A. 0.75 A
- B. 1.5 A
- C. 0.05 A
- D. 0.21 A

21. Phantom power for condenser microphones is typically:

- A. 48V DC
- B. 24V AC
- C. 12V DC
- D. 70V AC

22. A room with an RT60 of 2.5 seconds will typically have:

- A. Excellent speech clarity
- B. Ideal conferencing acoustics
- C. Poor speech intelligibility
- D. Reduced background noise

23. The 6H rule allows maximum viewing distance of:

- A. 4× image height
- B. 6× image height
- C. 8× image width
- D. 10× image diagonal

24. A balanced audio signal uses:

- A. One conductor only
- B. Two conductors only
- C. Four conductors always
- D. Three conductors

25. NEC Article 725 addresses:

- A. Residential lighting circuits
- B. Fire alarm pathways only
- C. Class 2 signaling circuits
- D. Industrial motor controls

26. A client's IT team requests AV devices on a dedicated VLAN. The appropriate response is:

- A. Refuse the request
- B. Bypass IT entirely
- C. Install on consumer Wi-Fi
- D. Coordinate the VLAN design

27. Sabine's equation calculates:

- A. Power amplifier output
- B. Reverberation time
- C. Voltage drop per foot
- D. Cable attenuation

28. 4K UHD resolution is specifically:

- A. 3840×2160
- B. 4096×2160
- C. 7680×4320
- D. 1920×1080

29. A CTS holder discovers a safety hazard on site. The first action is:

- A. Complete the assigned task
- B. Document for later reporting
- C. Stop affected work and report
- D. Continue with extra caution

30. The NRC of an absorber measures:

- A. Surface reflection percentage
- B. Average absorption coefficient
- C. Temperature rating in Celsius
- D. Weight per square meter

31. An OLED display differs from LCD by:

- A. Using CCFL backlights
- B. Having lower contrast ratio
- C. Requiring more power always
- D. Using self-emissive pixels

32. A 16:9 display with a 50" diagonal has an image width of approximately:

- A. 44 inches
- B. 38 inches
- C. 48 inches
- D. 40 inches

33. Which connector carries SDI signals?

- A. XLR 3-pin
- B. RJ45 ethernet
- C. BNC 75-ohm
- D. USB Type-C

34. Dante is:

- A. An open public standard
- B. A proprietary audio-over-IP protocol
- C. A video compression codec
- D. A fiber optic connector type

35. A CTS holder is asked to back-date a commissioning certificate. The correct response is:

- A. Comply to maintain client relations
- B. Back-date with a disclaimer only
- C. Charge extra for the accommodation
- D. Decline as ethics violation

36. The CTS credential renews every:

- A. 3 years
- B. 1 year
- C. 5 years
- D. 10 years

37. Chroma subsampling 4:4:4 represents:

- A. Quarter horizontal sampling
- B. Half vertical sampling
- C. Full luma and chroma sampling
- D. No color information at all

38. A projector with a 4500-lumen rating on a 150 sq-ft screen produces:

- A. 15 foot-lamberts
- B. 30 foot-lamberts
- C. 45 foot-lamberts
- D. 60 foot-lamberts

39. An amplifier's THD+N specification measures:

- A. Total output wattage
- B. Peak voltage capability
- C. Input impedance matching
- D. Distortion and noise combined

40. A CTS holder recommends a product in which they hold a financial interest. Ethics require:

- A. Disclosure of the interest
- B. Concealment to protect sale
- C. Increased product markup
- D. Silent recommendation only

41. The inverse square law states SPL drops how much per doubling of distance?

- A. 3 dB
- B. 10 dB
- C. 6 dB
- D. 12 dB

42. A touch panel interface installed for ADA compliance should be mounted:

- A. Above 54 inches AFF
- B. Between 15 and 48 inches AFF
- C. Below 12 inches AFF
- D. At any convenient height

43. Rec. 709 defines the color space for:

- A. Digital cinema content
- B. Web design standards only
- C. HDR10 metadata
- D. Standard dynamic range HDTV

44. Two identical loudspeakers summing coherently produce approximately:

- A. 3 dB SPL increase
- B. 10 dB SPL increase
- C. 15 dB SPL increase
- D. 20 dB SPL increase

45. A projector mounted in a ceiling configuration requires:

- A. Only aesthetic consideration
- B. No mounting hardware
- C. Properly rated mounting hardware
- D. Residential-grade support

46. HDCP stands for:

- A. High-Data Content Processing
- B. High-bandwidth Digital Content Protection
- C. Hardware Display Control Protocol
- D. Home Distribution Content Platform

47. A loudspeaker sensitivity of 90 dB SPL/W/m means:

- A. 90 watts of power delivered
- B. 90% efficiency rating
- C. 90 Hz resonant frequency
- D. 90 dB output at 1W/1m

48. A client requests cloud-based recording for HIPAA-covered meetings. The response is:

- A. Verify HIPAA-compliant configuration
- B. Use consumer recording services
- C. Skip compliance verification
- D. Install without documentation

49. Two 8-ohm loudspeakers in parallel produce:

- A. 16 ohms
- B. 8 ohms
- C. 4 ohms
- D. 2 ohms

50. A DSP's acoustic echo cancellation removes:

- A. All room reverberation entirely
- B. Loudspeaker signal from mic input
- C. Network jitter and packet loss
- D. Electrical ground loop hum

51. The AVIXA CTS-D specialty focuses on:

- A. AV system design
- B. Installation practice only
- C. Sales training exclusively
- D. Help desk operations

52. A video wall shows inconsistent color across tiles. The likely cause is:

- A. Insufficient network bandwidth
- B. Incorrect resolution setting
- C. Audio processing drift
- D. Calibration drift between tiles

53. Pixel pitch primarily determines:

- A. Minimum viewing distance
- B. Maximum refresh rate
- C. Color temperature
- D. Power consumption total

54. A CTS holder is engaged by two clients with conflicting interests. The correct approach is:

- A. Proceed without disclosure
- B. Terminate both engagements
- C. Disclose and seek informed consent
- D. Choose the higher-paying client

55. An assistive listening system is required under ADA in:

- A. Only government buildings
- B. Residential homes only
- C. Any small meeting room
- D. Assembly areas meeting thresholds

56. A 16:9 display with 100" diagonal has an image width of approximately:

- A. 87 inches
- B. 75 inches
- C. 95 inches
- D. 100 inches

57. HDMI 2.1 supports maximum bandwidth of:

- A. 18 Gbps
- B. 24 Gbps
- C. 48 Gbps
- D. 80 Gbps

58. A projector's ANSI lumen rating uses:

- A. Single-point peak measurement
- B. Nine-point averaging method
- C. Manufacturer marketing data
- D. Subjective visual impression

59. An amplifier produces 50 watts into 8 ohms. Output voltage is approximately:

- A. 10 V
- B. 15 V
- C. 25 V
- D. 20 V

60. A boardroom's HVAC has increased noise. The first action is:

- A. Immediately replace all speakers
- B. Measure new ambient noise floor
- C. Reduce microphone sensitivity
- D. Disable the conferencing system

61. A cardioid microphone rejects sound from:

- A. The sides left and right
- B. Above the microphone
- C. The rear of the microphone
- D. The front primary source

62. NFPA 72 addresses:

- A. Plumbing installations
- B. Fire alarm systems
- C. Residential wiring only
- D. Plumbing and gas codes

63. A client requests wireless presentation with 20 simultaneous users. The appropriate consideration is:

- A. Use any consumer product
- B. Ignore bandwidth requirements
- C. Skip authentication design
- D. Evaluate bandwidth and security

64. The professional line level reference is:

- A. +4 dBu approximately
- B. -10 dBV always
- C. 0 dBFS fixed value
- D. 1 V peak standard

65. A VLAN in networking:

- A. Provides physical cable routing
- B. Controls only wireless traffic
- C. Logically segments network traffic
- D. Replaces the need for routing

66. A CTS holder notices another installer bypassing grounding. The response is:

- A. Ignore as not personal work
- B. Report through proper channels
- C. Publicly criticize the installer
- D. Take over the installer's work

67. The Nyquist frequency for 48 kHz sampling is:

- A. 48 kHz total
- B. 96 kHz effective
- C. 12 kHz bandwidth
- D. 24 kHz maximum

68. A 16:9 display has image height of 30 inches. Maximum 4H viewing distance is:

- A. 120 inches (10 ft)
- B. 60 inches (5 ft)
- C. 180 inches (15 ft)
- D. 80 inches (6.7 ft)

69. A client requests AV system monitoring integration with their SIEM. The response is:

- A. Refuse the integration request
- B. Use manufacturer default only
- C. Design integration with IT team
- D. Skip all security considerations

70. The EDID handshake communicates:

- A. Network authentication credentials
- B. Display capabilities to source
- C. Audio encryption key data
- D. Remote control commands only

71. A 16:9 display with image width 64 inches has image height of approximately:

- A. 24 inches
- B. 30 inches
- C. 40 inches
- D. 36 inches

72. A plenum-rated cable (CMP) is required in:

- A. Return-air plenums
- B. Underground conduit runs
- C. Residential wall cavities
- D. Outdoor pathway installations

73. OSHA fall protection is generally required for construction work above:

- A. 4 feet in all cases
- B. 20 feet standard rule
- C. 6 feet in construction
- D. 10 feet for everyone

74. A client has requested 24/7/365 AV system support. The appropriate response is:

- A. Provide support informally
- B. Develop a formal SLA
- C. Refuse the request entirely
- D. Require the client to self-support

75. An LED pixel pitch of 2.5mm is appropriate for viewing at:

- A. 1 foot typical distance
- B. 100 feet or more distance
- C. 50 feet only viewing
- D. Approximately 8-10 feet

76. A CTS holder must maintain competence through:

- A. Ongoing continuing education
- B. Initial certification only
- C. Employer-paid training exclusively
- D. Random self-study approach

77. The standard professional digital audio sample rate is:

- A. 22.05 kHz baseline
- B. 44.1 kHz consumer only
- C. 48 kHz for production
- D. 96 kHz for all work

78. A microphone's polar pattern describes:

- A. Its frequency response curve
- B. Its directional sensitivity profile
- C. Its maximum SPL handling
- D. Its physical dimensions

79. A client's codec fails after a firmware update. The first troubleshooting step is:

- A. Replace the codec entirely
- B. Reset network configuration
- C. Change the conferencing platform
- D. Review the firmware change log

80. HDBaseT signal transport uses:

- A. Twisted-pair Category cable
- B. Coaxial RG-6 cable only
- C. Fiber optic multimode cable
- D. Consumer HDMI cable only

81. NEC Article 800 covers:

- A. Only residential wiring methods
- B. Industrial motor branch circuits
- C. Communications circuits cabling
- D. Service entrance equipment

82. A DSP performs:

- A. Only analog signal processing
- B. Audio processing in digital domain
- C. Video encoding exclusively
- D. Network packet routing only

83. A wireless microphone operating frequency must:

- A. Exceed 3 GHz in all regions
- B. Use channel 1 exclusively
- C. Match the speaker impedance
- D. Comply with local regulations

84. The CTS Code of Ethics applies to credential holders:

- A. In all professional activities
- B. Only when dealing with AVIXA
- C. Only during business hours
- D. Only in written contracts

85. A 16:9 display at 45" diagonal has an image height of approximately:

- A. 26 inches
- B. 30 inches
- C. 22 inches
- D. 35 inches

86. A projector's throw distance in a room with 20-foot depth and 1.5 throw ratio produces a maximum image width of:

- A. 10 feet
- B. 13.3 feet
- C. 15 feet
- D. 20 feet

87. Which article of the NEC addresses grounding and bonding?

- A. Article 310
- B. Article 408
- C. Article 725

D. Article 250

88. A CTS holder asked to work outside their expertise should:

- A. Coordinate with qualified professional
- B. Proceed with confidence anyway
- C. Hide limitation from client
- D. Refuse the engagement outright

89. Color temperature of 6500K represents:

- A. Cool sunset lighting
- B. Warm candlelight glow
- C. Daylight standard reference
- D. Incandescent bulb color

90. Applying the 4H rule, a 36-inch image height allows maximum viewing of:

- A. 72 inches (6 ft)
- B. 144 inches (12 ft)
- C. 216 inches (18 ft)
- D. 288 inches (24 ft)

91. A video compression codec H.265 offers:

- A. No improvement over H.264
- B. Worse quality at same bitrate

- C. Audio-only compression
- D. Better efficiency than H.264

92. A CTS holder discovers a HIPAA exposure during installation. The response is:

- A. Report to client compliance team
- B. Continue operations without action
- C. Hide the finding from the client
- D. Blame the client for the issue

93. The CTS renewal cycle requires accumulating:

- A. Manufacturer certifications only
- B. Peer review approvals only
- C. Specific continuing education
- D. Annual exam passes only

94. An LCR loudspeaker configuration includes:

- A. Low, center, reflected channels
- B. Left, center, right positions
- C. Line, channel, return paths
- D. Live, canceled, reset zones

95. A display calibration delta-E value below 2 means:

- A. The display has failed completely

- B. Calibration has drifted severely
- C. Color accuracy is unacceptable
- D. Color difference is imperceptible

96. A conferencing room's camera should be positioned:

- A. At approximately participant eye level
- B. Only on the ceiling surface
- C. Below the horizontal floor line
- D. Behind the participants always

97. A projector's lens shift enables:

- A. Automatic lamp replacement
- B. Color correction adjustment
- C. Image positioning without distortion
- D. Faster warm-up sequence

98. An SPDIF interface carries:

- A. Only analog stereo audio
- B. Digital audio signals
- C. Video signals only
- D. Power for devices

99. A CTS holder is pressured to violate ethics for career benefit. The response is:

- A. Comply to protect employment
- B. Escalate publicly immediately
- C. Resign without discussion
- D. Raise concern and decline

100. The foundation of professional AV practice is:

- A. Ethical and competent service
- B. Manufacturer certification only
- C. Lowest-cost delivery always
- D. Fast project completion

SIMULATION EXAM 20 — ANSWER

KEY AND FULL EXPLANATIONS

1. C — Conduct a site survey with the client. The site survey is the foundational first step in any AV project, establishing actual room conditions, client needs, existing infrastructure, and constraints that inform every subsequent design decision. Skipping the site survey and ordering equipment or estimating costs without first understanding the room produces mismatched systems that require costly rework. The survey creates the baseline from which all design choices flow.
2. A — Analytical decision-making. The 4H rule from ANSI/AVIXA V202.01 establishes maximum viewing distance as four times the image height for Analytical Decision-Making content — spreadsheets, CAD drawings, medical imaging, or anything requiring fine detail resolution. Viewers beyond this distance cannot resolve the detail the content was designed to show. The 6H rule applies to Basic Decision-Making content where fine detail isn't required.
3. D — 8 ohms. Series wiring sums impedances, so $4 + 4 = 8$ ohms. This contrasts with parallel wiring which divides impedance. Series-parallel combinations are used to match loudspeaker configurations to amplifier minimum load ratings, avoiding both too-low impedance (which stresses amplifiers) and too-high impedance (which reduces power delivery).
4. B — ANSI/AVIXA A102.01. The Audio Coverage Uniformity in Listener Areas standard specifies acceptable SPL variation (± 3 dB) across a listening space along with the measurement methodology. NFPA 70 is the electrical code; ISO 27001 is information security; IEEE 802.3 is ethernet — none of which govern audio coverage.
5. A — 100 meters. HDBaseT is designed to operate over twisted-pair Category cable up to 100 meters, matching the standard structured cabling distance. This extended reach enables HDMI-equivalent video, audio, control, and Ethernet transport using existing cable infrastructure, making it widely used for long-distance AV signal distribution in commercial installations.
6. C — Address room absorption. Excessive echo indicates insufficient absorption in the room, which can only be effectively resolved by adding absorptive treatment to reduce reflections. Adding microphones compounds the problem by capturing more reflections; increasing amplifier power amplifies the echo; and replacing loudspeakers doesn't address the room acoustics that are actually causing the issue.
7. B — 18 Gbps. HDMI 2.0 supports a maximum bandwidth of 18 Gbps, enabling 4K60 at 4:4:4 8-bit or 4:2:0 with HDR configurations. This represents a significant advancement over HDMI 1.4's 10.2 Gbps ceiling, but is substantially below HDMI 2.1's 48 Gbps that supports 8K60 and 4K120.

8. D — Disclose conflicts of interest. The CTS Code of Ethics explicitly requires disclosure of conflicts that could affect professional judgment, allowing clients to evaluate recommendations with full information. The other options contradict ethical obligations — recommending based on cost alone, price-matching competitors, or prioritizing employer profits all violate the duty of loyal professional service to the client.
9. A — Cat 6A. Category 6A cable is rated for 10 Gbps ethernet at the full 100-meter horizontal channel length, which is the standard structured cabling distance. Cat 6 supports 10 Gbps only at shorter distances (typically 55 meters); Cat 5e tops out at 1 Gbps; Cat 3 supports only 10 Mbps and voice applications.
10. C — 34 inches. For a 16:9 display, image height equals approximately 49% of the diagonal: $70 \times 0.49 \approx 34.3$ inches. This multiplier derives from the geometry of the 16:9 aspect ratio where height equals $9/\sqrt{(16^2 + 9^2)}$ of the diagonal. Knowing this conversion enables rapid verification of viewing distance compliance.
11. B — IGMP. Internet Group Management Protocol manages multicast group membership on IP networks, enabling endpoints to subscribe to and unsubscribe from multicast streams. IGMP snooping at the switch level is essential for efficient multicast operation in AV-over-IP systems, preventing multicast traffic from flooding all network ports.
12. D — 3.412. The conversion factor is exactly 3.412 BTU/hr per watt. This value is foundational for HVAC sizing calculations — all electrical power consumed by AV equipment eventually becomes heat that the cooling system must remove to maintain reliable equipment operation. Equipment room and rack cooling design depends on accurate BTU calculations.
13. A — Has equal sensitivity in all directions. Omnidirectional microphones respond approximately equally to sound arriving from all directions, producing a spherical pickup pattern. This makes them useful for capturing ambient sound or group discussions where directional rejection isn't desired, but less useful where feedback rejection or isolation of specific sources is important.
14. C — 15 feet. Throw distance equals throw ratio multiplied by image width: $1.5 \times 10 = 15$ feet. This calculation is the foundation of projector lens selection — matching the projector's throw ratio capability to the available throw distance and desired image size. Short-throw projectors have ratios below 1.0; long-throw projectors have higher ratios.
15. B — ANSI/AVIXA V202.01. The Display Image Size for 2D Content in Audiovisual Systems standard establishes the 4H rule for Analytical Decision-Making content and the 6H rule for Basic Decision-Making content. These rules govern the relationship between image height and maximum viewing distance, ensuring content is appropriately sized for its intended viewing audience.
16. D — 1024 shades. 10-bit color depth provides $2^{10} = 1,024$ shades per channel. Combined across RGB, this yields approximately 1.07 billion total colors, compared to 8-bit color's 16.7 million.

The wider range reduces visible banding in gradients and enables the expanded dynamic range required for HDR content.

17. A — Check microphone and DSP gain structure. Muffled far-end audio points to the local-to-far-end signal chain: microphone coverage, gain structure through the DSP, and outbound processing. Network switch replacement doesn't address signal path issues; display brightness is unrelated to audio; firmware updates are a later step after investigating the actual signal path.
18. C — 343 m/s. Sound velocity in air at 20°C (standard reference temperature) is approximately 343 m/s or 1,125 ft/s. This value is foundational for acoustic calculations including delay timing, loudspeaker array spacing, and speech intelligibility analysis. Temperature and humidity cause small variations in actual speed, but 343 m/s is the accepted reference.
19. B — Layer 3. The Network layer (Layer 3) in the OSI/TCP-IP model handles logical addressing (IP) and routing between networks. This is where IP routing, subnets, and NAT operate. Layer 1 handles physical signal transmission; Layer 5 manages sessions; Layer 7 is application-level protocols like HTTP and SMTP.
20. D — 0.21 A. Using Ohm's law for 70V distributed audio, current equals power divided by voltage: $15 \div 70 \approx 0.21$ amperes. This low per-loudspeaker current is why 70V distribution enables long cable runs with minimal voltage drop — the key design advantage over direct low-impedance speaker wiring.
21. A — 48V DC. Phantom power for condenser microphones is typically 48V DC, delivered through balanced XLR lines to power the microphone's internal electronics. This is the industry standard across professional audio equipment, though some equipment uses reduced voltages (12V or 24V) for different microphone types or power-constrained applications.
22. C — Poor speech intelligibility. A reverberation time of 2.5 seconds is excessively long for speech-focused environments. Conference rooms typically target 0.4-0.6 seconds; spaces with RT60 above approximately 1.5 seconds experience significant speech intelligibility problems as consonant sounds are masked by lingering reverberation. Speech intelligibility is a function of appropriate reverberation control.
23. B — $6\times$ image height. The 6H rule from ANSI/AVIXA V202.01 allows viewing distance up to 6 times the image height for Basic Decision-Making content. BDM content doesn't require the fine detail resolution of ADM content, so viewers can be farther from the display. This more permissive rule enables larger viewing areas for general-purpose content.
24. D — Three conductors. Balanced audio uses three conductors: hot (signal), cold (inverted signal), and ground/shield. The inverted signal pair enables differential signal reception that rejects common-mode noise picked up along the cable run. This is why balanced interconnects are standard for professional audio over long runs where noise immunity matters.

25. C — Class 2 signaling circuits. NEC Article 725 governs Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits, which includes most low-voltage AV cabling. Class 2 circuits have inherent power and voltage limits that provide safety. Understanding this article is essential for compliant AV pathway and cable installation.
26. D — Coordinate the VLAN design. Dedicated VLANs for AV are common enterprise practice, providing traffic isolation and performance guarantees. The appropriate response is collaboration with IT to design the VLAN configuration that meets both AV performance needs and IT security/management requirements. Refusing, bypassing, or using consumer Wi-Fi all fail the enterprise governance structure.
27. B — Reverberation time. Sabine's equation calculates reverberation time (RT60) from room volume and total absorption: $RT60 = 0.161 \times V/A$ (metric) or $0.049 \times V/A$ (imperial). This is the foundational equation for acoustic room design, enabling prediction of reverberation time before construction and analysis of treatment effectiveness.
28. A — 3840×2160 . 4K UHD (Ultra High Definition) is specifically 3840×2160 , which is four times the pixel count of 1080p. DCI 4K at 4096×2160 is the digital cinema variant with slightly wider aspect ratio. 7680×4320 is 8K UHD, and 1920×1080 is 1080p HD.
29. C — Stop affected work and report. Safety concerns override schedule — stopping affected work and reporting through documented safety channels protects people and complies with OSHA requirements. Continuing the task, documenting for later, or proceeding with "extra caution" all fail the safety discipline that protects workers and fulfills legal obligations.
30. B — Average absorption coefficient. NRC (Noise Reduction Coefficient) is the average absorption coefficient across speech-critical frequencies (250, 500, 1000, 2000 Hz), expressed as a decimal between 0 (no absorption) and 1 (complete absorption). NRC 0.85 indicates 85% average absorption, making the material highly effective for reducing reverberation in speech-focused spaces.
31. D — Using self-emissive pixels. OLED technology has each pixel produce its own light, enabling true blacks when pixels are completely off and superior contrast compared to LCD. LCD displays use a backlight passing through a liquid crystal modulation layer, which limits black level performance because the backlight always produces some light leakage.
32. A — 44 inches. For a 16:9 display, image width equals approximately 87% of the diagonal: $50 \times 0.87 \approx 43.6$ inches, rounded to 44. This 0.87 multiplier derives from the geometry of the 16:9 aspect ratio where width equals $16/\sqrt{16^2 + 9^2}$ of the diagonal, a useful conversion for display sizing.
33. C — BNC 75-ohm. BNC connectors with their bayonet-lock mechanical engagement are the professional standard for SDI (Serial Digital Interface) in broadcast and professional video

installations. The impedance-controlled 75-ohm coaxial connection is critical for SDI signal integrity over the required distances.

34. B — A proprietary audio-over-IP protocol. Dante (Digital Audio Network Through Ethernet) is Audinate's proprietary audio-over-IP protocol, widely adopted across the professional audio industry. It requires licensed hardware but provides integrated management and low-latency operation. Open standards like AES67 enable interoperability between Dante and other proprietary systems.
35. D — Decline as ethics violation. Back-dating a commissioning certificate is document falsification — ethically prohibited under the CTS Code of Ethics and potentially legally actionable as fraud. The professional response maintains integrity even at the cost of client accommodation. Compliance, disclaimers, or charging extra do not mitigate the ethics violation.
36. A — 3 years. The CTS credential operates on a three-year renewal cycle, requiring accumulated Renewal Units (RUs) through documented continuing education and payment of renewal fees. This cycle ensures credential holders maintain current knowledge as AV technology evolves, reflecting the rapid pace of change in the industry.
37. C — Full luma and chroma sampling. 4:4:4 chroma sampling preserves all color information — every pixel has full luminance and both chroma values sampled fully with no subsampling. This is the highest-quality chroma configuration, used in color-critical applications like cinema and professional production where maximum color fidelity is required.
38. B — 30 foot-lamberts. Screen illuminance (before screen gain) approximately equals lumens divided by screen area: $4,500 \div 150 = 30$ foot-lamberts. This value falls within the acceptable range for projection in moderately controlled lighting. Cinema reference is 16 foot-lamberts; presentation environments typically target 25-50 foot-lamberts depending on ambient conditions.
39. D — Distortion and noise combined. THD+N (Total Harmonic Distortion plus Noise) combines harmonic distortion and noise into a single metric expressed as a percentage of the output signal. Lower THD+N values indicate more accurate amplifier reproduction. This specification is a key indicator of amplifier quality and a primary comparison metric for amplifier selection.
40. A — Disclosure of the interest. The CTS Code of Ethics requires disclosure of financial interests that could affect professional recommendations, enabling the client to evaluate recommendations with full information. Concealment violates the duty of honest dealing; increased markup or silent recommendation both compound the ethics violation by hiding the conflict.
41. C — 6 dB. The inverse square law states that sound pressure level decreases by 6 dB per doubling of distance from a point source in the free (direct) field. This occurs because sound energy spreads spherically, with pressure inversely proportional to the square of distance. This relationship is foundational for predicting SPL at listener positions.

42. B — Between 15 and 48 inches AFF. ADA 2010 Standards for Accessible Design specify reach range limits for operable parts, with 15"-48" as the range for unobstructed forward reach. These dimensions ensure that people using wheelchairs or with limited mobility can reach and operate touch panels, switches, and other controls.
43. D — Standard dynamic range HDTV. Rec. 709 (ITU-R BT.709) defines the color space, primaries, white point, and transfer characteristics for standard-dynamic-range HDTV content. This remains the baseline color space for most current broadcast and streaming content, despite the emergence of wider-gamut HDR formats like Rec. 2020.
44. A — 3 dB SPL increase. Two identical coherent loudspeakers typically sum incoherently to produce approximately 3 dB SPL increase across a listening area, following $10 \cdot \log(2) \approx 3$ dB. This represents the power-sum average gain. Coherent in-phase summation at specific focal points can reach 6 dB, but 3 dB is the realistic average across the coverage area.
45. C — Properly rated mounting hardware. Ceiling-mounted projectors require mounting hardware rated for the projector's weight plus appropriate safety factor, typically meeting UL or equivalent standards. Aesthetic-only or residential-grade hardware doesn't meet the safety requirements for overhead installations, creating liability exposure and potential injury risk if the mount fails.
46. B — High-bandwidth Digital Content Protection. HDCP is the content protection standard that authenticates devices in digital video signal chains before allowing protected commercial content to pass. Authentication failures produce blank screens or reduced-resolution output. Understanding HDCP is essential for troubleshooting modern AV distribution where protected content is common.
47. D — 90 dB output at 1W/1m. Loudspeaker sensitivity specifies the SPL produced at 1 meter distance with 1 watt input signal. This is the baseline from which SPL at other power levels and distances is calculated. Higher sensitivity indicates more efficient conversion of electrical power to acoustic output, requiring less amplifier power to reach target SPL.
48. A — Verify HIPAA-compliant configuration. Healthcare recording captures Protected Health Information, requiring HIPAA-compliant handling including encryption, access controls, audit logging, and business associate agreements. Consumer services typically don't meet HIPAA requirements; skipping verification or documentation exposes the client to significant regulatory risk and potential penalties.
49. C — 4 ohms. Two 8-ohm loudspeakers in parallel yield $8 \div 2 = 4$ ohms. Parallel wiring halves the impedance with two identical loudspeakers. This must be verified against amplifier minimum load ratings — most amplifiers can handle 4 ohms, but dropping below that stresses amplifier output stages and can cause protection engagement or damage.
50. B — Loudspeaker signal from mic input. Acoustic echo cancellation mathematically subtracts the loudspeaker reference signal from the microphone input, allowing simultaneous loudspeaker playback and microphone pickup in conferencing without feedback. AEC doesn't eliminate all

reverberation, affect network jitter, or address ground loop hum — those require different solutions.

51. A — AV system design. The CTS-D (Certified Technology Specialist — Design) specialty certification focuses on AV system design expertise, building on the base CTS credential. It validates advanced competencies in system architecture, specification, documentation, and design verification. Installation focus is CTS-I; other specialties address different professional roles.
52. D — Calibration drift between tiles. Inconsistent color across video wall tiles is characteristic of per-tile calibration drift or LED panel aging that varies by tile due to manufacturing differences or operational variations. Network bandwidth affects signal integrity not color; incorrect resolution produces geometric issues; audio processing is unrelated to visual color.
53. A — Minimum viewing distance. Pixel pitch — the center-to-center distance between adjacent pixels — directly determines how close viewers can approach the display before individual pixels become visible. Tighter pixel pitch enables closer viewing without pixelation, which is the fundamental design criterion for LED video walls and other pixel-structured displays.
54. C — Disclose and seek informed consent. Conflicts between clients require disclosure to all affected parties. If representation of both clients could harm either, the professional either declines or obtains informed consent from all parties. Proceeding without disclosure violates ethical duties; unilaterally terminating or choosing by payment both fail the ethics framework.
55. D — Assembly areas meeting thresholds. ADA Standards for Accessible Design specify ALS requirements in assembly areas based on occupant load thresholds — not all rooms, not only certain building types, not only small spaces. The thresholds trigger ALS provision to prevent discriminatory exclusion of people with hearing disabilities from meaningful participation.
56. A — 87 inches. For a 16:9 display with 100-inch diagonal, width = diagonal \times 0.87 = 100 \times 0.87 = 87 inches. This is consistent with the width-to-diagonal ratio for 16:9 displays, useful for verifying that a specified display meets width requirements for a given wall space or seating arrangement.
57. C — 48 Gbps. HDMI 2.1 supports up to 48 Gbps through enhanced signaling, enabling 8K60, 4K120, and higher color depth configurations. This is a substantial increase over HDMI 2.0's 18 Gbps ceiling and enables next-generation video formats, dynamic HDR, and variable refresh rate for gaming and advanced applications.
58. B — Nine-point averaging method. ANSI lumens use a nine-point averaging method standardized by ANSI, providing consistent comparison between projectors across the industry. Other rating methods (peak center measurement, manufacturer marketing figures, subjective impression) can overstate actual useful brightness or lack standardization, making them less reliable for objective comparison.

59. D — 20 V. Using the power formula $V = \sqrt{(P \times R)} = \sqrt{(50 \times 8)} = \sqrt{400} = 20$ V. This voltage calculation is foundational for amplifier-loudspeaker matching, demonstrating that power, impedance, and voltage are mathematically interrelated. Understanding this relationship informs amplifier specification and system design decisions.
60. B — Measure new ambient noise floor. HVAC changes have altered the room's acoustic baseline; measuring the new ambient noise is the necessary first step before any remediation. This establishes the actual problem quantitatively. Wholesale equipment replacement, reducing mic sensitivity, or disabling conferencing all fail to address the root cause of the acoustic change.
61. C — The rear of the microphone. Cardioid microphones have a heart-shaped pickup pattern with maximum sensitivity forward and minimum sensitivity behind — hence "cardioid" (heart-shaped). This rear-rejection reduces pickup of unwanted sounds from behind the microphone, such as ambient noise or loudspeaker output, making cardioid patterns standard for sound reinforcement where feedback control matters.
62. B — Fire alarm systems. NFPA 72 is the National Fire Alarm and Signaling Code, governing fire alarm system installation, monitoring, and mass notification. AV installations often intersect with this code through emergency notification integration, pathway coordination with fire alarm cabling, and audio system integration with emergency announcements.
63. D — Evaluate bandwidth and security. A 20-user wireless presentation deployment requires substantive design analysis — per-user bandwidth multiplied by concurrent users drives network capacity, and security considerations address access control, data protection, and session isolation. Skipping these analyses creates performance and security exposures that affect real-world operation.
64. A — +4 dBu approximately. Professional line level is +4 dBu, which equals approximately 1.23 V RMS. This is the standard interconnect level between professional audio devices, providing adequate headroom and signal-to-noise ratio. Consumer line level is -10 dBV (about 0.316 V RMS), which is why consumer and professional equipment require level-matching when interconnected.
65. C — Logically segments network traffic. VLANs (Virtual LANs) logically segment a physical network into separate broadcast domains, isolating traffic for security, performance, or management purposes. AV installations often use dedicated VLANs to separate AV streams from corporate data traffic, enabling traffic prioritization and security isolation without requiring separate physical networks.
66. B — Report through proper channels. The CTS Code of Ethics addresses conduct of colleagues, particularly safety-affecting issues. Structured reporting protects public welfare while maintaining professional decorum. Ignoring fails the safety obligation; public criticism damages professional relationships; taking over someone else's work exceeds one's role and can create other issues.

67. D — 24 kHz maximum. The Nyquist frequency equals half the sampling rate. For 48 kHz sampling, the Nyquist frequency is 24 kHz, representing the maximum frequency that can be accurately represented without aliasing. Signals above this frequency must be filtered out before sampling. This determines the practical audio bandwidth of 48 kHz digital systems.
68. A — 120 inches (10 ft). Applying the 4H rule: maximum viewing distance = $4 \times \text{image height} = 4 \times 30 = 120$ inches (10 feet). This calculation drives seating layout decisions — viewers beyond 10 feet from this display won't be able to resolve ADM content detail. Reverse calculation specifies minimum display height from room depth.
69. C — Design integration with IT team. SIEM (Security Information and Event Management) integration is a cybersecurity collaboration requiring joint design between AV and IT security teams. Refusing misses the business need; manufacturer defaults may not match the SIEM's requirements; skipping security considerations creates exposures that violate enterprise security policies.
70. B — Display capabilities to source. EDID (Extended Display Identification Data) communicates the display's supported resolutions, refresh rates, color spaces, and audio formats to the source device. The source uses this information to automatically configure its output to match what the display can accept, enabling plug-and-play operation across varied source-display combinations.
71. D — 36 inches. For a 16:9 display, height = width $\times (9/16) = 64 \times 0.5625 = 36$ inches. This direct aspect-ratio calculation from width to height is the inverse of the width-to-diagonal conversion and is used when verifying display height requirements from known width dimensions.
72. A — Return-air plenums. Plenum-rated (CMP) cable has low-smoke, low-flame-spread construction required in air-handling spaces like above suspended ceilings used as return-air plenums. Standard PVC-jacketed cables release toxic smoke when burned, failing fire safety requirements in these spaces where smoke could spread throughout the building through the HVAC system.
73. C — 6 feet in construction. OSHA's construction fall protection standard (29 CFR 1926.501) generally requires fall protection for work at 6 feet or above. Different industries have different thresholds — general industry is typically 4 feet. Specific activity requirements can trigger protection at lower heights. Knowing the applicable threshold is essential for compliance.
74. B — Develop a formal SLA. 24/7/365 support requires a formal Service Level Agreement specifying response times, coverage scope, escalation procedures, and pricing. Informal provision, blanket refusal, or requiring self-support all fail to establish the structured professional support relationship the client has requested and needs for enterprise operations.
75. D — Approximately 8-10 feet. Pixel pitch minimum viewing distance roughly equals pitch (in mm) \times approximately 3-4 (using different standards of methodology). For 2.5mm pitch, that's

approximately 7.5-10 feet — close enough that individual pixels blend into continuous image perception for typical viewers. This drives pixel pitch selection based on viewing distance.

76. A — Ongoing continuing education. The CTS renewal cycle requires continuing education accumulated through the three-year period, reflecting the ethical obligation to maintain current competence as AV technology evolves. Initial certification alone doesn't suffice; employer-dependent training creates gaps for self-employed or between-jobs professionals; random approaches don't meet structured renewal requirements.
77. C — 48 kHz for production. 48 kHz is the standard professional digital audio sample rate for video and broadcast production, providing audio bandwidth up to approximately 24 kHz per the Nyquist theorem. 44.1 kHz is the CD/consumer music standard; 96 kHz is used for high-end production with wider bandwidth margins; 22.05 kHz is reduced-quality legacy.
78. B — Its directional sensitivity profile. A microphone's polar pattern describes how its sensitivity varies with the direction of sound arrival. Common patterns include omnidirectional, cardioid, supercardioid, hypercardioid, and bidirectional (figure-8). Understanding polar patterns enables appropriate microphone selection for specific pickup requirements and feedback control considerations.
79. D — Review the firmware change log. When problems correlate with a specific firmware update, the firmware change is the primary suspect. Reviewing the change log identifies what changed; this informs whether rollback, configuration adjustment, or escalation to the manufacturer is appropriate. Wholesale equipment replacement, network reset, or platform change are disproportionate first responses.
80. A — Twisted-pair Category cable. HDBaseT uses twisted-pair Category cable (Cat 5e/6) to carry video, audio, control, and Ethernet signals up to 100 meters. This enables long-distance HDMI extension using standard structured cabling infrastructure. It's distinct from coaxial, fiber, or direct HDMI cable approaches, making HDBaseT particularly cost-effective for extended runs.
81. C — Communications circuits cabling. NEC Article 800 addresses communications circuits — the pathway and installation requirements for structured cabling, telephone, and low-voltage signal cabling commonly used in AV installations. This article covers separation requirements from power circuits, firestop provisions, and listing requirements for different installation environments.
82. B — Audio processing in digital domain. DSP (Digital Signal Processing) performs computational audio processing in the digital domain, including EQ, filtering, compression, routing, delay compensation, and echo cancellation. Modern DSP enables complex audio systems to be configured in software, providing flexibility and precision beyond what analog processing can achieve.
83. D — Comply with local regulations. Wireless microphone frequencies are regulated by jurisdiction (FCC in the U.S., Ofcom in UK, etc.), with specific allocated bands that vary by country. Operating

outside allocated bands is illegal and can cause harmful interference. Frequency requirements have nothing to do with channel numbers or speaker impedance matching.

84. A — In all professional activities. The CTS Code of Ethics applies broadly to professional conduct, not limited to AVIXA interactions, business hours, or written contracts. This includes digital communication, documentation, and social media where professional identity is conveyed. The broad application protects the profession's standing across all contexts where credential holders act professionally.
85. C — 22 inches. For a 16:9 display with 45-inch diagonal, height = $45 \times 0.49 \approx 22$ inches. This is a smaller commercial display size, suitable for smaller meeting spaces or huddle rooms. The 0.49 multiplier consistently applies across all 16:9 diagonal-to-height conversions, a useful rule of thumb for display sizing work.
86. B — 13.3 feet. Image width = throw distance \div throw ratio = $20 \div 1.5 \approx 13.3$ feet. This reverse calculation determines maximum image width given available throw distance and specified throw ratio. The result helps verify whether a specific projector and lens combination produce adequate image width for the viewing audience.
87. D — Article 250. NEC Article 250 addresses grounding and bonding — foundational electrical safety provisions ensuring that fault current has a low-impedance path back to source and that metal parts maintain equal potential. AV installations must comply with grounding requirements for equipment, racks, and systems that interact with building electrical systems.
88. A — Coordinate with qualified professional. The CTS Code of Ethics requires recognizing one's competence limitations. When work involves expertise beyond the CTS holder's qualification, coordinating with appropriately qualified professionals produces competent service while maintaining ethics. Proceeding with confidence, hiding limitations, or refusing entirely all fail the dual obligations to client service and ethical practice.
89. C — Daylight standard reference. 6500K color temperature (D65) is the standard daylight reference used in most video calibration including Rec. 709. It represents the color characteristic of natural daylight and is the target white point for reference-calibrated displays. Lower Kelvin values appear warmer (candlelight, incandescent); higher values appear cooler.
90. B — 144 inches (12 ft). Applying the 4H rule: maximum viewing distance = $4 \times$ image height = $4 \times 36 = 144$ inches, which is 12 feet. This rule ensures Analytical Decision-Making content remains resolvable at the farthest viewer position. Rooms where viewers would be beyond this distance require larger displays to maintain content legibility.
91. D — Better efficiency than H.264. H.265 (HEVC) achieves approximately 50% better compression efficiency than H.264 at equivalent perceived quality. This efficiency improvement enables 4K streaming and reduces bandwidth and storage requirements for video distribution. The

tradeoff is increased computational requirements for encoding and decoding, which modern hardware accommodates.

92. A — Report to client compliance team. Discovered HIPAA exposure requires immediate response through the client's compliance function. Continuing operations, concealment, or blame-shifting all violate ethical duties and potentially incur personal liability under HIPAA. The professional response engages the client's compliance team to evaluate and remediate the exposure appropriately.
93. C — Specific continuing education. CTS renewal requires accumulating specific continuing education credits (Renewal Units) within the three-year renewal cycle. Manufacturer certifications or peer reviews alone don't meet the structured continuing education requirement; the structured CE requirement ensures credential holders maintain current knowledge across the body of AV practice.
94. B — Left, center, right positions. An LCR loudspeaker configuration places loudspeakers at Left, Center, and Right positions relative to the viewing area — a foundational spatial arrangement for presentation, cinema, and multi-channel applications. The center loudspeaker anchors dialog and primary content; left and right provide stereo imaging and spatial context.
95. D — Color difference is imperceptible. Delta E below 2 is generally considered the threshold of perceptibility for trained observers. Lower values indicate more accurate calibration to reference standards. Values above 3-5 are typically visible to trained eyes; values above 10 are generally visible to most observers. $\Delta E < 2$ is the target for critical color work.
96. A — At approximately participant eye level. Camera height matching participant eye level produces natural conversational perspective for remote participants, simulating natural face-to-face interaction. Ceiling-only mounting creates a downward angle that feels unnatural; below-horizontal creates an upward angle that can look awkward; behind-participant defeats the purpose of video conferencing.
97. C — Image positioning without distortion. Lens shift physically moves the projection lens relative to the imaging engine, repositioning the image without introducing geometric distortion. This contrasts with digital keystone correction, which introduces scaling artifacts. Lens shift preserves image geometry and clarity while adjusting position within the lens design's limits.
98. B — Digital audio signals. SPDIF (Sony/Philips Digital Interface Format) is a digital audio interface carrying digital audio signals between devices, available in coaxial (S/PDIF) and optical (TOSLINK) variants. It's widely used in consumer and prosumer audio for connecting sources like Blu-ray players to receivers or other audio processing equipment.
99. D — Raise concern and decline. Ethical obligations apply regardless of employer pressure. The professional response involves raising concerns through appropriate channels, documenting the situation, and ultimately declining to perform unethical work even at career cost. The Code of

Ethics doesn't yield to employer demands; complying, public escalation, or silent resignation all fail the ethical framework.

100. A — Ethical and competent service. The foundation of professional AV practice, as reflected in the CTS Code of Ethics and credential framework, is ethical and competent service to clients, the profession, and the public. Cost minimization, speed, or certification alone don't constitute the professional foundation — they may be considerations, but the underlying foundation is the combination of ethics and competence that defines professional practice.