

PRACTICE EXAM 14: CTS-D SIMULATION (110 QUESTIONS)

Time Limit: 180 minutes | Passing Score: 70%

1. A corporate conference room at 20 ft farthest viewing requires BDM image. The DISCAS minimum image height is:

- A. 24 inches
- B. 30 inches
- C. 40 inches
- D. 60 inches

2. The primary advantage of 70V distributed audio over low-impedance is:

- A. Minimal cable loss over long runs
- B. Higher audio fidelity
- C. Lower equipment cost
- D. Simpler installation

3. A designer receives an RFI asking to substitute a specified 12-channel DSP with an 8-channel unit. The evaluation priority is:

- A. Cost comparison
- B. Manufacturer preference

C. Delivery timeline

D. Channel count fails specification — return as non-compliant

4. ACU High grade per A102.01 specifies coverage uniformity of:

A. ± 3 dB

B. ± 1 dB

C. ± 6 dB

D. ± 9 dB

5. A hospital video conferencing specification must include:

A. Consumer-grade codec

B. Standard office setup

C. HIPAA-compliant encrypted transport with access controls

D. Cloud-only architecture

6. Doubling the distance from a loudspeaker reduces SPL by:

A. 6 dB

B. 3 dB

C. 10 dB

D. 12 dB

7. A punchlist item states "touch panel displays wrong room name." This is classified as:

A. Cosmetic issue

- B. Incomplete work
- C. User error
- D. Non-conforming programming work

8. The Sabine RT60 coefficient in imperial units is:

- A. 0.161
- B. 0.049
- C. 0.08
- D. 0.25

9. A fire-rated wall penetrated by AV conduit requires:

- A. UL-listed firestop assembly
- B. Generic caulking
- C. Foam insulation
- D. Painted fire coating

10. SMPTE ST 2110 synchronization requires:

- A. NTP at millisecond accuracy
- B. GPS-only synchronization
- C. Sub-microsecond PTP (IEEE 1588)
- D. Manual time configuration

11. A 30 A, 120 V circuit with NEC continuous derating supports maximum:

- A. 3,600 W
- B. 3,000 W
- C. 2,400 W
- D. 2,880 W

12. The cable labeling standard for professional AV installations is:

- A. TIA-568
- B. AVIXA RP-38-17
- C. NEC Article 300
- D. NFPA 72

13. A needs assessment for a hybrid meeting room must address:

- A. Equivalent experience for both in-room and remote participants
- B. In-room experience only
- C. Remote experience only
- D. Display size alone

14. A 4K@60 Hz 4:4:4 signal at HDMI 2.0 maximum bandwidth operates at:

- A. 12 Gbps
- B. 10 Gbps
- C. 18 Gbps
- D. 48 Gbps

15. NOM penalty for 8 open microphones is:

- A. 3 dB
- B. 6 dB
- C. 12 dB
- D. 9 dB

16. A designer specifies Cat5e for a 4K HDBaseT run. The specification error is:

- A. Cat5e is adequate
- B. Cat6A required for reliable 4K HDBaseT transmission
- C. Cat6 is sufficient
- D. Fiber is required

17. Typical meeting room RT60 target is:

- A. 0.4–0.6 seconds
- B. 1.0 seconds
- C. 1.5 seconds
- D. 2.0 seconds

18. ISCR for Full Motion Video per V201.01 is:

- A. 7:1
- B. 50:1
- C. 80:1
- D. 15:1

19. A commissioning report shows 2 of 10 verification items untested. The response is:

- A. Accept partial testing
- B. Approve with notation
- C. Defer to post-occupancy
- D. Require completion of all items per AVSPV before acceptance

20. A 70V system with 15 speakers at 4 W each. Continuous load is:

- A. 40 W
- B. 60 W
- C. 75 W
- D. 45 W

21. The DISCAS standard for image sizing is:

- A. ANSI/AVIXA V202.01
- B. ANSI/AVIXA V201.01
- C. ANSI/AVIXA A102.01
- D. ANSI/AVIXA 10:2013

22. A control system touch panel response time target for good UX is:

- A. 3 seconds
- B. 1-2 seconds
- C. Under 500 ms
- D. 5 seconds

23. An integrator submits training materials referencing wrong firmware version. The review response is:

- A. Accept as-is
- B. Return requesting current-version documentation
- C. Approve with notation
- D. Accept with verbal correction

24. Speed of sound at room temperature produces delay of:

- A. 1 ms per foot
- B. 5 ms per meter
- C. 10 ms per meter
- D. 2.9 ms per meter

25. A designer must coordinate ceiling speaker placement with the:

- A. Reflected ceiling plan showing all trades
- B. Equipment list alone
- C. Floor plan only
- D. Verbal agreement

26. Typical broadcast studio RT60 target is:

- A. 1.0 seconds
- B. 1.5 seconds
- C. Under 0.5 seconds
- D. 2.0 seconds

27. PoE++ Type 4 (802.3bt) delivers at device:

- A. 25.5 W
- B. 71 W
- C. 30 W
- D. 51 W

28. A conduit carrying 6 cables must meet NEC fill of:

- A. 53%
- B. 31%
- C. 60%
- D. 40%

29. HDCP 2.2 is required for:

- A. All HDMI connections
- B. Analog signals
- C. Protected 4K UHD content
- D. Audio-only transmission

30. A PDU serving 6 devices at 2 A each on 120 V continuous. Minimum circuit per NEC is:

- A. 20 A (12 A continuous \div 0.80 = 15 A, round to 20 A)
- B. 15 A
- C. 25 A
- D. 30 A

31. A specification omits emergency audio override integration. The life safety gap is:

- A. No impact
- B. Minor inconvenience
- C. General contractor responsibility
- D. Fire alarm must override AV audio per code

32. BTU conversion from watts uses factor:

- A. 2.412
- B. 3.412
- C. 4.412
- D. 5.412

33. Typical CRI minimum for video conferencing lighting is:

- A. 90
- B. 80
- C. 75
- D. 70

34. A courtroom AV recording retention period is typically:

- A. 30 days
- B. 6 months
- C. Years per jurisdictional requirements
- D. 90 days

35. A designer specifies DHCP for AV devices on a production network. The management risk is:

- A. DHCP is industry standard
- B. No risk
- C. Only affects new devices
- D. IP reassignment can break device communication

36. A specification must define warranty as:

- A. Manufacturer warranty only
- B. Parts and labor duration with clear start date and scope
- C. Labor only
- D. No warranty specification needed

37. Typical IMAG latency target is:

- A. Under 100 ms
- B. Under 50 ms
- C. Under 200 ms
- D. Under 500 ms

38. A designer specifies standard drywall mounting for a 200-lb video wall. The structural concern is:

- A. Drywall is adequate
- B. Standard toggle bolts sufficient
- C. Structural backing and engineering required
- D. Manufacturer mounting adequate

39. DALI-1 supports how many devices per circuit:

- A. 32
- B. 128
- C. 12
- D. 64

40. A specification for outdoor speakers must include:

- A. Indoor-rated speakers
- B. IP-rated weather-resistant speakers appropriate for the environment
- C. Consumer speakers
- D. Standard commercial speakers

41. A commissioning walk-through generates the:

- A. Punchlist
- B. As-built drawings
- C. Final payment
- D. Warranty documentation

42. Typical video conferencing latency target is:

- A. Under 50 ms
- B. Under 300 ms
- C. Under 150 ms
- D. Under 500 ms

43. The APEx 2M-2010 standard addresses:

- A. Image sizing
- B. Performance verification
- C. Coverage uniformity
- D. AV design coordination

44. A designer must verify lens shift range when specifying:

- A. Ceiling-mounted projectors at maximum throw
- B. Displays only
- C. Loudspeakers
- D. Microphones

45. ANSI/AVIXA AVSEM addresses:

- A. Image contrast
- B. Performance verification
- C. Coverage uniformity
- D. Energy management

46. A specification for a classified government facility requires:

- A. Standard commercial equipment
- B. Consumer equipment
- C. Cloud-based systems
- D. TEMPEST-rated equipment with isolated networks

47. The Haas effect precedence window is:

- A. 5–35 ms
- B. 1–3 ms
- C. 50–100 ms
- D. 100+ ms

48. An AV equipment room with 4,000 W requires cooling of:

- A. 10,000 BTU/hr
- B. 15,000 BTU/hr
- C. 13,648 BTU/hr
- D. 20,000 BTU/hr

49. A punchlist item "display mounted 2 inches above spec" is:

- A. Cosmetic and acceptable
- B. Integrator's discretion
- C. Functionally adequate
- D. Non-conforming requiring correction per dimensioned specification

50. Typical pixel pitch rule for minimum viewing distance is:

- A. Pitch \times 2,000
- B. Pitch (mm) \times 3,000 = distance (mm)
- C. Pitch \times 5,000
- D. Pitch \times 1,000

51. A submittal with handwritten modifications on manufacturer data sheets should be:

- A. Returned for resubmission with clean manufacturer documentation
- B. Accepted as integrator clarification
- C. Approved with notation
- D. Filed without review

52. ANSI/AVIXA 10:2013 AVSPV addresses:

- A. Image sizing
- B. Energy management
- C. Performance verification
- D. Coverage uniformity

53. A conference room with loudspeakers and microphones requires:

- A. Volume limiting only
- B. Acoustic echo cancellation for far-end participant experience
- C. Microphone gating only
- D. No audio processing

54. Typical educational auditorium RT60 target is:

- A. Under 0.5 seconds
- B. 0.6 seconds
- C. 2.0 seconds
- D. 1.0–1.3 seconds

55. Class D amplifier efficiency range is:

- A. 80–95%
- B. 50–60%
- C. 60–70%
- D. 40–50%

56. A designer specifies 100 Mbps switches for AV-over-IP with 4K streams. The bandwidth error is:

- A. 100 Mbps is adequate
- B. Only uplinks need upgrade
- C. Gigabit or higher required — single 4K stream exceeds 100 Mbps
- D. Compression solves the issue

57. IGMP snooping prevents:

- A. DHCP conflicts
- B. Multicast flooding to unsubscribed ports
- C. VLAN broadcasting
- D. DNS resolution failure

58. A designer specifies 3:1 safety factor for rigging over occupied seating. The safety error is:

- A. 10:1 required for overhead loads above occupied space
- B. 3:1 is standard
- C. 5:1 is adequate
- D. Safety factor is optional

59. Typical lobby daylight-readable display brightness is:

- A. 250 nits
- B. 500 nits
- C. 350 nits
- D. 700+ nits

60. A specification for AV system closeout documentation must include:

- A. Equipment list only
- B. Manufacturer brochures
- C. As-builts, programming docs, user guides, training records, and warranty info
- D. Verbal summary

61. A 4-channel amp at 500 W per channel, 80% efficiency. Total heat generated is:

- A. 400 W
- B. 500 W
- C. 250 W
- D. 1,000 W

62. A specification omits IGMP snooping for 12 AV-over-IP encoders. The result is:

- A. Multicast flooding consuming bandwidth on every port
- B. No impact
- C. Minor performance reduction
- D. Audio-only impact

63. Typical STC for conference room speech privacy is:

- A. STC 25
- B. STC 30
- C. STC 35
- D. STC 40+

64. A designer specifies consumer HDMI cable for permanent in-wall installation. The code issue is:

- A. Consumer cable is adequate
- B. Only affects performance
- C. Plenum-rated CL2/CL3 or CMP cable required per NEC
- D. Cable gauge is the concern

65. A 100 W amplifier with 90 dB sensitivity speaker produces maximum SPL at 1 m of:

- A. 100 dB
- B. 110 dB
- C. 105 dB
- D. 115 dB

66. The ISCR standard per V201.01 for Passive Viewing is:

- A. 7:1
- B. 15:1
- C. 50:1
- D. 80:1

67. A room with parallel hard walls and no acoustic treatment produces:

- A. Flutter echo degrading speech intelligibility
- B. Improved bass response
- C. Better coverage uniformity
- D. Enhanced reverberation for music

68. Typical Dante bandwidth per channel at 48 kHz/24-bit is:

- A. 5 Mbps
- B. 10 Mbps
- C. Approximately 1 Mbps
- D. 500 Kbps

69. A specification for a mission-critical broadcast facility requires:

- A. Single control processor
- B. Standard commercial reliability
- C. Consumer backup
- D. Redundant systems with automatic failover

70. AES67 is:

- A. Dante's proprietary protocol
- B. AoIP cross-vendor interoperability standard
- C. Consumer audio format
- D. Video compression codec

71. Typical STI target for worship space speech reinforcement is:

- A. 0.70+
- B. 0.50
- C. 0.60
- D. 0.45

72. A 120 V, 20 A dedicated circuit maximum continuous power is:

- A. 2,400 W
- B. 1,440 W
- C. 1,920 W
- D. 1,200 W

73. A designer specifies NTP for an ST 2110 facility. The synchronization error is:

- A. NTP is adequate
- B. GPS replaces NTP
- C. NTP and PTP are equivalent
- D. Sub-microsecond PTP required — NTP is insufficient

74. Typical HDMI passive cable limit at 4K@60 Hz is:

- A. 25 feet
- B. 15 feet (approximately 5 meters)
- C. 35 feet
- D. 50 feet

75. A needs assessment for a hotel ballroom must address:

- A. Flexible preset scenes for multiple event types
- B. Fixed theater configuration only
- C. Banquet-only setup
- D. Consumer equipment

76. An integrator submits 1-year warranty against specified 2-year requirement. The response is:

- A. Accept 1-year coverage
- B. Accept with owner approval
- C. Return requesting specification-compliant 2-year warranty
- D. Accept with notation

77. A room measures $40 \times 30 \times 10$ ft (12,000 cu ft) with 600 sabins. RT60 is:

- A. 0.5 seconds
- B. 1.2 seconds
- C. 1.5 seconds
- D. 0.98 seconds

78. A designer specifies identical DSP settings for a lecture hall and gymnasium. The error is:

- A. Standardization is efficient
- B. Different room acoustics require individually tuned DSP parameters
- C. Identical settings save programming cost
- D. DSP self-adjusts to room

79. Typical AEC tail length should match:

- A. Room RT60
- B. Microphone sensitivity
- C. Speaker output level
- D. DSP processing speed

80. TLS minimum version for modern AV security is:

- A. 1.0
- B. 1.1
- C. 1.3
- D. 1.2

81. A substantial completion walk-through requires:

- A. Owner verbal approval
- B. Integrator self-certification
- C. Formal punchlist generation with specification references
- D. Final payment processing

82. A display at 400 cd/m² peak, 0.8 cd/m² black, 10 cd/m² ambient. ISCR is:

- A. 38:1
- B. 50:1
- C. 45:1
- D. 30:1

83. A control system specification must define:

- A. Equipment model numbers
- B. Use-case scenarios with system behavior for each operational mode
- C. Programming language
- D. Manufacturer preference

84. A designer specifies ceiling speakers at 15 ft spacing with 12 ft coverage diameter. The ACU impact is:

- A. Coverage is adequate
- B. Minor SPL variation
- C. Spacing is conservative
- D. 3 ft gaps between coverage areas violate Standard ACU

85. A specification for an AV-over-IP network omits QoS. The risk is:

- A. No performance impact
- B. Minor video quality reduction
- C. AV traffic competes with data causing artifacts and dropouts
- D. Only affects audio

86. Typical rack unit (1U) height is:

- A. 1.75 inches
- B. 2.0 inches
- C. 1.5 inches

D. 2.5 inches

87. A designer specifies a projector without ambient light control in a sunlit room. The ISCR impact is:

- A. Brightness compensates
- B. Screen gain compensates
- C. Content quality compensates
- D. Sunlight destroys projection ISCR — light control required

88. A 70V system advantage over low-impedance is:

- A. Higher fidelity
- B. Minimal cable loss over distance
- C. Simpler wiring
- D. Lower cost

89. A specification omits as-built drawing requirements. The operational impact is:

- A. Construction drawings are adequate
- B. Integrator provides automatically
- C. Actual installed condition undocumented for future service
- D. As-builts are optional

90. Parallel impedance of two 8-ohm speakers is:

- A. 4 ohms
- B. 8 ohms

- C. 16 ohms
- D. 2 ohms

91. A specification for a healthcare telemedicine room must include:

- A. Consumer video conferencing
- B. Standard commercial codec
- C. Home-office setup
- D. Clinical-grade codec with HIPAA compliance

92. Typical Cat6A maximum frequency is:

- A. 100 MHz
- B. 500 MHz
- C. 250 MHz
- D. 1000 MHz

93. A designer specifies open-back racks in a room accessible to non-technical staff. The concern is:

- A. Open racks are standard
- B. Staff won't touch equipment
- C. Enclosed locked racks required to prevent accidental damage
- D. Open racks save cost

94. HDBaseT 100-meter maximum applies at:

- A. 1080p resolution

- B. 4K@60 Hz 4:4:4
- C. 8K@60 Hz
- D. Any resolution

95. A specification for a performing arts center orchestra pit must include:

- A. Single unified mix
- B. Consumer headphones
- C. Background music system
- D. Individual musician cue mixes with low-latency monitoring

96. Typical conduit separation from 120 V power is:

- A. 3 inches
- B. 6 inches
- C. 12 inches
- D. 18 inches

97. A commissioning test shows SPL variation of 8 dB across listener positions. Per ACU Standard (± 3 dB), this:

- A. Passes
- B. Is marginal
- C. Fails — range exceeds ± 3 dB tolerance
- D. Requires retesting only

98. A specification must define AV system IP addressing as:

- A. Static or DHCP reservation with documented IP schedule
- B. DHCP automatic only
- C. Integrator assigns
- D. No documentation needed

99. A designer omits surge protection for AV equipment. The equipment risk is:

- A. Building protection is adequate
- B. AV equipment has internal protection
- C. Surges are rare events
- D. Voltage transients can permanently damage sensitive AV electronics

100. Typical 1" EMT conduit internal area is:

- A. 0.5 sq in
- B. 0.864 sq in
- C. 0.625 sq in
- D. 1.2 sq in

101. A specification for digital art displays must include:

- A. Standard commercial displays
- B. Consumer televisions
- C. Color-accurate displays with calibration targets and content management
- D. Budget displays

102. The DSCP marking for real-time audio/VoIP is:

- A. 46 (EF — Expedited Forwarding)
- B. 34 (AF41)
- C. 26 (AF31)
- D. 0 (Best Effort)

103. A specification omits control system source code transfer. The owner risk is:

- A. Source code is integrator property
- B. Programming is not modifiable
- C. Owner doesn't need programming access
- D. Permanent dependency on original integrator for modifications

104. Typical online double-conversion UPS transition time is:

- A. 20 ms
- B. Zero transition
- C. 5 ms
- D. 100 ms

105. A specification for 40 conference rooms omits IT coordination. The deployment risk is:

- A. AV operates independently
- B. IT automatically accommodates
- C. Inconsistent VLAN, QoS, and security across rooms
- D. No network impact

106. A designer specifies PoE (802.3af) for a camera requiring 40 W. The power gap is:

- A. PoE delivers only 12.95 W — PoE++ required
- B. PoE is adequate for all cameras
- C. Camera draws less than rated
- D. External power resolves this

107. A specification for an outdoor amphitheater must address:

- A. Standard indoor equipment
- B. Consumer speakers
- C. Office-grade amplification
- D. IP-rated weather-resistant equipment with outdoor coverage patterns

108. A video wall specification omitting structural engineering for 200+ pounds creates:

- A. No concern
- B. Safety hazard — structural backing and engineering verification required
- C. Standard mounting adequate
- D. Installer determines adequacy

109. ANSI/AVIXA V201.01 addresses:

- A. Image System Contrast Ratio
- B. Image sizing
- C. Coverage uniformity
- D. Performance verification

110. A specification for a multi-use worship space must include:

- A. Fixed acoustic treatment only
- B. Amplified-only system
- C. Variable acoustics supporting speech and music performance modes
- D. Acoustic-only design

PRACTICE EXAM 14: ANSWER KEY AND EXPLANATIONS

1. C — 40 inches minimum image height for BDM at 20 ft. DISCAS BDM formula: viewing distance $\div 6 =$ minimum image height. $20 \text{ ft} \times 12 = 240 \text{ inches} \div 6 = 40 \text{ inches}$. This calculation determines whether the specified display provides adequate image size for basic decision-making tasks at the farthest seat.
2. A — Minimal cable loss over long runs is 70V distributed audio's primary advantage. Higher transmission voltage reduces the current flowing through cable resistance, dramatically reducing power dissipation in the wire. Low-impedance systems lose significant power over the same distances, making 70V essential for large-venue distributed audio.
3. D — Channel count fails specification and must be returned as non-compliant. An 8-channel DSP cannot physically accommodate a 12-channel design requirement regardless of cost, delivery, or manufacturer preference. The substitution fundamentally violates the specification and must be rejected.
4. B — $\pm 1 \text{ dB}$ defines ACU High grade per ANSI/AVIXA A102.01:2017. This is the most stringent coverage uniformity requirement, reserved for critical listening environments where minimal SPL variation is essential. Standard grade allows $\pm 3 \text{ dB}$; Basic allows $\pm 6 \text{ dB}$.
5. C — HIPAA-compliant encrypted transport with access controls is mandatory for healthcare video conferencing. Protected health information transmitted through video conferencing falls under HIPAA security requirements. Consumer codecs, standard office setups, and cloud-only architectures typically lack the encryption, access controls, and audit logging HIPAA mandates.
6. A — 6 dB SPL reduction per distance doubling per the inverse square law. Sound intensity decreases to one-quarter with each doubling of distance, translating to a 6 dB reduction. This fundamental principle drives all loudspeaker coverage calculations and amplifier power sizing.
7. D — Non-conforming programming work is the correct classification. Touch panel labels are programmed content; an incorrect room name indicates programming that doesn't match the specification. This is distinct from cosmetic issues, incomplete work, or user error.
8. B — 0.049 is the Sabine formula coefficient in imperial units (seconds per cubic foot per sabin). The formula $RT60 = 0.049 \times V/A$ calculates reverberation time from room volume and total absorption. The metric equivalent is 0.161.

9. A — UL-listed firestop assembly required for all penetrations through fire-rated assemblies. Code mandates that every penetration through a fire-rated wall or floor must be sealed with a tested and listed firestop system. Generic caulking, foam, or paint do not meet code requirements for maintaining fire-barrier integrity.
10. C — Sub-microsecond PTP (IEEE 1588) synchronization is required for ST 2110. This precision timing enables frame-accurate alignment of separate audio, video, and metadata essence streams across the production network. NTP provides only millisecond accuracy, which is three orders of magnitude insufficient.
11. D — 2,880 W maximum continuous power on 30 A/120 V circuit. NEC 80% continuous derating: $30\text{ A} \times 0.80 = 24\text{ A}$ continuous. Power: $24\text{ A} \times 120\text{ V} = 2,880\text{ W}$. This prevents thermal accumulation in conductors during extended operation.
12. B — AVIXA RP-38-17 defines professional AV cable labeling standards. The standard specifies label content, format, and application methodology specifically for AV installations. Labels at both cable ends enable identification of signal type, source, and destination for future serviceability.
13. A — Equivalent experience for both in-room and remote participants drives hybrid meeting design. Hybrid rooms must serve two audiences simultaneously with comparable engagement quality. Camera coverage, microphone pickup, display positioning, and codec performance all affect the remote participant experience equally to the in-room experience.
14. C — 18 Gbps is HDMI 2.0 maximum bandwidth supporting 4K@60 Hz 4:4:4 at 8-bit. This represents the ceiling of HDMI 2.0 capability with virtually no headroom. 10-bit or 12-bit 4:4:4 at 4K@60 requires HDMI 2.1 (48 Gbps).
15. D — 9 dB NOM penalty for 8 open microphones. Formula: $10 \times \log_{10}(8) = 10 \times 0.903 = 9.03\text{ dB}$. Each doubling adds 3 dB: 2 mics = 3 dB, 4 mics = 6 dB, 8 mics = 9 dB. Automatic microphone mixing mitigates this penalty.
16. B — Cat6A required for reliable 4K HDBaseT transmission. Cat5e lacks the frequency performance and alien crosstalk specifications needed for high-bandwidth 4K signals. HDBaseT requires Cat6A's 500 MHz frequency capability for full 4K@60 Hz 4:4:4 performance.
17. A — 0.4–0.6 seconds is the typical meeting room RT60 target. This range balances speech intelligibility with natural room character. Longer reverberation times degrade speech clarity and make video conferencing difficult due to echo and intelligibility problems.
18. C — 80:1 is the Full Motion Video ISCR per V201.01:2021. This is the highest contrast requirement in the standard, supporting broadcast-quality motion video reproduction. Achieving 80:1 ISCR requires significant ambient light control.

19. D — Require completion of all verification items per AVSPV before acceptance. AVSPV establishes complete verification as the acceptance standard. Partial testing or deferred items undermine the verification process and may mask system deficiencies.
20. B — 60 W continuous tap load. Calculation: $15 \text{ speakers} \times 4 \text{ W} = 60 \text{ W}$. This continuous load figure drives amplifier sizing; adding 25-33% headroom brings recommended amplifier capacity to 75-80 W.
21. A — ANSI/AVIXA V202.01 DISCAS is the image sizing standard. It defines minimum image height calculations for four viewing task categories: Passive, Basic Decision Making, Analytical Decision Making, and Full Motion Video based on viewing distance.
22. C — Under 500 ms response time provides good touch panel user experience. Faster response creates the perception of immediate system reaction. Response times exceeding 1 second cause users to press buttons repeatedly, creating operational confusion.
23. B — Return requesting documentation matching the currently-installed firmware version. Training materials must accurately represent the installed system. Wrong-version documentation confuses users and undermines training effectiveness.
24. D — 2.9 ms per meter at room temperature (343 m/s). This conversion is essential for calculating delay-fill loudspeaker timing. Also expressed as approximately 1.13 feet per millisecond for imperial calculations.
25. A — Reflected ceiling plan showing all trades coordinates speaker placement. The RCP is where ceiling-mounted elements from all trades appear together, revealing conflicts between speakers, lights, HVAC diffusers, and sprinkler heads that separate drawings cannot show.
26. C — Under 0.5 seconds RT60 for broadcast studios. Dry, controlled acoustics prevent room reverberation from coloring microphone pickup. This enables audio processing to be applied intentionally rather than compensating for uncontrolled room characteristics.
27. B — 71 W delivered at device for PoE++ Type 4 (IEEE 802.3bt). This is the highest tier in the PoE standard. Source equipment provides approximately 90 W to account for cable resistance loss over the maximum 100-meter run.
28. D — 40% NEC fill for three or more conductors per NEC Chapter 9. This prevents heat buildup from cable crowding and ensures cables can be pulled without damage. One conductor allows 53%; two conductors allow 31%.
29. C — Protected 4K UHD content requires HDCP 2.2 at every device in the signal chain. Any non-compliant device breaks the content protection chain, causing protected content to blank or downgrade. This applies to sources, switchers, distribution amplifiers, and displays.

30. A — 20 A minimum circuit. Total continuous: $6 \times 2 \text{ A} = 12 \text{ A}$. NEC 80% derating: $12 \div 0.80 = 15 \text{ A}$ minimum. Next standard breaker size is 20 A. This ensures adequate capacity for continuous AV equipment operation.
31. D — Fire alarm must override AV audio per code. Building codes require emergency notification audio to take priority over all other audio sources. Without this integration, background music or paging could mask fire alarm messages during evacuation.
32. B — 3.412 BTU/hr per watt is the standard thermal conversion factor. Multiply total AV equipment wattage by 3.412 to determine cooling load for HVAC coordination. This calculation is essential for preventing equipment room overheating.
33. A — CRI 90 minimum for video conferencing ensures accurate skin tone reproduction on camera. Lower CRI values produce unnatural color rendering that degrades video quality and creates unprofessional appearance for remote participants.
34. C — Years per jurisdictional requirements for courtroom recording retention. Legal recordings serve as evidence through appeal processes that can extend 5-10 years or longer. Storage systems must maintain archival-grade reliability and tamper-evident integrity throughout retention.
35. D — DHCP IP reassignment can break AV device communication. Control system programming references specific IP addresses; if DHCP assigns different addresses, devices lose connectivity. Static IP or DHCP reservation ensures consistent addressing.
36. B — Parts and labor warranty with clear start date and scope must be specified. Manufacturer warranties vary and may cover parts only. The specification establishes the project's required warranty terms independent of manufacturer defaults.
37. A — Under 100 ms IMAG latency target prevents lip-sync disconnect. Image magnification systems must maintain synchronization between the performer on stage and the magnified image on screen. Exceeding 100 ms creates perceivable mismatch for audience members.
38. C — Structural backing and engineering required for 200-pound concentrated loads. Standard drywall cannot support heavy video walls. Structural blocking, plywood backing, or steel support installed during construction and verified by the structural engineer is mandatory.
39. D — 64 devices per DALI-1 circuit. The Digital Addressable Lighting Interface protocol supports individual control of up to 64 luminaires per bus. DALI-2 expanded this to 128 devices.
40. B — IP-rated weather-resistant speakers required for outdoor environments. Outdoor installations face water, humidity, temperature extremes, and UV degradation. Equipment must carry appropriate IP ratings (IP65+) with corrosion-resistant hardware.
41. A — Punchlist is generated at the substantial completion walk-through. This formal inspection documents all items requiring attention before final acceptance. The punchlist creates a binding record of outstanding work.

42. C — Under 150 ms video conferencing latency target preserves natural conversation. Higher latency disrupts turn-taking and creates conversational overlap. This threshold maintains the interactive quality essential for productive remote meetings.
43. D — APEX 2M-2010 addresses AV design coordination with allied trades. This AVIXA standard defines the process for coordinating AV design with electrical, mechanical, structural, and architectural disciplines.
44. A — Ceiling-mounted projectors at maximum throw require lens shift verification. Lens shift range varies by model; insufficient shift range at maximum throw means the projected image cannot be positioned correctly, requiring costly projector relocation.
45. D — ANSI/AVIXA AVSEM addresses energy management for AV systems. The standard defines sustainable design practices including scheduling, occupancy-based power management, and standby power reduction.
46. B — TEMPEST-rated equipment with isolated networks required for classified government facilities. Federal security standards mandate protection against electromagnetic emanations that could reveal classified information. Commercial or consumer equipment does not meet these requirements.
47. A — 5–35 ms is the Haas effect precedence window. Sound arrivals within this range fuse perceptually with the first-arriving sound. This principle enables delay-fill loudspeaker design where reinforcement enhances level without revealing the secondary source location.
48. C — 13,648 BTU/hr cooling requirement. Calculation: $4,000 \text{ W} \times 3.412 = 13,648 \text{ BTU/hr}$. This precise figure ensures the mechanical engineer sizes HVAC equipment correctly for the AV equipment room heat load.
49. D — Non-conforming requiring correction per dimensioned specification. Dimensioned elevations in construction documents are contract requirements. A 2-inch deviation exceeds typical tolerance and must be corrected to specification compliance.
50. B — Pixel pitch (mm) \times 3,000 = minimum viewing distance (mm). This rule of thumb determines the closest distance at which individual pixels become imperceptible. For example, 2 mm pitch \times 3,000 = 6,000 mm = 6 meters minimum ideal viewing distance.
51. A — Returned for resubmission with clean manufacturer documentation. Submittals must be based on authoritative, unmodified manufacturer data. Handwritten modifications compromise the review process and create ambiguity about what is actually being proposed.
52. C — ANSI/AVIXA 10:2013 AVSPV provides the performance verification framework. This standard establishes methodology for systematically verifying installed AV systems against design specifications with defined measurement procedures and pass/fail criteria.

53. B — Acoustic echo cancellation required for far-end participant experience. Without AEC, room loudspeakers feed audio back into microphones, creating echo that remote participants hear. AEC processing removes this acoustic coupling.
54. D — 1.0–1.3 seconds educational auditorium RT60 target. This range balances speech intelligibility with the warmth needed for occasional musical performance. Too short is dry and sterile; too long degrades speech clarity.
55. A — 80–95% efficiency for Class D switching amplifiers. This dramatically exceeds Class AB efficiency (50–65%), reducing heat generation and enabling smaller form factors. Lower heat output reduces equipment room cooling requirements.
56. C — Gigabit or higher required for AV-over-IP with 4K streams. Even compressed 4K streams typically consume 500 Mbps to 1 Gbps. A single 4K stream exceeds 100 Mbps switch port capacity entirely.
57. B — IGMP snooping prevents multicast flooding to unsubscribed ports. Without IGMP snooping, multicast traffic is treated as broadcast, consuming bandwidth on every port. This is the single most critical switch configuration for AV-over-IP deployments.
58. A — 10:1 safety factor required for overhead loads above occupied space. Performance venue rigging over seated audiences is a life-safety application. A 3:1 factor is appropriate only for non-overhead, non-occupied applications.
59. D — 700+ nits minimum brightness for daylight-readable lobby displays. Standard commercial displays (350–500 nits) appear washed out in high-ambient lobby environments. High-brightness panels maintain readability in direct and indirect sunlight conditions.
60. C — Complete closeout package includes as-builts, programming, guides, training records, and warranty. Each document serves a specific operational need. Missing components create gaps in the owner's ability to operate, maintain, and modify the system.
61. B — 500 W total heat generated. Total output: $4 \times 500 = 2,000$ W. Input at 80% efficiency: $2,000 \div 0.80 = 2,500$ W. Heat: $2,500 - 2,000 = 500$ W (1,706 BTU/hr). This heat load must be managed through rack ventilation and room cooling.
62. A — Multicast flooding consumes bandwidth on every switch port without IGMP snooping. Twelve encoders generating multicast traffic flood every port, potentially saturating links serving non-AV devices and degrading overall network performance.
63. D — STC 40+ required for conference room speech privacy. At STC 30–35, normal conversational speech remains audible through partitions. STC 40+ renders speech unintelligible, providing privacy adequate for confidential discussions.

64. C — Plenum-rated CL2/CL3 or CMP cable required per NEC for in-wall installation. Consumer HDMI cables lack the fire-retardant jacket ratings required by NEC for permanent installation within walls and above ceilings.
65. B — 110 dB maximum SPL at 1 meter. Formula: $\text{sensitivity} + 10 \times \log_{10}(\text{power}) = 90 + 10 \times \log_{10}(100) = 90 + 20 = 110 \text{ dB}$. This calculation determines whether the loudspeaker/amplifier combination achieves target SPL.
66. A — 7:1 Passive Viewing ISCR per V201.01:2021. This is the lowest contrast requirement, suitable for lobby signage and background video displays where audiences view content without needing to extract decision-making detail.
67. A — Flutter echo between parallel hard surfaces degrades speech intelligibility. Rapid repetitive reflections between untreated parallel walls create audible artifacts that smear speech. Acoustic treatment on at least one surface eliminates this common defect.
68. C — Approximately 1 Mbps per Dante channel at 48 kHz/24-bit. This bandwidth figure supports aggregate calculations for Dante network deployments. Higher sample rates increase per-channel bandwidth proportionally.
69. D — Redundant systems with automatic failover required for mission-critical broadcast. Single control processor failure in a broadcast facility takes operations offline. Redundant processors with automatic failover maintain broadcast continuity during equipment failures.
70. B — AES67 is the AoIP cross-vendor interoperability standard. It defines a common transport layer enabling compatibility between different networked audio protocols including Dante, Ravenna, and Livewire+. This prevents vendor lock-in.
71. A — STI 0.70+ is the typical worship space speech reinforcement target. Houses of worship require high intelligibility for sermons, readings, and liturgy. Achieving this requires coordinated coverage uniformity, acoustic treatment, and adequate signal-to-noise ratio.
72. C — 1,920 W maximum continuous on 20 A/120 V circuit. NEC 80% derating: $20 \text{ A} \times 0.80 = 16 \text{ A continuous} \times 120 \text{ V} = 1,920 \text{ W}$. This is the fundamental calculation for AV circuit sizing.
73. D — Sub-microsecond PTP required for ST 2110 — NTP provides only millisecond accuracy. The three-order-of-magnitude difference makes NTP completely inadequate for frame-accurate synchronization of separate audio, video, and metadata streams.
74. B — 15 feet (approximately 5 meters) passive HDMI limit at 4K@60 Hz. Signal attenuation in passive copper HDMI cable exceeds receiver tolerance beyond this distance at 18 Gbps bandwidth. Active cable, HDBaseT, or fiber extension required for longer runs.
75. A — Flexible preset scenes for multiple event types drives hotel ballroom design. Ballrooms serve weddings, corporate events, galas, and conferences with zero-delay reconfiguration. Preset scene control enables single-button transformation between event types.

76. C — Return requesting specification-compliant 2-year warranty. Specifications are contract requirements. Accepting 1-year coverage when 2 years is specified violates the project's warranty standards and leaves the owner with inadequate coverage.
77. D — 0.98 seconds RT60. Sabine formula: $0.049 \times 12,000 \div 600 = 0.98$ seconds. This exceeds typical meeting room targets (0.4–0.6 s), indicating additional acoustic absorption treatment is needed.
78. B — Different room acoustics require individually tuned DSP parameters. A lecture hall and gymnasium have dramatically different volumes, RT60, and surface characteristics. Identical EQ, delay, and processing settings ignore these fundamental acoustic differences.
79. A — Room RT60 determines appropriate AEC tail length. The echo cancellation algorithm must model room reverberation to effectively cancel acoustic echoes. A tail shorter than RT60 allows reverberation to escape processing, producing audible echo for remote participants.
80. D — TLS 1.2 is the minimum for modern AV security. TLS 1.0 and 1.1 are formally deprecated due to known cryptographic vulnerabilities. Specifying deprecated versions leaves AV devices vulnerable to known network attacks.
81. C — Formal punchlist generation with specification references at substantial completion. The walk-through creates a binding document of outstanding items with specific reference to contract requirements. Each item must be traceable to a specification section for proper remediation.
82. A — 38:1 ISCR. Formula: $(400 + 10) \div (0.8 + 10) = 410 \div 10.8 = 37.96:1$, approximately 38:1. This exceeds BDM (15:1) but falls below ADM (50:1), meaning ambient light reduction would be needed for analytical viewing tasks.
83. B — Use-case scenarios with system behavior for each operational mode. Control system specifications must define what happens when users interact with each scenario. Without documented behaviors, programmers interpret intent, producing user experiences that don't match operational needs.
84. D — 3 ft gaps between coverage areas violate Standard ACU (± 3 dB). At 10 ft ceiling with 90° pattern, coverage diameter is approximately 12 ft per speaker. Spacing at 15 ft creates gaps where SPL drops well below the ± 3 dB tolerance band.
85. C — AV traffic competes with enterprise data causing artifacts and dropouts without QoS. Network switches without QoS treat AV streams identically to email and web traffic. During peak periods, AV packets are delayed or dropped, producing visible tearing and audible interruptions.
86. A — 1.75 inches per standard rack unit (1U). A 42U rack stands 73.5 inches tall (42×1.75). This universal sizing standard ensures equipment interoperability across all professional rack manufacturers.

87. D — Sunlight destroys projection ISCR requiring ambient light control specification. Uncontrolled daylight contributes hundreds of lux to the screen surface, reducing ISCR well below any useful viewing task threshold. Motorized shades or screen relocation must be specified.
88. B — Minimal cable loss over distance is 70V distributed audio's primary advantage. Higher transmission voltage means lower current for the same power, dramatically reducing resistive loss in speaker cables. This enables reliable audio delivery over cable runs that would be impractical with low-impedance systems.
89. C — Actual installed condition remains undocumented without as-built drawings. Future technicians cannot locate equipment, trace signal paths, or identify routing without accurate as-built documentation. This creates permanent maintenance difficulty and modification risk.
90. A — 4 ohms parallel impedance for two 8-ohm speakers. Formula: $1/R_{total} = 1/8 + 1/8 = 2/8$, $R_{total} = 4$ ohms. The amplifier must be rated for the resulting 4-ohm load.
91. D — Clinical-grade codec with HIPAA compliance required for healthcare telemedicine. Protected health information transmitted during video consultations mandates encrypted transport, access controls, and audit logging per HIPAA security requirements.
92. B — 500 MHz is Cat6A's maximum rated frequency. This supports 10GBASE-T signaling over 100-meter runs and provides the bandwidth required for HDBaseT and AV-over-IP applications.
93. C — Enclosed locked racks required to prevent accidental damage by non-technical staff. Open-back racks expose cabling, connections, and equipment to untrained personnel who may accidentally disconnect cables, obstruct airflow, or create safety hazards.
94. A — 1080p resolution is the HDBaseT 100-meter maximum specification. Higher resolutions reduce reliable distance: 4K@60 Hz 4:4:4 drops to approximately 70 meters. The 100-meter figure applies only at 1080p bandwidth levels.
95. D — Individual musician cue mixes with low-latency monitoring for orchestra pit. Each performer requires a personalized mix of relevant instruments. Single unified mixes cannot serve the varied monitoring needs of different orchestral positions.
96. B — 6 inches typical separation between signal and 120 V power cables. NEC and industry practice require this clearance to prevent electromagnetic coupling. Shielded cables may permit reduced separation in some installations.
97. C — Fails ACU Standard tolerance with 8 dB range. ACU Standard specifies ± 3 dB, meaning total acceptable range is 6 dB. An 8 dB range exceeds this tolerance, indicating coverage deficiencies requiring loudspeaker adjustment or addition.
98. A — Static IP or DHCP reservation with documented IP schedule. AV devices referenced by IP address in control programming require consistent addresses. Documentation enables troubleshooting, maintenance, and future network modifications.

99. D — Voltage transients can permanently damage sensitive AV electronics without surge protection. Power line transients from lightning, utility switching, and building events produce voltage spikes that destroy sensitive electronic components. Surge protection devices clamp these transients to safe levels.
100. B — 0.864 square inches is the internal area of 1" EMT per NEC Chapter 9 Table 4. This value determines cable fill capacity at the applicable NEC percentage. Accurate area calculations prevent over-filled conduits that cause installation damage and thermal problems.
101. C — Color-accurate displays with calibration targets and content management for digital art. Art display requires color fidelity that standard commercial and consumer displays cannot guarantee. Calibration specifications, Delta E targets, and content management ensure artwork appears as intended.
102. A — DSCP 46 (Expedited Forwarding) marks real-time audio and VoIP for highest priority. This instructs network equipment to provide minimum latency and jitter treatment for time-critical audio traffic. Video conferencing uses AF41 (DSCP 34).
103. D — Permanent dependency on original integrator for any system modifications without source code. Control system source code enables the owner to modify room configurations, update device commands, and troubleshoot programming independently. Without it, every change requires the original programmer.
104. B — Zero transition time for online double-conversion UPS. This topology continuously converts AC to DC to AC, maintaining inverter-powered output regardless of utility status. No transfer switching is needed because the output is always running from the inverter.
105. C — Inconsistent VLAN, QoS, and security across 40 rooms without IT coordination. Enterprise-scale AV deployment requires structured IT documentation to ensure consistent network configuration. Each room may receive different treatment, creating troubleshooting complexity and security gaps.
106. A — PoE (802.3af) delivers only 12.95 W, far below the 40 W camera requirement. PoE+ (25.5 W) is also insufficient. PoE++ Type 3 (51 W) or Type 4 (71 W) is required to power a 40 W device.
107. D — IP-rated weather-resistant equipment with outdoor coverage patterns. Outdoor amphitheaters face rain, wind, temperature extremes, and UV exposure. Equipment IP ratings, weather-resistant enclosures, and specialized outdoor coverage patterns must be specified.
108. B — Safety hazard requiring structural backing and engineering verification. Standard drywall cannot support 200+ pounds of concentrated load. Structural blocking or steel backing installed during construction and approved by the structural engineer is mandatory.

109. A — ANSI/AVIXA V201.01 addresses Image System Contrast Ratio. The standard defines four ISCR grades (Passive 7:1, BDM 15:1, ADM 50:1, FMV 80:1) accounting for both display native contrast and ambient light contribution.
110. C — Variable acoustics supporting both speech and music performance modes. Multi-use worship spaces hosting traditional and contemporary services require adjustable acoustics because optimal reverberation differs dramatically. Variable treatment enables the room to serve both worship styles.