

SIMULATION EXAM 19 — QUESTIONS 1-100

1. A 70V tap at 10 watts draws how much current?

- A. 0.70 A
- B. 0.35 A
- C. 0.07 A
- D. 0.14 A

2. Which standard addresses audio coverage uniformity?

- A. V202.01
- B. A102.01
- C. F502.01
- D. ISO 9001

3. HDCP authentication failure typically produces:

- A. Blank screen or reduced resolution
- B. Distorted audio only
- C. Increased power draw
- D. Network connection loss

4. Cat 6A supports 10 Gbps up to what distance?

- A. 55 meters
- B. 75 meters
- C. 100 meters
- D. 250 meters

5. What does RT60 measure?

- A. Room temperature variation
- B. Total room absorption
- C. Speech intelligibility score
- D. Sound decay by 60 dB

6. A 16:9 display with 80" diagonal has what width?

- A. 64 inches
- B. 70 inches
- C. 75 inches
- D. 80 inches

7. HDMI 2.1 maximum bandwidth is:

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

8. A cardioid microphone rejects sound from:

- A. The rear
- B. The front
- C. The sides only
- D. Above and below

9. Which article covers Class 2 circuits?

- A. NEC 300
- B. NEC 800
- C. NEC 760
- D. NEC 725

10. 4K UHD resolution is:

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

11. The 4H rule applies to which content type?

- A. Basic presentation
- B. General viewing
- C. Analytical decision-making
- D. Passive entertainment

12. What does EDID transmit?

- A. Display capabilities to source
- B. Audio signals only
- C. Control commands
- D. Encryption keys

13. Two 8-ohm speakers in parallel yield:

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

14. A 6 dB SPL increase requires power to be:

- A. Doubled
- B. Quadrupled
- C. Tripled
- D. Multiplied by 10

15. AES67 is a standard for:

- A. Audio-over-IP interoperability
- B. Video compression
- C. Network cabling
- D. Wireless microphones

16. NFPA 72 addresses:

- A. Electrical installations
- B. Plumbing codes
- C. Fire alarm systems
- D. Life safety egress

17. Pixel pitch determines:

- A. Display refresh rate
- B. Minimum viewing distance
- C. Color accuracy
- D. Power consumption

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

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

19. The speed of sound at 20°C is:

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

20. DALI is a protocol for:

- A. Audio distribution
- B. Video switching
- C. Lighting control
- D. Network routing

21. The nominal impedance of a typical microphone is:

- A. 50 ohms
- B. 150–600 ohms
- C. 8 ohms
- D. 75 ohms

22. Sabine's equation calculates:

- A. Sound pressure level
- B. Frequency response
- C. Absorption coefficient
- D. Reverberation time

23. A subnet mask separates:

- A. Network and host portions
- B. Input and output ports
- C. Primary and backup paths
- D. Voice and data traffic

24. Which chroma sampling is highest quality?

- A. 4:2:0
- B. 4:2:2
- C. 4:4:4
- D. 4:1:1

25. A 1 RU rack space equals:

- A. 1 inch
- B. 1.75 inches
- C. 2 inches
- D. 3.5 inches

26. OSHA fall protection is typically required above:

- A. 6 feet
- B. 10 feet
- C. 15 feet
- D. 20 feet

27. The decibel formula for power uses:

- A. 20 log
- B. Natural log
- C. 10 log
- D. Square root

28. Plenum-rated cable (CMP) is required in:

- A. Underground installations
- B. Return-air spaces
- C. Residential applications
- D. Outdoor pathways

29. What does IGMP manage?

- A. Routing tables
- B. DHCP leases
- C. VLAN assignment
- D. Multicast group membership

30. A projector's throw ratio is calculated as:

- A. Distance divided by image width
- B. Image width divided by distance
- C. Diagonal times aspect ratio
- D. Lumens per square foot

31. Latency in conferencing primarily affects:

- A. Image resolution
- B. Audio clarity
- C. Conversation naturalness
- D. File transfer speed

32. The Rec. 709 standard defines:

- A. HDR10 metadata
- B. SDR HDTV color space
- C. Cinema color gamut
- D. Web color standard

33. A VLAN logically separates:

- A. Power circuits
- B. Audio channels
- C. Video streams
- D. Network traffic

34. Balanced audio uses:

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

35. The CTS credential renews every:

- A. 1 year
- B. 2 years
- C. 3 years
- D. 5 years

36. A graphic equalizer adjusts:

- A. Temporal delay
- B. Fixed frequency bands
- C. Dynamic range
- D. Spatial imaging

37. Which is a lossless audio format?

- A. MP3
- B. AAC
- C. Ogg Vorbis
- D. FLAC

38. Acoustic echo cancellation prevents:

- A. Loudspeaker feedback into microphones
- B. Room reflections only
- C. Network jitter
- D. HDMI handshake issues

39. A 16:9 image height-to-diagonal ratio is approximately:

- A. 0.87
- B. 0.75
- C. 0.49
- D. 0.33

40. HDBaseT maximum run length is:

- A. 50 meters
- B. 100 meters
- C. 150 meters
- D. 200 meters

41. Which connector carries SDI?

- A. XLR
- B. RJ45
- C. Fiber LC
- D. BNC

42. The 6H rule allows viewing up to:

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

43. A contrast ratio compares:

- A. Color primaries
- B. Gamma values
- C. Brightest to darkest output
- D. Power to brightness

44. 1 watt equals how many BTU/hr?

- A. 1.0
- B. 3.412
- C. 5.0
- D. 10.0

45. OLED displays differ from LCD by:

- A. Using polarized filters
- B. Requiring no power
- C. Producing wider colors
- D. Having self-emissive pixels

46. An NC-30 rating is appropriate for:

- A. Conference rooms
- B. Industrial facilities
- C. Concert venues
- D. Outdoor stadiums

47. Which network layer handles IP routing?

- A. Layer 1 — Physical
- B. Layer 2 — Data Link
- C. Layer 3 — Network
- D. Layer 7 — Application

48. A passive crossover separates:

- A. Audio into frequency bands
- B. Power phases
- C. Video resolutions
- D. Control signals

49. The AVIXA A102.01 standard addresses:

- A. Cable labeling
- B. Rack construction
- C. Display sizing
- D. Audio coverage uniformity

50. Class 2 circuits are defined by:

- A. Power and voltage limits
- B. Cable jacket color
- C. Installation depth
- D. Equipment manufacturer

51. A 4:2:0 signal subsamples:

- A. Luma only
- B. Chroma components
- C. Audio channels
- D. Frame rate

52. The CTS Code of Ethics requires:

- A. Specific employer affiliation
- B. Manufacturer certifications
- C. Annual conference attendance
- D. Honest representation of credentials

53. An amplifier's THD+N measures:

- A. Distortion and noise
- B. Peak output voltage
- C. Input sensitivity
- D. Frequency response

54. A projector with 2.0 throw ratio at 20 feet produces:

- A. 5-foot image
- B. 15-foot image
- C. 10-foot image
- D. 25-foot image

55. Phantom power is typically:

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

56. Color temperature of 6500K represents:

- A. Warm candlelight
- B. Incandescent bulbs
- C. Sunset lighting
- D. Daylight reference

57. A digital audio sample rate of 48 kHz means:

- A. 48 channels per second
- B. 48,000 samples per second
- C. 48 bits per sample
- D. 48 Hz bandwidth

58. SMPTE timecode enables:

- A. Network synchronization
- B. Audio routing
- C. Frame-accurate timing
- D. Video encoding

59. A capacitor in a crossover:

- A. Passes high frequencies
- B. Blocks all signals
- C. Amplifies bass
- D. Controls phase only

60. Refresh rate is measured in:

- A. Microseconds
- B. Pixels per second
- C. Bits per frame
- D. Hertz

61. A projector's ANSI lumen rating averages:

- A. Peak center reading
- B. Nine measurement points
- C. Three axis readings
- D. Edge-only samples

62. Horizontal blanking in video is:

- A. Signal between lines
- B. Color processing stage
- C. Synchronization signal
- D. Error correction data

63. Negative feedback in amplifiers:

- A. Reduces distortion
- B. Increases distortion
- C. Adds noise floor
- D. Boosts output only

64. A twisted pair reduces:

- A. Attenuation
- B. Propagation delay
- C. Cable weight
- D. Electromagnetic interference

65. The inverse square law states SPL drops:

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

66. DCI 4K resolution is:

- A. 3840×2160
- B. 3840×2048
- C. 4096×2160
- D. 4096×2304

67. A preamplifier's primary role is:

- A. Boost low-level signals
- B. Drive loudspeakers
- C. Filter audio
- D. Mix multiple sources

68. The NEC is published by:

- A. OSHA
- B. ANSI
- C. IEEE
- D. NFPA

69. Active speakers contain built-in:

- A. Wireless receivers
- B. Amplifiers
- C. Network switches
- D. Video processors

70. A microphone's polar pattern describes:

- A. Its frequency response
- B. Its impedance curve
- C. Directional sensitivity
- D. Output level

71. The Nyquist frequency for 48 kHz sampling is:

- A. 48 kHz
- B. 96 kHz
- C. 12 kHz
- D. 24 kHz

72. NEC Article 250 addresses:

- A. Grounding and bonding
- B. Raceway installation
- C. Panel schedules
- D. Wire ampacity

73. Dante is a protocol for:

- A. Video over IP
- B. Control systems
- C. Audio over IP
- D. Lighting networks

74. A video scaler:

- A. Compresses signals
- B. Converts resolutions
- C. Boosts brightness
- D. Switches sources

75. Two identical speakers double SPL by approximately:

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

76. Which codec offers better efficiency than H.264?

- A. MPEG-2
- B. DV
- C. H.265
- D. JPEG

77. A USB-C connector supports:

- A. DisplayPort alt-mode
- B. HDMI only
- C. VGA natively
- D. SDI transport

78. The ADA governs accessibility in:

- A. Residential homes only
- B. Federal buildings only
- C. International venues
- D. Public accommodations

79. Gain staging optimizes:

- A. Frequency balance
- B. Signal-to-noise ratio
- C. Polar pattern
- D. Room acoustics

80. Fiber optic cable is immune to:

- A. Physical damage
- B. Tight bend radius
- C. Electromagnetic interference
- D. Connector wear

81. A tweeter reproduces:

- A. Low bass
- B. Midrange
- C. Subsonic signals
- D. High frequencies

82. NEC Article 800 covers:

- A. Communications circuits
- B. Service entrances
- C. Transformer vaults
- D. Emergency systems

83. A crossover frequency is where:

- A. Power peaks
- B. Voltage is maximum
- C. Drivers hand off
- D. Phase reverses

84. The sRGB color space is standard for:

- A. Cinema content
- B. Web and PC displays
- C. Broadcast HDR
- D. Print media

85. GPIO stands for:

- A. General Purpose I/O
- B. Generic Protocol Interface
- C. Graphics Processing I/O
- D. Global Port Identifier

86. A projection screen's gain measures:

- A. Its total area
- B. Its mounting weight
- C. Its fabric thickness
- D. Its reflected brightness

87. The CTS-D specialty focuses on:

- A. Sales training
- B. Installation practices
- C. AV system design
- D. Project management

88. A flat frequency response is:

- A. Completely inaudible
- B. Uniform across bands
- C. Peaked at highs
- D. Rolled off at lows

89. PoE+ delivers up to:

- A. 15.4 W
- B. 60 W
- C. 100 W
- D. 30 W

90. The Haas effect relates to:

- A. Bass reinforcement
- B. Room reverberation
- C. Phase cancellation
- D. Precedence in localization

91. An audio mixer's bus routes:

- A. Power to speakers
- B. Timecode signals
- C. Signal groups
- D. Control messages

92. LED displays viewed close-up require:

- A. Wider aspect ratio
- B. Finer pixel pitch
- C. Brighter illumination
- D. Lower refresh rate

93. A wireless microphone frequency must:

- A. Exceed 3 GHz always
- B. Use channel 1 only
- C. Match speaker impedance
- D. Match local regulations

94. An LCR speaker configuration includes:

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

95. Video wall calibration matches:

- A. Power consumption
- B. Refresh rates only
- C. Color and brightness
- D. Mounting angles

96. A feedback loop in PA systems occurs when:

- A. Gain exceeds threshold
- B. Mic picks up speaker output
- C. Cables are too long
- D. Power is insufficient

97. Dynamic range compression:

- A. Increases peak levels
- B. Shifts frequencies
- C. Adds harmonics
- D. Reduces level differences

98. The NFPA 70E standard covers:

- A. Electrical workplace safety
- B. Fire sprinkler systems
- C. Building egress
- D. Hazard communication

99. A passive splitter divides signal into:

- A. Frequency bands
- B. Multiple outputs
- C. Digital streams
- D. Impedance zones

100. The goal of impedance matching is:

- A. Equal cable lengths
- B. Matching connector types
- C. Maximum power transfer
- D. Uniform voltage output

SIMULATION EXAM 19 — ANSWER

KEY AND FULL EXPLANATIONS

1. D — 0.14 A. Using Ohm's law for 70V distributed audio, current equals power divided by voltage: $10 \div 70 \approx 0.14$ amperes. This low current per loudspeaker is the fundamental advantage of constant-voltage distribution, enabling long cable runs with minimal voltage drop and many loudspeakers on a single amplifier channel.
2. B — A102.01. ANSI/AVIXA A102.01 is the Audio Coverage Uniformity in Listener Areas standard, specifying permissible SPL variation (± 3 dB) across a listening space and the measurement methodology. V202.01 addresses display sizing; F502.01 addresses cable labeling; ISO 9001 is quality management.
3. A — Blank screen or reduced resolution. HDCP authentication failure produces these specific symptoms when source and sink cannot successfully exchange authentication keys. The system either shows no video (blank screen) or downgrades to lower-resolution non-protected signal, depending on the failure mode and content protection policy.
4. C — 100 meters. Cat 6A cable is rated for 10 Gbps ethernet at the full 100-meter horizontal channel length — the standard structured cabling distance. This capability distinguishes Cat 6A from Cat 6, which supports 10 Gbps only at shorter distances (typically 55 meters).
5. D — Sound decay by 60 dB. RT60 (reverberation time) measures how long it takes for sound pressure level in a room to decay by 60 dB after the source stops. This is the fundamental acoustic characteristic of a room and directly affects speech intelligibility, music clarity, and overall listening experience.
6. B — 70 inches. For a 16:9 display, image width \approx diagonal \times 0.87. So $80 \times 0.87 \approx 70$ inches. This 0.87 multiplier derives from the 16:9 aspect ratio geometry where width equals $16/\sqrt{(16^2 + 9^2)}$ of the diagonal.
7. C — 48 Gbps. HDMI 2.1 supports up to 48 Gbps through six 8-lane signaling, enabling 8K60, 4K120, and higher color depth configurations. This represents a substantial increase over HDMI 2.0's 18 Gbps ceiling and enables next-generation video format support.
8. A — The rear. Cardioid microphones have a heart-shaped pickup pattern with maximum sensitivity forward and minimum sensitivity behind. This rear-rejection is used to reduce pickup of unwanted sounds — ambient noise, feedback from loudspeakers behind the microphone — making cardioid patterns standard for sound reinforcement.

9. D — NEC 725. NEC Article 725 specifically governs Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits. This article is foundational to AV low-voltage work because most AV cabling falls into Class 2 — understanding this article is essential for compliant pathway and cable installation.
10. B — 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, while 7680×4320 is 8K UHD.
11. C — Analytical decision-making. The 4H rule from ANSI/AVIXA V202.01 applies to Analytical Decision-Making (ADM) content — content requiring fine detail resolution like spreadsheets, CAD drawings, or medical imaging. The 6H rule applies to Basic Decision-Making content that doesn't require fine detail.
12. A — 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.
13. D — 4 ohms. Parallel impedance for equal loads equals the single-unit impedance divided by the number of units: $8 \div 2 = 4$ ohms. Parallel wiring halves the impedance with two identical loudspeakers, which must be verified against amplifier minimum load ratings.
14. B — Quadrupled. The decibel formula $10 \cdot \log(\text{power ratio})$ shows that $6 \text{ dB} = 10 \cdot \log(4)$, so $4\times$ power produces 6 dB SPL increase. The rule sequence: 3 dB requires $2\times$, 6 dB requires $4\times$, 9 dB requires $8\times$, 10 dB requires $10\times$. These rules drive amplifier sizing calculations.
15. A — Audio-over-IP interoperability. AES67 is an open standard published by the Audio Engineering Society that enables interoperability between different audio-over-IP systems including Dante, Ravenna, and Livewire. Dante and other proprietary systems can operate in AES67-compatible modes for cross-system compatibility.
16. C — Fire alarm systems. NFPA 72 is the National Fire Alarm and Signaling Code, governing fire alarm system installation, monitoring, and signaling. AV installations often intersect with this code through emergency notification integration and pathway coordination with fire alarm cabling.
17. B — Minimum viewing distance. Pixel pitch directly determines how close viewers can approach a display before individual pixels become visible. Tighter pixel pitch enables closer viewing without pixel visibility, which is the primary design criterion for LED video walls and other pixel-structured displays.
18. 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's 16.7 million. Higher bit depth reduces banding in gradients and enables wider dynamic range for HDR content.

19. A — 343 m/s. The speed of sound in air at 20°C is approximately 343 m/s or 1,125 ft/s. This value is foundational for acoustic calculations including delay timing, array spacing, loudspeaker positioning, and speech intelligibility analysis. Temperature and humidity affect the actual value slightly.
20. C — Lighting control. DALI (Digital Addressable Lighting Interface) is a dedicated protocol for commercial lighting control, enabling individual addressing and control of lighting fixtures. AV integration with lighting scenes frequently requires DALI gateway integration.
21. B — 150–600 ohms. Professional dynamic and condenser microphones typically have output impedances in the 150-600 ohm range (low-impedance or "low-Z"). This matches professional balanced line inputs designed for this impedance range, providing long-run noise immunity and proper signal transfer.
22. D — 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 and treatment analysis.
23. A — Network and host portions. A subnet mask determines which portion of an IP address represents the network (routing) versus the host (specific device). For example, 255.255.255.0 separates the first three octets as network and the last as host, defining which addresses are in the local subnet.
24. C — 4:4:4. 4:4:4 chroma sampling preserves all color information — full luminance and full chroma sampling for every pixel with no subsampling. This produces the highest color fidelity and is used in color-critical applications like cinema and professional production. 4:2:2 and 4:2:0 reduce chroma resolution.
25. B — 1.75 inches. A single rack unit (1U or RU) is defined as 1.75 inches (44.45 mm) of vertical rack height. This standardization enables equipment interchangeability across manufacturers — a 2U device always occupies 3.5 inches of rack height regardless of manufacturer.
26. A — 6 feet. 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), and specific activities can require protection at lower heights.
27. C — 10 log. The decibel formula for power ratios uses $10 \cdot \log$: $dB = 10 \cdot \log(P1/P2)$. This differs from voltage or pressure where $20 \cdot \log$ is used. Understanding which formula applies to which quantity is essential for correct dB calculations.
28. B — Return-air spaces. 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 cable releases toxic smoke when burned, failing fire safety requirements in these spaces.

29. D — Multicast group membership. IGMP (Internet Group Management Protocol) manages multicast group membership, enabling endpoints to subscribe to and unsubscribe from multicast streams. IGMP snooping on network switches is essential for efficient multicast-based AV-over-IP.
30. A — Distance divided by image width. Throw ratio equals projection distance divided by image width. A throw ratio of 2.0 means the projector must be 20 feet away to produce a 10-foot-wide image. This relationship is fundamental to projector lens selection and room planning.
31. C — Conversation naturalness. Video and audio latency primarily affect the perceived naturalness of interactive conversation. Latency above approximately 100-150 ms causes perceptible delay, leading to participants talking over each other and awkward conversation flow. This drives low-latency design in conferencing systems.
32. B — SDR HDTV color space. Rec. 709 (ITU-R BT.709) defines the color space, primaries, white point, and transfer characteristics for standard-dynamic-range HDTV. This is the baseline color space for most current broadcast and streaming content.
33. D — 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.
34. A — 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, making balanced interconnect superior for long runs.
35. C — 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.
36. B — Fixed frequency bands. Graphic equalizers provide multiple fixed frequency bands with adjustable level for each band, typically 1/3 octave (31 bands) for professional work. The name derives from the visual slider arrangement that resembles a frequency response curve when viewed as a whole.
37. D — FLAC. FLAC (Free Lossless Audio Codec) compresses audio without losing any information, achieving approximately 50-60% file size reduction compared to uncompressed WAV while preserving perfect fidelity on decompression. MP3, AAC, and Ogg Vorbis are all lossy compressed formats.
38. A — Loudspeaker feedback into microphones. Acoustic echo cancellation (AEC) mathematically subtracts the loudspeaker reference signal from the microphone input, allowing simultaneous loudspeaker playback and microphone pickup in conferencing without feedback. This enables natural full-duplex conversation.

39. C — 0.49. For a 16:9 display, image height equals approximately 49% of the diagonal, derived from $9/\sqrt{16^2 + 9^2} = 9/\sqrt{337} \approx 0.49$. This multiplier enables rapid diagonal-to-height conversion, commonly used when verifying 4H and 6H viewing distance compliance.
40. B — 100 meters. HDBaseT signal transport operates over twisted-pair Category cable up to 100 meters — the standard structured cabling distance. This enables long-distance HDMI extension using existing cable infrastructure, carrying video, audio, control, and Ethernet in a single run.
41. D — BNC. 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 coaxial connection is critical for SDI signal integrity.
42. A — $6\times$ image height. The 6H rule from ANSI/AVIXA V202.01 allows viewing up to 6 times the image height for Basic Decision-Making content. This is more permissive than the 4H rule for Analytical Decision-Making because BDM content doesn't require fine detail resolution.
43. C — Brightest to darkest output. Contrast ratio compares the display's maximum luminance output to its minimum (black) level. Higher ratios enable better dark scene detail and more impactful highlights. This is a fundamental display performance specification.
44. B — 3.412. The exact watt-to-BTU/hr conversion is 3.412 BTU/hr per watt. This conversion factor is essential for HVAC load calculations — all electrical power consumed by AV equipment eventually becomes heat that the cooling system must remove.
45. D — Having self-emissive pixels. OLED technology uses self-emissive pixels where each pixel produces its own light, enabling true blacks (pixels completely off) and superior contrast. LCD displays use a backlight passing through liquid crystal layers, which limits black level performance.
46. A — Conference rooms. NC-30 represents background noise levels that support reliable speech communication without raised voices — appropriate for conference rooms and similar speech-focused environments. Industrial facilities, concert venues, and outdoor stadiums have much higher acceptable noise levels.
47. C — Layer 3 — Network. 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 — distinct from the Physical layer (cables) or Data Link layer (switching).
48. A — Audio into frequency bands. Passive crossovers use capacitors and inductors to separate an audio signal into frequency bands (low, mid, high) for delivery to appropriate loudspeaker drivers (woofers, midranges, tweeters). This is fundamental to multi-way loudspeaker operation.
49. D — Audio coverage uniformity. ANSI/AVIXA A102.01 is the Audio Coverage Uniformity in Listener Areas standard. It specifies acceptable SPL variation (± 3 dB) across listener positions and the measurement methodology for verifying compliance.

50. A — Power and voltage limits. Class 2 circuits are defined by specific power and voltage limits under NEC Article 725, which provide inherent safety by limiting energy available to a level that's unlikely to cause fire or shock hazard. Most AV low-voltage circuits are Class 2.
51. B — Chroma components. 4:2:0 subsamples the chroma (color) components while preserving full luma resolution. The subsampling reduces chroma to one-quarter horizontal and half vertical resolution, cutting bandwidth approximately in half while remaining visually acceptable for most content.
52. D — Honest representation of credentials. The CTS Code of Ethics requires credential holders to accurately describe their qualifications, experience, and capabilities without exaggeration. This principle protects clients from relying on inflated credentials and preserves the credential's integrity across the profession.
53. A — Distortion and noise. 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 indicates more accurate amplifier reproduction and is a key specification for amplifier quality.
54. C — 10-foot image. Image width equals throw distance divided by throw ratio: $20 \div 2.0 = 10$ feet. This calculation is used to determine the image size a projector will produce at a given mounting distance, essential for specifying the correct lens for a room.
55. A — 48V DC. Phantom power for condenser microphones is typically 48V DC, delivered through balanced XLR lines. This powers the microphone's internal electronics and is industry-standard across professional audio equipment, though some equipment uses reduced voltages (12V or 24V).
56. D — Daylight 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.
57. B — 48,000 samples per second. A sample rate of 48 kHz means the audio signal is sampled 48,000 times per second. This is the standard sample rate for professional digital audio and video production, providing audio bandwidth up to approximately 24 kHz (per the Nyquist theorem).
58. C — Frame-accurate timing. SMPTE timecode provides frame-accurate time reference in HH:MM:SS:FF format, enabling precise synchronization of video, audio, and related signals across production, broadcast, and live event systems.
59. A — Passes high frequencies. A capacitor in a loudspeaker crossover network blocks low frequencies and passes high frequencies, making it the foundation of high-pass filter sections that feed tweeters. Inductors do the opposite, passing low frequencies for woofer sections.

60. D — Hertz. Display refresh rate is measured in Hertz (Hz), representing updates per second. 60 Hz means the display refreshes its image 60 times per second. Higher refresh rates (120 Hz, 240 Hz) enable smoother motion rendering for fast-moving content like gaming and sports.
61. B — Nine measurement points. ANSI lumens are measured using a nine-point averaging method standardized by ANSI, providing consistent comparison between projectors. Other rating methods (peak center, marketing lumens) can overstate actual useful brightness across the image area.
62. C — Synchronization signal. Horizontal blanking is the time between the end of one scan line and the start of the next, during which synchronization information is transmitted. This originated in analog video where the electron beam needed time to return to the left side of the screen.
63. A — Reduces distortion. Negative feedback in amplifiers returns a portion of the output signal to the input in opposite phase, which reduces distortion and stabilizes gain at the cost of some gain reduction. This is a foundational technique in amplifier design for improving accuracy.
64. D — Electromagnetic interference. Twisted pair cable construction reduces electromagnetic interference (EMI) pickup by causing induced noise to affect both conductors equally, which the differential receiver then cancels. This is why twisted pair is standard for ethernet and balanced audio.
65. B — 6 dB per doubling. 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. Sound spreads spherically, reducing pressure as the surface area of the sphere increases with distance squared.
66. C — 4096×2160 . DCI 4K (Digital Cinema Initiative) resolution is 4096×2160 , wider than consumer UHD 4K at 3840×2160 . This cinema-specific resolution maintains the digital cinema aspect ratio and is used in theatrical projection systems.
67. A — Boost low-level signals. A preamplifier's primary role is to boost low-level signals (microphones, phono cartridges, instruments) to line level suitable for mixing, processing, and further amplification. Without preamps, these low-level sources would be too quiet and noisy.
68. D — NFPA. The National Electrical Code (NEC, NFPA 70) is published by the National Fire Protection Association. NFPA develops many fire and life safety codes through a consensus-based process, with the NEC being the most widely adopted electrical code in the United States.
69. B — Amplifiers. Active loudspeakers contain built-in amplifiers matched to the loudspeaker drivers, eliminating the need for external amplification. This integration allows manufacturer-optimized amplifier-driver matching and often includes built-in crossovers and protection circuits.
70. C — Directional sensitivity. A microphone's polar pattern describes how its sensitivity varies with the direction of sound arrival. Common patterns include omnidirectional (equal all directions), cardioid (heart-shaped, rear-rejecting), supercardioid, hypercardioid, and bidirectional (figure-8).

71. D — 24 kHz. 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. Signals above Nyquist must be filtered out before sampling to prevent aliasing.
72. A — Grounding and bonding. NEC Article 250 addresses grounding and bonding requirements — foundational electrical safety provisions that ensure fault current has a low-impedance path and that metal parts are maintained at the same potential. AV installations must comply with grounding requirements for equipment, racks, and systems.
73. C — Audio over IP. Dante (Digital Audio Network Through Ethernet) is Audinate's proprietary audio-over-IP protocol, widely adopted in professional audio. It enables networked audio distribution with low latency, high channel counts, and integrated device management over standard ethernet infrastructure.
74. B — Converts resolutions. A video scaler converts input resolutions and refresh rates to match the display's native capabilities. This enables diverse sources to be displayed properly on a target display, with quality scaling algorithms preserving image integrity across the conversion.
75. D — 3 dB. Two coherent identical loudspeakers typically sum incoherently to produce approximately 3 dB SPL increase ($10 \cdot \log(2) \approx 3$ dB). This represents the power-sum average across a listening area. Coherent in-phase summation at specific focal points can reach 6 dB.
76. C — H.265. H.265 (HEVC) achieves approximately 50% better compression efficiency than H.264 at equivalent perceived quality. This efficiency improvement enables 4K streaming and reduces storage and bandwidth requirements for video distribution.
77. A — DisplayPort alt-mode. USB-C supports DisplayPort alt-mode, enabling video signal transport over the USB-C physical connection. This is how many modern laptops and tablets output video through their USB-C ports, supporting single-cable video, audio, data, and power.
78. D — Public accommodations. The Americans with Disabilities Act (ADA) Title III governs accessibility in places of public accommodation and commercial facilities — including offices, conference centers, restaurants, hotels, and most commercial AV installation environments. This broad scope affects most commercial AV projects.
79. B — Signal-to-noise ratio. Gain staging optimizes signal-to-noise ratio by ensuring each stage in the signal chain operates at an appropriate level — not so low that noise dominates, not so high that clipping occurs. Proper gain staging is fundamental to achieving clean audio.
80. C — Electromagnetic interference. Fiber optic cable transmits information as light pulses through glass or plastic, making it inherently immune to electromagnetic interference from power lines, motors, or other RF sources. This is a key advantage for long-distance AV signal transport in electrically noisy environments.

81. D — High frequencies. A tweeter is the loudspeaker driver designed to reproduce high frequencies, typically from about 2 kHz to 20 kHz. Its small diaphragm can move quickly enough to produce these rapid pressure variations but isn't suited for lower frequencies that require more air movement.
82. A — Communications circuits. 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, firestop, and listing requirements for these cable types.
83. C — Drivers hand off. The crossover frequency is the frequency at which one loudspeaker driver hands off signal reproduction to another — for example, where a woofer rolls off and a tweeter takes over. Proper crossover design ensures smooth transitions between drivers across the audio spectrum.
84. B — Web and PC displays. sRGB is the standard color space for consumer digital imagery, web content, Windows, and most PC applications. It provides a consistent color space across browsers, operating systems, and consumer displays, making it the baseline for general computing and web content.
85. A — General Purpose I/O. GPIO stands for General Purpose Input/Output, referring to configurable pins on a device that can serve as either inputs or outputs for simple signaling. GPIO is commonly used in AV control systems for switch closures, relay control, and simple triggering.
86. D — Its reflected brightness. Screen gain measures how much a projection screen concentrates reflected light at the viewing position compared to a unity-gain reference white surface. Higher gain screens trade viewing angle for on-axis brightness — useful in bright rooms but narrowing optimal viewing range.
87. C — 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, and design documentation.
88. B — Uniform across bands. A flat frequency response is one where the system's output level is uniform across all frequency bands — no emphasized or attenuated regions. This is typically the target for accurate reproduction systems, though some applications intentionally tailor response for specific effects.
89. D — 30 W. PoE+ (IEEE 802.3at, Type 2) delivers up to 30 watts per port. Standard PoE (802.3af, Type 1) provides 15.4 W; PoE++ Type 3 provides 60 W; and PoE++ Type 4 delivers up to 100 W over standard Category cable.
90. D — Precedence in localization. The Haas effect (precedence effect) describes how humans localize sound based on the first arrival when multiple arrivals occur within a short time window

(typically 1-40 ms). This principle is exploited in distributed loudspeaker systems using delay to preserve localization to the primary source.

91. C — Signal groups. An audio mixer's bus routes signal groups — for example, sending multiple channels to a single destination (recording, monitor output, effects send). Buses enable organizational grouping and parallel signal processing, fundamental to complex audio system architectures.
92. B — Finer pixel pitch. LED displays viewed at close distances require finer pixel pitch (smaller center-to-center pixel spacing) to prevent individual pixels from being visible. The minimum viewing distance roughly scales with pixel pitch — tighter pitch enables closer viewing without pixelation.
93. D — Match local regulations. Wireless microphone frequencies must match local regulatory allocations, which vary by country and region. In the U.S., FCC regulations specify available bands; other jurisdictions have their own regulators (Ofcom in UK, etc.). Operating outside allocated bands is illegal and can cause interference.
94. A — Left, center, right. An LCR loudspeaker configuration includes Left, Center, and Right loudspeakers — a foundational layout for stereo-plus-center imaging used in presentation, cinema, and multi-channel applications. The center loudspeaker anchors dialog and primary content.
95. C — Color and brightness. Video wall calibration addresses tile-to-tile variations in color, brightness, and gamma to produce a seamless unified image across multiple displays. Uncorrected variations produce visible boundaries that fragment content spanning the wall.
96. B — Mic picks up speaker output. Acoustic feedback occurs when the loop from microphone to amplifier to loudspeaker back to microphone has gain greater than 1 at any frequency. The system oscillates, producing the characteristic howl. Understanding the root cause enables practical feedback management strategies.
97. D — Reduces level differences. Dynamic range compression reduces the difference between the loudest and softest passages of audio, producing more consistent program level. This is used extensively in broadcast, music production, and sound reinforcement to maintain controlled listening levels.
98. A — Electrical workplace safety. NFPA 70E is the Standard for Electrical Safety in the Workplace, addressing safe work practices for employees working on or near electrical equipment. It complements the NEC (which addresses installation) by focusing on worker safety during installation, maintenance, and operation.
99. B — Multiple outputs. A passive splitter divides a single input signal into multiple outputs, enabling distribution of the signal to several destinations. Passive splitters introduce some insertion loss and require impedance-matching design; active splitters use amplification to maintain signal levels.

100. C — Maximum power transfer. Impedance matching's primary goal in signal systems is maximum power transfer between stages, which occurs when source and load impedances are equal. In modern audio systems, voltage transfer (source impedance much lower than load) is often preferred over strict impedance matching.