SIMULATION EXAM 17 — QUESTIONS 1–100

1. A loudspeaker produces 85 dB SPL at 1 meter with 1 watt input. What SPL will it produce with 10 watts at 1 meter?

A. 88 dB SPL

B. 95 dB SPL

C. 100 dB SPL

D. 105 dB SPL

2. A 16:9 display has a diagonal of 55 inches. What is the approximate image height?

A. 19 inches

B. 35 inches

C. 48 inches

D. 27 inches

3. The impedance of three 8-ohm loudspeakers wired in parallel is approximately:

A. 2.67 ohms

B. 8 ohms

C. 24 ohms

D. 4 ohms

4. An amplifier delivering 200 watts into an 8-ohm load produces approximately what voltage?

A. 20 V

B. 25 V

C. 40 V

D. 80 V

5. Converting 1,500 watts to BTU per hour gives approximately:

A. 3,500 BTU/hr

B. 5,118 BTU/hr

C. 10,000 BTU/hr

D. 1,500 BTU/hr

6. A projector with a throw ratio of 1.5 produces a 12-foot-wide image when mounted at what distance?

A. 18 feet

B. 24 feet

C. 8 feet

D. 12 feet

7. Applying the 4H rule for Analytical Decision-Making, a 36-inch image height allows maximum viewing distance of:

A. 72 inches

B. 108 inches

C. 180 inches

D. 144 inches

8. A 70V distributed audio system uses an amplifier rated at 400 watts. If each loudspeaker is tapped at 8 watts, the maximum number of loudspeakers supported (without safety margin) is:

A. 20 loudspeakers

B. 40 loudspeakers

C. 50 loudspeakers

D. 80 loudspeakers

9. The inverse square law predicts that sound pressure level decreases by approximately what amount per doubling of distance in the direct field?

A. 3 dB

B. 6 dB

C. 10 dB

D. 12 dB

10. A 16:9 display has a diagonal of 75 inches. What is the approximate image width?

A. 65 inches

B. 48 inches

C. 55 inches

D. 75 inches

11. The voltage developed across a 4-ohm load when an amplifier delivers 100 watts to the load is approximately:

A. 10 V

B. 15 V

C. 28 V

D. 20 V

12. At 70V distribution, a loudspeaker tapped at 10 watts draws how much current from the 70V line?

A. 0.7 amperes

B. 1.4 amperes

C. 0.14 amperes

D. 10 amperes

13. A room measuring 40 feet × 30 feet × 12 feet has a volume of:

A. 1,200 cubic feet

B. 14,400 cubic feet

C. 120,000 cubic feet

D. 144,000 cubic feet

14. A 16:9 display with an image width of 104 inches has an image height of approximately:

A. 59 inches

B. 48 inches

C. 72 inches

D. 104 inches

15. Sabine's equation for reverberation time is RT60 = 0.161 × V / A (metric). A room of 200 cubic meters with total absorption of 40 m^2 of Sabines has an RT60 of approximately:

A. 2.0 seconds

B. 1.2 seconds

C. 0.8 seconds

D. 0.4 seconds

16. A projector rated at 4,000 ANSI lumens projecting onto a 150-square-foot screen produces approximately what illuminance?

A. 10 foot-lamberts

B. 15 foot-lamberts

C. 40 foot-lamberts

D. 27 foot-lamberts

17. Converting 500 watts to BTU per hour gives approximately:

A. 1,000 BTU/hr

B. 1,706 BTU/hr

C. 3,000 BTU/hr

D. 5,000 BTU/hr

18. A projector with a throw ratio of 2.5 and a 10-foot-wide image requires a throw distance of:

A. 25 feet

B. 15 feet

C. 10 feet

D. 4 feet

19. Four 8-ohm loudspeakers wired in parallel produce a combined impedance of:

A. 8 ohms

B. 4 ohms

C. 2 ohms

D. 32 ohms

20. Applying the 6H rule for Basic Decision-Making, a 24-inch image height allows maximum viewing distance of:

A. 72 inches

B. 96 inches

C. 120 inches

D. 144 inches

21. A 4K60 4:4:4 8-bit video signal has a bandwidth of approximately:

A. 12 Gbps

B. 3 Gbps

C. 800 Mbps

D. 48 Gbps

22. A ceiling loudspeaker with 90-degree conical coverage mounted at 10 feet produces a coverage circle diameter at floor level (6 feet below) of approximately:

A. 6 feet

B. 12 feet

C. 20 feet

D. 10 feet

23. Two identical coherent loudspeakers producing the same signal coherently increase SPL by approximately:

A. 0 dB (no change)

B. 10 dB

C. 3 dB

D. 6 dB

24. Converting 2,500 watts to BTU per hour gives approximately:

A. 2,500 BTU/hr

B. 5,000 BTU/hr

C. 7,000 BTU/hr

D. 8,530 BTU/hr

25. A 500-watt UPS with a 450-watt load has headroom of approximately:

A. 50 watts

B. 100 watts

C. 250 watts

D. 450 watts

26. Applying the 4H rule, a room requires viewers no farther than 20 feet from the display. The minimum image height required is:

A. 3 feet

B. 4 feet

C. 5 feet

D. 8 feet

27. A 1080p60 4:4:4 video signal has a bandwidth of approximately:

A. 3 Gbps

B. 6 Gbps

C. 12 Gbps

D. 18 Gbps

28. Converting 750 watts to BTU per hour gives approximately:

A. 1,500 BTU/hr

B. 750 BTU/hr

C. 3,000 BTU/hr

D. 2,559 BTU/hr

29. A 16:9 display with image height of 45 inches has an approximate diagonal of:

A. 85 inches

B. 92 inches

C. 78 inches

D. 72 inches

30. Two 4-ohm loudspeakers wired in parallel produce a combined impedance of:

A. 8 ohms

B. 4 ohms

C. 1 ohm

D. 2 ohms

31. An amplifier produces 120 V peak voltage into an 8-ohm load. The peak power is approximately:

A. 900 watts

B. 1,200 watts

C. 1,800 watts

D. 2,400 watts

32. A speaker's sensitivity is 92 dB SPL at 1W/1m. What wattage is required to produce 101 dB SPL at 1 meter?

A. 2 watts

B. 8 watts

C. 16 watts

D. 32 watts

33. A room needs NC-30 ambient noise level. A sound measurement shows NC-40. The ambient noise must be reduced by approximately how many decibels?

A. 5 dB

B. 8 dB

C. 12 dB

D. 10 dB

34. Increasing loudspeaker power by 10 times (from 1 watt to 10 watts) increases SPL by approximately:

A. 3 dB

B. 6 dB

C. 10 dB

D. 20 dB

35. Four identical coherent loudspeakers increase SPL by approximately:

A. 3 dB

B. 6 dB

C. 10 dB

D. 12 dB

36. A 65-inch 16:9 display has an image width of approximately:

A. 48 inches

B. 40 inches

C. 55 inches

D. 57 inches

37. Converting 3,000 watts to BTU per hour gives approximately:

A. 10,236 BTU/hr

B. 3,000 BTU/hr

C. 6,000 BTU/hr

D. 15,000 BTU/hr

38. Applying the 6H rule, a 36-inch image height allows viewing up to:

A. 72 inches

B. 144 inches

C. 216 inches

D. 288 inches

39. A projector with a throw ratio of 2.0 mounted 20 feet from the screen produces an image width of:

A. 5 feet

B. 10 feet

C. 15 feet

D. 40 feet

40. A 16:9 display has an image width of 128 inches. The approximate image height is:

A. 72 inches

B. 96 inches

C. 128 inches

D. 144 inches

41. A 70V distributed audio system's amplifier delivers 300 watts total. If each loudspeaker is tapped at 6 watts, how many loudspeakers can be safely supported (without safety margin)?

A. 30 loudspeakers

B. 50 loudspeakers

C. 60 loudspeakers

D. 100 loudspeakers

42. An amplifier rated at 150 watts continuous needs approximately how many BTU/hr of cooling?

A. 100 BTU/hr

B. 200 BTU/hr

C. 400 BTU/hr

D. 512 BTU/hr

43. A 40-degree conical loudspeaker mounted at 15 feet (listener at 4 feet) produces a coverage circle diameter at the listener level of approximately:

A. 20 feet

B. 15 feet

C. 8 feet

D. 12 feet

44. A microphone cable has a resistance of 100 ohms per 1000 feet. A 200-foot run has a resistance of:

A. 20 ohms

B. 50 ohms

C. 100 ohms

D. 200 ohms

45. A video wall composed of 2x2 panels of 1920x1080 pixels each produces a combined resolution of:

A. 1920 × 1080

B. 3840 × 1080

C. 1920 × 2160

D. 3840 × 2160

46. At 70V, the current draw for a 50-watt tapped loudspeaker is:

A. 0.35 amperes

B. 0.71 amperes

C. 1.4 amperes

D. 7.0 amperes

47. Two 16-ohm loudspeakers wired in parallel produce an impedance of:

A. 8 ohms

B. 4 ohms

C. 16 ohms

D. 32 ohms

48. A 16:9 display has a diagonal of 100 inches. The approximate image height is:

A. 56 inches

B. 75 inches

C. 49 inches

D. 87 inches

49. A ceiling speaker with 60-degree conical coverage mounted at 10 feet, listener at 4 feet, produces coverage at listener level with diameter approximately:

A. 5 feet

B. 8 feet

C. 10 feet

D. 7 feet

50. A 120-foot cable run at 1 Gbps requires what category cable minimum?

A. Category 3

B. Category 5e or higher

C. Category 6 only

D. Fiber-only

51. Sabine's equation: A room of 5,000 cubic feet with 500 Sabines (ft^2) of absorption has an RT60 of approximately:

A. 0.5 seconds

B. 1.0 seconds

C. 1.5 seconds

D. 2.0 seconds

52. Applying the 4H rule, a viewer 12 feet away needs an image height of at least:

A. 1 foot

B. 2 feet

C. 3 feet

D. 6 feet

53. A 4K60 4:2:0 8-bit video signal has a bandwidth of approximately:

A. 3 Gbps

B. 6 Gbps

C. 12 Gbps

D. 48 Gbps

54. A 16:9 display at 60 inches diagonal has an approximate image height of:

A. 40 inches

B. 36 inches

C. 45 inches

D. 29 inches

55. The power gain in decibels when power increases from 50 watts to 200 watts is approximately:

A. 6 dB

B. 3 dB

C. 10 dB

D. 12 dB

56. A room's maximum viewing distance is 30 feet. Applying the 6H rule, the minimum image height is:

A. 3 feet

B. 4 feet

C. 5 feet

D. 8 feet

57. Two 4-ohm speakers wired in series produce an impedance of:

A. 8 ohms

B. 4 ohms

C. 2 ohms

D. 1 ohm

58. Converting 1,000 watts to BTU per hour gives approximately:

A. 500 BTU/hr

B. 2,000 BTU/hr

C. 1,000 BTU/hr

D. 3,412 BTU/hr

59. A 70V distributed audio system has a 200-watt amplifier. The maximum number of loudspeakers at 4-watt taps each is:

A. 25 loudspeakers

B. 40 loudspeakers

C. 50 loudspeakers

D. 100 loudspeakers

60. A projector with a throw ratio of 1.0 produces an image width equal to:

A. Half the throw distance

B. The throw distance

C. Twice the throw distance

D. Three times the throw distance

61. A 16:9 display with image width of 80 inches has an image height of approximately:

A. 45 inches

B. 30 inches

C. 60 inches

D. 80 inches

62. Increasing SPL by 10 dB at a given distance requires approximately how many times the power?

A. 2 times

B. 3 times

C. 5 times

D. 10 times

63. A 16:9 display has an image height of 36 inches. Applying the 4H rule, viewers cannot exceed:

A. 108 inches

B. 144 inches

C. 216 inches

D. 288 inches

64. A ceiling loudspeaker's coverage circle diameter at the listener level equals twice the vertical distance to the listener when the loudspeaker has a coverage angle of:

A. 30 degrees

B. 60 degrees

C. 90 degrees

D. 120 degrees

65. A projector of 2,500 ANSI lumens on a 100-square-foot screen produces approximately:

A. 25 foot-lamberts

B. 50 foot-lamberts

C. 10 foot-lamberts

D. 15 foot-lamberts

66. A room of 10,000 cubic feet with 1,000 Sabines (ft^2) absorption has an RT60 of approximately:

A. 0.25 seconds

B. 0.50 seconds

C. 0.75 seconds

D. 0.49 seconds

67. A cable run at 1,125 feet per second signal propagation delay over 200 feet is approximately:

A. 100 ms

B. 50 ms

C. 178 microseconds

D. 1 second

68. A 16:9 display with an image height of 50 inches has an approximate diagonal of:

A. 75 inches

B. 102 inches

C. 96 inches

D. 120 inches

69. A loudspeaker array with 8 loudspeakers all producing the same coherent signal increases SPL by approximately:

A. 3 dB

B. 6 dB

C. 12 dB

D. 18 dB (approximate for coherent addition)

70. A projector with a 4,500-lumen rating on a 150-square-foot screen produces approximately:

A. 30 foot-lamberts

B. 15 foot-lamberts

C. 60 foot-lamberts

D. 100 foot-lamberts

71. A room of 8,000 cubic feet with 800 Sabines (ft^2) has an RT60 of approximately:

A. 0.25 seconds

B. 0.75 seconds

C. 0.49 seconds

D. 1.0 seconds

72. Converting 600 watts to BTU per hour gives approximately:

A. 600 BTU/hr

B. 1,200 BTU/hr

C. 3,000 BTU/hr

D. 2,047 BTU/hr

73. A 16:9 display has an image width of 88 inches. The approximate image height is:

A. 30 inches

B. 50 inches

C. 72 inches

D. 88 inches

74. A 70V audio line has 100 volts peak during signal peaks. The RMS voltage is approximately:

A. 70 volts

B. 50 volts

C. 35 volts

D. 141 volts

75. Two loudspeakers in a coverage pattern where each has 6 dB of overlap region produce at the overlap point approximately:

A. 3 dB boost

B. 6 dB boost

C. 0 dB (no change)

D. 10 dB boost

76. A 16:9 display at 85 inches diagonal has an image width of approximately:

A. 42 inches

B. 55 inches

C. 65 inches

D. 74 inches

77. At 70V with a 20-watt tap, the current draw is:

A. 0.14 amperes

B. 0.29 amperes

C. 0.71 amperes

D. 1.4 amperes

78. A 4K60 4:2:2 10-bit video signal has a bandwidth of approximately:

A. 10 Gbps

B. 6 Gbps

C. 3 Gbps

D. 48 Gbps

79. Applying the 6H rule, a viewer 18 feet from the display needs an image height of at least:

A. 1 foot

B. 2 feet

C. 3 feet

D. 6 feet

80. A projector with a 2,000 ANSI lumen rating on a 50-square-foot screen produces approximately:

A. 20 foot-lamberts

B. 30 foot-lamberts

C. 10 foot-lamberts

D. 40 foot-lamberts

81. Three 8-ohm loudspeakers wired in series produce an impedance of:

A. 8 ohms

B. 24 ohms

C. 2.67 ohms

D. 4 ohms

82. A 16:9 display with a diagonal of 50 inches has an approximate image height of:

A. 24 inches

B. 36 inches

C. 30 inches

D. 48 inches

83. The RT60 of a room that is 5,000 cubic feet with 500 Sabines of absorption is approximately:

A. 0.25 seconds

B. 0.75 seconds

C. 0.49 seconds

D. 1.0 seconds

84. Converting 2,000 watts to BTU per hour gives approximately:

A. 1,000 BTU/hr

B. 5,000 BTU/hr

C. 2,000 BTU/hr

D. 6,824 BTU/hr

85. A 16:9 display at 100-inch diagonal has an image width of approximately:

A. 70 inches

B. 87 inches

C. 100 inches

D. 140 inches

86. A loudspeaker producing 90 dB SPL at 1W/1m produces what SPL with 4 watts at 1 meter?

A. 96 dB SPL

B. 94 dB SPL

C. 93 dB SPL

D. 100 dB SPL

87. Two 8-ohm loudspeakers wired in parallel and then in series with another parallel pair produce an impedance of:

A. 2 ohms

B. 4 ohms

C. 8 ohms

D. 16 ohms

88. Converting 4,000 watts to BTU per hour gives approximately:

A. 10,000 BTU/hr

B. 13,648 BTU/hr

C. 2,000 BTU/hr

D. 20,000 BTU/hr

89. A 16:9 display has an image height of 20 inches. The approximate diagonal is:

A. 25 inches

B. 30 inches

C. 36 inches

D. 41 inches

90. The voltage developed across a 16-ohm load when an amplifier delivers 50 watts is approximately:

A. 28 V

B. 20 V

C. 14 V

D. 40 V

91. An amplifier delivers 100 watts into an 8-ohm load, producing an output voltage of approximately:

A. 15 V

B. 20 V

C. 28 V

D. 40 V

92. A 70V line at 2 amperes is delivering approximately:

A. 70 watts

B. 140 watts

C. 210 watts

D. 280 watts

93. A room of 20,000 cubic feet with 2,000 Sabines (ft^2) of absorption has an RT60 of approximately:

A. 0.25 seconds

B. 0.75 seconds

C. 1.0 seconds

D. 0.49 seconds

94. A 16:9 display at 32-inch diagonal has an image height of approximately:

A. 16 inches

B. 24 inches

C. 20 inches

D. 12 inches

95. A 16:9 display with an image height of 27 inches has an approximate image width of:

A. 36 inches

B. 40 inches

C. 48 inches

D. 54 inches

96. Coverage of a single 90-degree conical loudspeaker at 10 feet above the listener creates a coverage circle diameter at the listener of:

A. 10 feet

B. 20 feet

C. 30 feet

D. 40 feet

97. Applying the 4H rule, a 48-inch image height allows maximum viewing distance of:

A. 192 inches (16 feet)

B. 288 inches (24 feet)

C. 384 inches (32 feet)

D. 480 inches (40 feet)

98. A projector with a throw ratio of 1.8 produces a 10-foot-wide image at what throw distance?

A. 10 feet

B. 14 feet

C. 20 feet

D. 18 feet

99. Converting 5,000 watts to BTU per hour gives approximately:

A. 5,000 BTU/hr

B. 10,000 BTU/hr

C. 17,060 BTU/hr

D. 25,000 BTU/hr

100. A 16:9 display with a 72-inch diagonal has an approximate image width of:

A. 48 inches

B. 63 inches

C. 72 inches

D. 90 inches

SIMULATION EXAM 17 — ANSWER KEY AND FULL EXPLANATIONS

1. B — 95 dB SPL. The rule for SPL change from power change is 10·log(power ratio). Going from 1 watt to 10 watts is a 10× power increase, which adds 10·log(10) = 10 dB to the output. Starting at 85 dB and adding 10 dB gives 95 dB SPL. This calculation is foundational for amplifier sizing decisions — determining the power required to achieve target SPL at a given distance for a given loudspeaker sensitivity.

2. D — 27 inches. For a 16:9 display, image height can be calculated using the ratio of height to diagonal, which equals $9/\sqrt{(16^2 + 9^2)} = 9/\sqrt{337} \approx 0.49$. So image height ≈ diagonal × 0.49 = 55 × 0.49 ≈ 27 inches. This quick conversion is essential for verifying compliance with 4H and 6H viewing distance rules from AVIXA V202.01.

3. A — 2.67 ohms. Parallel impedance for equal loads equals the single-unit impedance divided by the number of units: 8 ÷ 3 ≈ 2.67 ohms. This impedance is below most amplifier minimum load ratings (typically 4 ohms), so parallel wiring of three 8-ohm loudspeakers would stress or damage most amplifiers. Understanding parallel impedance prevents equipment damage and informs proper distributed audio design.

4. C — 40 V. Using the power formula $P = V^2/R$ rearranged to $V = \sqrt{(P \times R)} = \sqrt{(200 \times 8)} = \sqrt{1,600} = 40$ V. This voltage calculation is foundational for amplifier-loudspeaker matching and understanding that higher power into a given load requires higher output voltage — which in turn requires amplifier rails capable of supporting it.

5. B — 5,118 BTU/hr. The conversion factor is 1 watt = 3.412 BTU/hr, so 1,500 × 3.412 = 5,118 BTU/hr. This calculation is essential for HVAC sizing of equipment closets, racks, and AV rooms — all electrical power consumed eventually becomes heat that the cooling system must remove to protect equipment.

6. A — 18 feet. Throw distance = throw ratio × image width = 1.5 × 12 = 18 feet. This relationship enables projector placement calculations for target image sizes. Short-throw projectors have throw ratios below 1.0; long-throw projectors have higher ratios. Knowing this relationship is essential for specifying projector lens options to match room geometry.

7. D — 144 inches. The 4H rule from ANSI/AVIXA V202.01 establishes maximum viewing distance for Analytical Decision-Making content as 4 × image height = 4 × 36 = 144 inches (12 feet). Viewers beyond this distance cannot resolve the fine detail that ADM content requires, such as spreadsheets or CAD drawings. This rule drives display sizing against room depth.

8. C — 50 loudspeakers. In 70V distributed audio design, maximum loudspeakers equals amplifier wattage divided by tap wattage: $400 \div 8 = 50$. Professional practice applies a 20% safety margin below this arithmetic maximum to account for amplifier headroom, system growth, and reliability. This calculation is fundamental to designing background music and paging systems.

9. B — 6 dB. The inverse square law describes how sound pressure level decreases as sound spreads spherically from a point source in the free (direct) field. Each doubling of distance halves the sound pressure, which equates to a 6 dB reduction. This relationship is critical for predicting SPL at listener positions in non-reverberant environments.

10. A — 65 inches. For a 16:9 display, image width-to-diagonal ratio equals $16/\sqrt{(16^2 + 9^2)} = 16/\sqrt{337} \approx 0.87$. So image width ≈ diagonal × 0.87 = $75 \times 0.87 \approx 65$ inches. This aspect-ratio conversion is used for screen-to-room analysis, particularly when verifying that a display fits a specified wall space or meets viewing requirements.

11. D — 20 V. Using $V = \sqrt{(P \times R)} = \sqrt{(100 \times 4)} = \sqrt{400} = 20$ V. The 4-ohm load produces less voltage than an 8-ohm load at the same power, illustrating the inverse relationship between impedance and voltage for a given power. This calculation informs amplifier selection — lower-impedance loads draw more current but less voltage for the same power output.

12. C — 0.14 amperes. At 70V distribution, current equals power divided by voltage: $10 \div 70 \approx 0.14$ amperes. The low current per loudspeaker is the key advantage of constant-voltage (70V or 100V) distribution, minimizing voltage drop on long cable runs and allowing many loudspeakers on a single amplifier channel without oversized wiring.

13. B — 14,400 cubic feet. Room volume equals length × width × height: $40 \times 30 \times 12 = 14{,}400$ cubic feet. This volume is the input to Sabine's equation for calculating reverberation time. Larger rooms with the same surface treatment will have longer reverberation times, which affects speech intelligibility and music clarity.

14. A — 59 inches. For a 16:9 display with image width 104 inches, height = width × (9/16) = $104 \times 0.5625 \approx 58.5$ inches, rounded to 59. This direct aspect-ratio calculation is used frequently in display selection and verifying that a specified display meets height requirements under the 4H or 6H rules.

15. C — 0.8 seconds. Using Sabine's equation $RT60 = 0.161 \times V/A$ (metric): $0.161 \times 200 / 40 = 0.805$ seconds. This reverberation time is within the typical target range for speech-focused rooms, though dedicated conference rooms often target 0.4 to 0.6 seconds for optimal speech intelligibility. Understanding Sabine's equation is fundamental to acoustic design.

16. D — 27 foot-lamberts. Screen illuminance in foot-lamberts (before considering screen gain) approximately equals lumens divided by screen area: $4{,}000 \div 150 \approx 26.7$ foot-lamberts. This calculation is the starting point for projector brightness analysis. SMPTE cinema reference is 16

foot-lamberts; practical presentation environments often target 25 to 50 foot-lamberts depending on ambient conditions.

17. B — 1,706 BTU/hr. Applying the 3.412 conversion factor: 500 × 3.412 = 1,706 BTU/hr. BTU calculation is essential for HVAC load planning of AV equipment. Even small amounts of continuous electrical consumption accumulate to significant thermal loads that must be accounted for in closed rack enclosures or small AV rooms.

18. A — 25 feet. Throw distance = throw ratio × image width = 2.5 × 10 = 25 feet. This is a relatively long-throw installation suitable for auditoriums or deep rooms where the projector is mounted far from the screen. Verifying throw distance against available room depth is a standard check during projector selection.

19. C — 2 ohms. Four 8-ohm loudspeakers in parallel: 8 ÷ 4 = 2 ohms. This impedance is below the minimum load rating of most amplifiers, which typically specify 4 ohms or 8 ohms minimum. Attempting to drive a 2-ohm load with an amplifier not rated for it will cause protection shutdown or damage. This math informs correct series-parallel wiring strategies.

20. D — 144 inches. The 6H rule from ANSI/AVIXA V202.01: maximum viewing distance = 6 × image height = 6 × 24 = 144 inches (12 feet). The 6H rule applies to Basic Decision-Making content, which doesn't require the fine detail resolution that ADM content does, so viewers can be farther from the display.

21. A — 12 Gbps. Uncompressed 4K60 at 4:4:4 8-bit bandwidth calculation: 3840 × 2160 × 60 × 8 × 3 (RGB channels) ≈ 12 Gbps before overhead. This bandwidth level exceeds HDMI 1.4's capacity and drives the requirement for HDMI 2.0 (18 Gbps) or higher infrastructure. Knowing bandwidth requirements enables correct cable and equipment specification.

22. B — 12 feet. For a 90° conical coverage pattern with the loudspeaker at 10 feet ceiling height and listener at 4 feet (6 feet of vertical drop to listener ears): coverage circle diameter = 2 × 6 × tan(45°) = 12 feet. The 45° is the half-angle of a 90° cone. This geometric calculation drives ceiling speaker spacing for uniform coverage.

23. C — 3 dB. Two identical loudspeakers producing the same signal typically sum incoherently as 10·log(2) ≈ 3 dB — the power-sum result for average SPL gain across a listening area. Coherent in-phase summation at specific focal points can reach +6 dB, but +3 dB represents the realistic average gain. This distinction matters when predicting array performance.

24. D — 8,530 BTU/hr. Applying the conversion: 2,500 × 3.412 = 8,530 BTU/hr. Large equipment installations with multiple amplifiers, processors, and video equipment can generate this level of heat, requiring dedicated HVAC capacity and appropriate airflow management to protect equipment and maintain reliable operation.

25. A — 50 watts. UPS headroom equals capacity minus load: 500 − 450 = 50 watts. Minimal headroom (10% here) leaves little room for load growth, startup transients, or battery degradation

over time. Professional practice typically sizes UPS with 25-30% headroom minimum to provide reliable operation throughout the equipment lifecycle.

26. C — 5 feet. The 4H rule in reverse: minimum image height = viewing distance ÷ 4 = 20 ÷ 4 = 5 feet. When the farthest viewer is 20 feet away and ADM content quality is required, the image must be at least 5 feet tall for content detail to be resolvable. This reverse calculation drives display specification from room dimensions.

27. A — 3 Gbps. Uncompressed 1080p60 at 4:4:4 8-bit bandwidth: 1920 × 1080 × 60 × 8 × 3 ≈ 3 Gbps. This is the foundation of 3G-SDI and was a key HD broadcast specification. Understanding how resolution, frame rate, color depth, and chroma sampling combine to determine bandwidth is essential for specifying signal transport.

28. D — 2,559 BTU/hr. Applying 3.412 × 750 ≈ 2,559 BTU/hr. Medium-power equipment groups (small rack with processors, small amplifier, switcher) generate moderate heat loads that must still be addressed in thermal design, particularly in enclosed racks or small equipment closets without dedicated HVAC.

29. B — 92 inches. For a 16:9 display with image height 45 inches, diagonal = image height ÷ 0.49 = 45 ÷ 0.49 ≈ 92 inches. This conversion derives from the 16:9 geometric relationship where height equals approximately 49% of diagonal. Designers use this calculation when specifying commercially available display sizes based on required image height.

30. D — 2 ohms. Two 4-ohm loudspeakers in parallel: 4 ÷ 2 = 2 ohms. This impedance is below many amplifier minimum load ratings, which could cause amplifier protection engagement or damage. Understanding this helps avoid configuration mistakes when combining low-impedance loudspeakers.

31. A — 900 watts. Peak voltage of 120V produces RMS voltage of $120/\sqrt{2} \approx 85$V, and RMS power equals $V^2/R = 85^2/8 \approx 900$ watts. Amplifier power specifications typically use RMS values rather than peak, so converting peak voltage to RMS before calculating power gives the meaningful rating. This distinction prevents overstating amplifier capabilities.

32. B — 8 watts. SPL increase calculation: 9 dB (101 − 92) = 10·log(power ratio), so power ratio = 10^0.9 ≈ 8. Starting from 1 watt sensitivity reference, 8 watts produces the 9 dB increase. The quick check: 3 dB requires 2×, 6 dB requires 4×, 9 dB requires 8×. Power-to-SPL relationships are fundamental for amplifier sizing.

33. D — 10 dB. NC (Noise Criteria) rating differences approximately correspond to dB differences in background noise across speech-critical frequencies. Moving from NC-40 to NC-30 represents about 10 dB reduction. Actual reduction depends on frequency distribution since NC curves have frequency-dependent contours, but the overall reduction approximates 10 dB.

34. C — 10 dB. The decibel formula for power: dB = 10·log(power ratio). For a 10× power increase, 10·log(10) = 10 dB SPL increase. This is the quick-calculation rule: each 10× power requires 10

dB SPL increase, each 2× power requires 3 dB increase. Memorizing these rules enables rapid amplifier sizing estimates.

35. B — 6 dB. Coherent summation of 4 identical sources: $10 \cdot \log(4) \approx 6$ dB. The progression is: 2 sources = 3 dB, 4 sources = 6 dB, 8 sources = 9 dB, each doubling adding 3 dB. This principle guides loudspeaker array design where multiple sources combine to achieve higher SPL than single sources.

36. D — 57 inches. For a 16:9 display with 65-inch diagonal, image width = $0.87 \times 65 \approx 57$ inches. This is the standard 16:9 width-to-diagonal conversion derived from the 16:9 aspect ratio. The 0.87 multiplier is worth memorizing for rapid diagonal-to-width conversion during design work.

37. A — 10,236 BTU/hr. Applying the conversion: $3{,}000 \times 3.412 = 10{,}236$ BTU/hr. Large power systems — large amplifier racks, video wall processors, LED walls — generate substantial heat requiring significant HVAC capacity. Inadequate thermal planning is a leading cause of equipment reliability problems in AV installations.

38. C — 216 inches. The 6H rule: $6 \times 36 = 216$ inches (18 feet). For a 36-inch image height, BDM content allows much farther viewing than ADM content under the 4H rule (which would limit viewing to 144 inches). This difference illustrates why content type drives the viewing distance rule that applies.

39. B — 10 feet. Image width = throw distance ÷ throw ratio = $20 \div 2.0 = 10$ feet. The throw ratio is the ratio of throw distance to image width, so dividing the throw distance by the throw ratio yields the image width produced at that distance.

40. A — 72 inches. For a 16:9 display, height = width × (9/16) = $128 \times 0.5625 = 72$ inches. Direct application of the aspect ratio to determine image height from image width. This is one of the most frequent AV calculations used in display and projection design work.

41. B — 50 loudspeakers. Maximum loudspeakers equals amplifier wattage divided by tap wattage: $300 \div 6 = 50$. Note that this matches the arithmetic maximum; professional practice would add safety margin and plan for amplifier headroom before reaching this theoretical limit.

42. D — 512 BTU/hr. Applying $150 \times 3.412 \approx 512$ BTU/hr. This thermal output from a modest-sized amplifier must be considered in rack cooling design, particularly in closed racks where heat accumulates and can affect multiple pieces of equipment in the airstream.

43. C — 8 feet. For a 40° conical loudspeaker with the listener 11 feet below (15 ft height − 4 ft listener height): coverage diameter = $2 \times 11 \times \tan(20°) = 2 \times 11 \times 0.364 \approx 8$ feet. Tighter coverage angles produce smaller coverage circles at any given distance, requiring denser speaker spacing for uniform coverage.

44. A — 20 ohms. Cable resistance scales with length: 100 ohms/1000 feet × 200 feet = 20 ohms. Cable resistance affects voltage drop, signal quality, and in some cases amplifier-loudspeaker

matching. Longer runs and thinner gauges increase resistance, which is why 70V distribution was developed to minimize this concern.

45. D — 3840 × 2160. Four 1920×1080 tiles arranged in a 2×2 grid produce a combined canvas of 3840 × 2160 pixels — the UHD 4K resolution. This configuration requires video wall processing to distribute a single source image across the four tiles while maintaining proper geometry and alignment.

46. B — 0.71 amperes. At 70V, current equals watts divided by volts: 50 ÷ 70 ≈ 0.71 amperes. Higher-wattage taps draw proportionally more current through the distribution line, so calculating per-loudspeaker current helps size the trunk cable to minimize voltage drop at the farthest loudspeaker.

47. A — 8 ohms. Two 16-ohm loudspeakers in parallel: 16 ÷ 2 = 8 ohms. This wiring strategy produces a convenient amplifier-friendly 8-ohm load from two higher-impedance loudspeakers, effectively doubling the amplifier power delivery relative to a single 16-ohm loudspeaker on the same amplifier.

48. C — 49 inches. For a 16:9 display with 100-inch diagonal, height = diagonal × 0.49 = 100 × 0.49 = 49 inches. Common calculation for display sizing verification — particularly useful when checking that a specified display provides sufficient image height to meet 4H or 6H viewing distance requirements.

49. D — 7 feet. For a 60° conical coverage pattern at 6 feet vertical distance (10 ft ceiling − 4 ft listener): coverage diameter = 2 × 6 × tan(30°) = 2 × 6 × 0.577 ≈ 7 feet. A 60° cone has 30° half-angle, producing narrower coverage than 90° cones at the same distance.

50. B — Category 5e or higher. Cat 5e supports 1 Gbps ethernet at distances up to 100 meters (328 feet) in the standard horizontal channel. For a 120-foot run at 1 Gbps, Cat 5e is the minimum specification — Cat 6 and higher work as well. Cat 3 is insufficient for 1 Gbps; fiber is unnecessary for this distance.

51. A — 0.5 seconds. Using Sabine's equation in imperial units: RT60 = 0.049 × V/A = 0.049 × 5000 / 500 = 0.49 seconds, rounded to 0.5 seconds. This is within the ideal range for speech-focused rooms — conference rooms typically target 0.4 to 0.6 seconds for optimal speech intelligibility without excessive acoustic deadness.

52. C — 3 feet. The 4H rule in reverse: minimum image height = viewing distance ÷ 4 = 12 ÷ 4 = 3 feet. This ensures ADM content detail is resolvable at the farthest viewer position. When room depth drives design, this reverse calculation specifies the minimum display height required.

53. B — 6 Gbps. Uncompressed 4K60 at 4:2:0 8-bit requires approximately 6 Gbps — roughly half the 12 Gbps bandwidth of 4:4:4 because chroma is subsampled to one-quarter the luma resolution. This reduction enables 4K60 transport through HDMI 2.0 infrastructure.

54. D — 29 inches. For a 16:9 display with 60-inch diagonal, height ≈ 0.49 × 60 = 29.4 inches. This is consistent with other 16:9 diagonal-to-height conversions using the 0.49 multiplier derived from the aspect ratio geometry.

55. A — 6 dB. Power gain in decibels: 10·log(200/50) = 10·log(4) ≈ 6 dB. This matches the rule that doubling power twice (50 → 100 → 200) adds 3 dB each time, totaling 6 dB. Understanding power-dB relationships enables rapid estimation in the field.

56. C — 5 feet. Applying the 6H rule: minimum image height = viewing distance ÷ 6 = 30 ÷ 6 = 5 feet. The 6H rule allows farther viewing distances than 4H for the same image height, so a given room depth requires a smaller display for BDM content than ADM content.

57. A — 8 ohms. Two 4-ohm loudspeakers in series: 4 + 4 = 8 ohms. Series wiring adds impedances while parallel wiring divides them. Series-parallel combinations enable specific impedance targets to match amplifier ratings when working with multiple loudspeakers.

58. B — 3,412 BTU/hr. Applying the conversion factor: 1,000 × 3.412 = 3,412 BTU/hr. The exact 3.412 BTU/hr per watt conversion is worth memorizing — it's used in every HVAC sizing calculation for AV equipment thermal loads.

59. D — 50 loudspeakers. Maximum loudspeakers = amplifier wattage ÷ tap wattage = 200 ÷ 4 = 50 loudspeakers. Lower per-loudspeaker tap values allow more loudspeakers on a given amplifier, though each loudspeaker produces lower SPL output. Tap selection balances loudspeaker count against required SPL.

60. A — The throw distance. A throw ratio of 1.0 means image width equals throw distance. This is extremely short-throw, typical of short-throw projectors designed for close-mounting applications like whiteboards or small meeting rooms where long projection distance isn't available.

61. B — 45 inches. For a 16:9 display, height = width × (9/16) = 80 × 0.5625 = 45 inches. Direct application of the 16:9 aspect ratio, showing that image height is approximately 56% of image width.

62. D — 10 times. Using the decibel-power relationship: 10 dB = 10·log(n), so n = 10. Each 10 dB SPL increase requires 10× the power. This rule combined with "3 dB requires 2×" provides the foundation for all power-to-SPL calculations in loudspeaker system design.

63. B — 144 inches. The 4H rule: maximum viewing distance = 4 × image height = 4 × 36 = 144 inches (12 feet). This defines the outer limit where ADM content (spreadsheets, detailed diagrams) remains resolvable to viewers — beyond this distance, the text and details become too small.

64. C — 90 degrees. Coverage diameter equals 2 × distance × tan(half-angle). For diameter to equal 2 × distance, tan(half-angle) must equal 1, so half-angle = 45° and full angle = 90°. Memorizing this relationship enables quick coverage estimation for 90° conical speakers.

65. A — 25 foot-lamberts. Screen illuminance before screen gain = lumens ÷ screen area = 2,500 ÷ 100 = 25 foot-lamberts. This is in the acceptable range for presentation-quality projection in moderately controlled lighting. Higher ambient light would require more lumens or higher screen gain.

66. D — 0.49 seconds. Sabine's equation in imperial: RT60 = 0.049 × V/A = 0.049 × 10,000 / 1,000 = 0.49 seconds. This room has excellent speech intelligibility characteristics at this reverberation time, well within the 0.4-0.6 second target for dedicated speech environments.

67. C — 178 milliseconds. At 1,125 ft/s sound velocity, 200 feet takes 200 ÷ 1,125 ≈ 0.178 seconds = 178 milliseconds. This delay time is relevant for distributed audio systems where electronic delay must compensate for acoustic arrival differences at listener positions. (Note: original option stated microseconds; correct unit is milliseconds.)

68. A — 102 inches. For a 16:9 display with image height 50 inches, diagonal = height ÷ 0.49 = 50 ÷ 0.49 ≈ 102 inches. This reverse conversion from image height to diagonal is used when specifying display sizes to meet minimum image height requirements.

69. D — 18 dB. Coherent in-phase summation of 8 identical sources can approach 20·log(8) ≈ 18 dB at focal points in a line array. This contrasts with the 9 dB (10·log(8)) expected from incoherent summation. Line arrays exploit coherent summation to achieve higher SPL than incoherent summation of the same number of sources.

70. B — 30 foot-lamberts. Screen illuminance = lumens ÷ area = 4,500 ÷ 150 = 30 foot-lamberts. This is in the good range for presentation environments with moderate ambient light, producing bright, readable images for typical conference and training applications.

71. C — 0.49 seconds. Applying Sabine's equation: RT60 = 0.049 × 8,000 / 800 = 0.49 seconds. Consistent with the ideal range for speech-focused applications. Rooms with RT60 around 0.5 seconds typically support clear, intelligible speech without excessive acoustic dryness.

72. D — 2,047 BTU/hr. Applying 600 × 3.412 ≈ 2,047 BTU/hr. Standard conversion for equipment heat load analysis. Cumulative heat loads from multiple devices in an equipment rack accumulate rapidly, making per-device BTU calculations important for rack cooling design.

73. B — 50 inches. For a 16:9 display, height = width × (9/16) = 88 × 0.5625 ≈ 50 inches. Direct application of the aspect ratio, showing a large commercial-grade display suitable for large conference rooms or presentation spaces.

74. A — 70 volts. The 70V constant-voltage distribution designation refers to the nominal RMS voltage at full amplifier output. Peak voltage = RMS × √2, so 70V RMS corresponds to approximately 99V peak — matching the 100V peak given in the question.

75. C — 0 dB (no change). At properly designed coverage overlap points (typically at the −6 dB coverage edge of each loudspeaker), the combined level approximates the on-axis level of a single

loudspeaker. The design intent is continuous coverage rather than level addition. This is why "−6 dB overlap" is a standard coverage criterion.

76. D — 74 inches. For a 16:9 display with 85-inch diagonal, width ≈ 0.87 × 85 ≈ 74 inches. Using the 0.87 width-to-diagonal ratio for 16:9 displays, which derives directly from the aspect ratio geometry.

77. B — 0.29 amperes. At 70V distribution, current = watts ÷ volts = 20 ÷ 70 ≈ 0.29 amperes. Direct application of P = V × I rearranged for current. Higher tap values draw more current, affecting voltage drop calculations for long cable runs.

78. A — 10 Gbps. Uncompressed 4K60 at 4:2:2 10-bit requires approximately 10 Gbps bandwidth. This sits between 4:2:0 8-bit (~6 Gbps) and 4:4:4 10-bit (~15 Gbps), representing a common professional compromise that preserves more color information than 4:2:0 while fitting within HDMI 2.0's 18 Gbps ceiling.

79. C — 3 feet. The 6H rule in reverse: minimum image height = viewing distance ÷ 6 = 18 ÷ 6 = 3 feet. For BDM content (wayfinding, general presentation), this 3-foot image height provides adequate content resolution at 18 feet viewing distance.

80. D — 40 foot-lamberts. Screen illuminance = lumens ÷ area = 2,000 ÷ 50 = 40 foot-lamberts. High illuminance suitable for well-lit rooms or bright presentation environments. Smaller screens concentrate projector lumens into higher per-square-foot illuminance values.

81. B — 24 ohms. Three 8-ohm loudspeakers in series: 8 + 8 + 8 = 24 ohms. Series wiring sums impedances, producing high-impedance loads that reduce amplifier current demand but also reduce power delivery. Most amplifiers prefer 4-8 ohm loads; 24 ohms is inefficient but safe.

82. A — 24 inches. For a 16:9 display with 50-inch diagonal, height ≈ 0.49 × 50 ≈ 24.5 inches, rounded to 24. This is a mid-size commercial display suitable for small to medium meeting spaces.

83. C — 0.49 seconds. Sabine's equation: RT60 = 0.049 × 5,000 / 500 = 0.49 seconds. Consistent calculation across multiple similar rooms, demonstrating that the V/A ratio drives RT60 — rooms with proportional volume-to-absorption relationships produce similar reverberation times.

84. D — 6,824 BTU/hr. Applying 2,000 × 3.412 = 6,824 BTU/hr. Key reference point for common equipment room thermal loads — a typical medium-sized equipment rack with multiple amplifiers and processors might generate this level of heat.

85. B — 87 inches. For a 16:9 display with 100-inch diagonal, width = 100 × 0.87 = 87 inches. This is a large display suitable for auditorium or large conference room applications.

86. A — 96 dB SPL. Power increase from 1 watt to 4 watts is 2 doublings (1→2→4), adding 3 dB each time for 6 dB total. Starting from 90 dB sensitivity: 90 + 6 = 96 dB SPL. This incremental approach to power-SPL calculations is useful for quick mental math in the field.

87. C — 8 ohms. Two 8-ohm loudspeakers in parallel produce 4 ohms each pair. Two such pairs wired in series: 4 + 4 = 8 ohms. This series-parallel combination maintains amplifier-friendly 8-ohm impedance while connecting four loudspeakers to a single amplifier channel.

88. B — 13,648 BTU/hr. Applying $4{,}000 \times 3.412 = 13{,}648$ BTU/hr. Large equipment rooms with multiple high-power amplifiers require substantial cooling capacity. Rack cooling strategies include front-to-back airflow management, active rack cooling, and dedicated room HVAC with appropriate return paths.

89. D — 41 inches. For a 16:9 display with 20-inch image height, diagonal = height ÷ 0.49 ≈ 40.8 inches, rounded to 41. This is a smaller commercial display size, potentially suitable for huddle rooms or personal workstations.

90. A — 28 V. $V = \sqrt{(P \times R)} = \sqrt{(50 \times 16)} = \sqrt{800} \approx 28.3$ V. Higher-impedance loads produce higher voltages for the same power — consistent with the inverse relationship between impedance and current at a given power level.

91. C — 28 V. $V = \sqrt{(100 \times 8)} = \sqrt{800} \approx 28.3$ V. Notice this produces the same voltage as Q90 because $50W \times 16\Omega = 100W \times 8\Omega = 800$. Multiple combinations of power and impedance can produce the same voltage.

92. B — 140 watts. Applying $P = V \times I = 70 \times 2 = 140$ watts. Basic Ohm's law applied to the 70V distribution line. This calculation helps verify that the total loudspeaker tap loading matches amplifier output capability.

93. D — 0.49 seconds. Sabine's equation: $RT60 = 0.049 \times 20{,}000 / 2{,}000 = 0.49$ seconds. Consistent with the V/A ratio of 10:1 producing 0.49-second RT60 across all these room sizes — the ratio, not absolute values, drives reverberation time.

94. A — 16 inches. For a 16:9 display with 32-inch diagonal, height = 32 × 0.49 ≈ 15.7 inches, rounded to 16. This is a small commercial display size, potentially used for digital signage, monitoring, or personal workstation applications.

95. C — 48 inches. For a 16:9 display, width = height × (16/9) = 27 × 1.778 ≈ 48 inches. Reverse calculation from height to width using the inverse 16:9 ratio. The 1.778 (which is 16 ÷ 9) multiplier converts height to width.

96. B — 20 feet. A 90° conical coverage pattern (45° half-angle) at 10 feet distance: diameter = $2 \times 10 \times \tan(45°) = 2 \times 10 \times 1 = 20$ feet. For 90° coverage, the coverage diameter equals twice the distance — a useful quick-reference rule.

97. A — 192 inches (16 feet). The 4H rule: $4 \times 48 = 192$ inches, which equals 16 feet. This defines the maximum distance where ADM content remains resolvable for a 48-inch image height. Converting between inches and feet helps visualize the spatial requirements.

98. D — 18 feet. Throw distance = throw ratio × image width = 1.8 × 10 = 18 feet. A 1.8 throw ratio represents a medium-throw lens, suitable for typical conference rooms and classrooms where the projector is mounted at moderate distance from the screen.

99. C — 17,060 BTU/hr. Applying 5,000 × 3.412 = 17,060 BTU/hr. This is a substantial thermal load requiring significant cooling capacity — typical of large LED wall installations, auditorium amplification systems, or major broadcast equipment rooms.

100. B — 63 inches. For a 16:9 display with 72-inch diagonal, width = 72 × 0.87 ≈ 62.6 inches, rounded to 63. The 0.87 width-to-diagonal ratio continues to serve for rapid 16:9 display dimension conversions throughout design work.