

PRACTICE EXAM 7: CONSTRUCTION ELECTRICIAN SIMULATION (100 QUESTIONS)

1. A worker must enter a vault to service energized 600 V equipment that cannot be de-energized. According to safe work procedures, what is the FIRST step before approaching the equipment?

- A. Apply rubber gloves rated for 1000 V and proceed
- B. Notify the utility to disconnect the feeder
- C. Establish an arc flash boundary and confirm required PPE
- D. Open the nearest downstream breaker only

2. Before energizing a newly installed panelboard, an electrician performs an insulation resistance test. Which instrument is used?

- A. Megohmmeter
- B. Clamp-on ammeter
- C. Wattmeter
- D. Phase rotation meter

3. Two apprentices must lift a 40 kg cable reel onto a rack 1.5 m high. What is the safest method?

- A. One worker lifts while bending at the waist
- B. Drag the reel up a ramp by hand
- C. Each worker grips one side and twists to place it
- D. Use a mechanical lifting device or team lift with proper technique

4. A lockout procedure requires which sequence on a disconnect switch?

- A. Tag, lock, de-energize, then verify
- B. De-energize, lock, tag, then verify zero energy
- C. Verify, tag, de-energize, then lock
- D. Lock, verify, de-energize, then tag

5. When fabricating a 90° offset in EMT, the multiplier used for a 30° bend is:

- A. 2.0
- B. 2.6
- C. 1.4
- D. 1.2

6. During commissioning of a distribution system, which document confirms the installation matches the approved design?

- A. The manufacturer's warranty card
- B. The daily safety log
- C. The material purchase order
- D. The as-built drawings

7. An electrician mentoring an apprentice notices an unsafe practice. The best response is to:

- A. Report the apprentice to the inspector
- B. Stop the task and demonstrate the correct method
- C. Document it and address it at the next review
- D. Allow them to finish, then explain afterward

8. A safety data sheet (SDS) for a solvent is consulted primarily to determine:

- A. The unit cost of the product
- B. The expiry date of the container
- C. Hazards, handling and first-aid measures
- D. The supplier's shipping address

9. Which support spacing requirement applies when installing a horizontal run of rigid metal conduit?

- A. Supported within 1 m of each box and at intervals per Code
- B. Supported only at each termination
- C. Supported every 6 m regardless of fittings
- D. No support required if conduit is threaded

10. When decommissioning an electrical system, conductors removed from service must be:

- A. Left coiled in the ceiling for future use
- B. Re-energized to confirm they are dead
- C. Sold to a scrap dealer immediately
- D. Properly identified, isolated and made safe

11. When a design change to a circuit must be communicated to the entire crew, what is the most reliable method?

- A. Tell one worker and rely on word of mouth to spread it
- B. Update and distribute the revised drawing to the crew
- C. Make the change without notifying anyone
- D. Post a note only in the lunchroom

12. A single-phase 120/240 V service uses a 100 A meter base. The neutral conductor at the meter is:

- A. Bonded to the panel only

- B. Insulated from all metal parts
- C. The grounded conductor, bonded at the service
- D. Sized larger than the line conductors

13. A 3-phase 600 V feeder supplies a 75 kVA load. The approximate line current is:

- A. 72 A
- B. 125 A
- C. 104 A
- D. 208 A

14. A fuse marked "Class J, 60 A, 600 V" is selected primarily for its:

- A. Low cost compared to Class H
- B. Ability to be reset after operation
- C. Larger physical size for easy handling
- D. Current-limiting characteristics

15. Surge protective devices (SPDs) installed at a service entrance are intended to:

- A. Increase the available fault current
- B. Divert transient overvoltages to ground
- C. Correct the power factor of the load
- D. Step down the incoming voltage

16. When a UPS is in "double-conversion" online mode, the load is:

- A. Fed directly from utility power until failure

- B. Fed only when the battery is fully charged
- C. Continuously fed through the inverter
- D. Disconnected during normal operation

17. A grounding electrode conductor connects the service neutral to the:

- A. Nearest receptacle ground
- B. Largest motor frame on site
- C. Main breaker handle
- D. Grounding electrode system

18. A current transformer (CT) used in metering must never have its secondary:

- A. Left open while the primary is energized
- B. Connected to a low-burden meter
- C. Grounded at one point
- D. Wired in series with the ammeter

19. A photovoltaic array's rapid shutdown system is required to:

- A. Increase string voltage during a fault
- B. Reduce conductor voltage to a safe level quickly
- C. Disconnect only the inverter cooling fan
- D. Maintain full output for emergency loads

20. A delta-wye transformer is commonly used to:

- A. Eliminate the need for overcurrent protection

- B. Reduce primary current to zero at no load
- C. Provide a neutral on the secondary
- D. Convert AC to DC for battery charging

21. A neutral grounding resistor (NGR) in a 3-phase system limits:

- A. Ground-fault current to a controlled value
- B. Phase-to-phase voltage during startup
- C. The transformer turns ratio
- D. Motor starting torque

22. High-voltage cable terminations require stress cones primarily to:

- A. Increase the cable ampacity
- B. Provide a colour-coded identification
- C. Allow easier pulling through conduit
- D. Control electrical stress at the termination

23. A 240 V battery bank for a UPS shows one cell reading significantly lower than the others. This indicates:

- A. The charger is oversized
- B. A weak or failing cell
- C. Normal float operation
- D. Excessive ambient cooling

24. When sizing a transformer secondary conductor, the primary consideration is the:

- A. Length of the primary feeder

- B. Colour of the conductor insulation
- C. Secondary full-load current
- D. Number of primary windings

25. Ground-fault protection of equipment (GFP) on a service operates when:

- A. Current returns through an unintended ground path
- B. The load power factor drops below 0.8
- C. The neutral current equals the line current
- D. Voltage rises above nominal by 5%

26. A standby generator's automatic transfer switch (ATS) must:

- A. Permit both sources to feed the load simultaneously
- B. Connect the generator before utility power fails
- C. Energize the neutral to both sources at once
- D. Prevent the utility and generator from being paralleled unintentionally

27. The purpose of bonding in an electrical installation is to:

- A. Increase circuit impedance
- B. Reduce the conductor ampacity
- C. Keep non-current-carrying metal parts at the same potential
- D. Replace the need for overcurrent devices

28. A wye-connected secondary at 120/208 V provides a line-to-neutral voltage of:

- A. 240 V

- B. 120 V
- C. 208 V
- D. 347 V

29. When testing a transformer for correct polarity, additive polarity is indicated when:

- A. The voltage across outer terminals is the sum of the windings
- B. The secondary voltage reads zero
- C. The primary current exceeds rated current
- D. The core temperature rises rapidly

30. A surge suppression system's let-through voltage rating describes:

- A. The maximum continuous operating voltage
- B. The current the device can carry indefinitely
- C. The physical size of the device
- D. The clamping voltage during a surge event

31. In a solar storage system, the battery management system (BMS) primarily protects against:

- A. Low ambient humidity
- B. Over-charge and over-discharge conditions
- C. Excessive inverter efficiency
- D. Reverse phase rotation

32. A metering installation requires the demand register to record:

- A. Instantaneous voltage only

- B. Total harmonic distortion
- C. Peak power usage over an interval
- D. Power factor correction capacitor size

33. Power conditioning equipment is installed ahead of sensitive electronics to:

- A. Provide clean, stable voltage to the load
- B. Increase the harmonic content
- C. Reduce the service entrance rating
- D. Bypass the grounding system

34. When connecting a high-voltage system, minimum approach distances are determined by the:

- A. Conductor colour code
- B. Time of day of the work
- C. Number of workers present
- D. System voltage and worker qualification

35. A 25 kVA single-phase transformer with a 240 V secondary delivers a rated secondary current of approximately:

- A. 60 A
- B. 208 A
- C. 104 A
- D. 75 A

36. Protection devices selected for a feeder must have an interrupting rating that is:

- A. Lower than the available fault current

- B. Equal to or greater than the available fault current
- C. Equal to the load current only
- D. Independent of fault current entirely

37. A generating system's synchronizing equipment matches the generator to the bus by aligning:

- A. Voltage, frequency and phase
- B. Conductor size and colour
- C. Ambient temperature and humidity
- D. Load power factor and current only

38. Surge suppression at sub-panels supplements the main SPD because:

- A. It eliminates the need for grounding
- B. It raises the system voltage downstream
- C. It corrects the load power factor
- D. It provides localized protection closer to equipment

39. A service-entrance conductor's ampacity must be coordinated with the:

- A. Colour of the meter base
- B. Length of the grounding electrode
- C. Calculated load and overcurrent protection
- D. Number of receptacles on the branch circuits

40. The maximum fill for a conduit containing more than two conductors is generally limited to:

- A. 53% of the cross-sectional area

- B. 40% of the cross-sectional area
- C. 60% of the cross-sectional area
- D. 31% of the cross-sectional area

41. A junction box must remain accessible after installation primarily to allow:

- A. Better appearance of the finished wall
- B. Reduced material cost
- C. Faster initial installation
- D. Future inspection and maintenance of splices

42. When derating conductors for ambient temperature, the correction factor is applied to the:

- A. Conductor length
- B. Conductor ampacity
- C. Overcurrent device rating only
- D. Box fill calculation

43. A 15 A general-purpose branch circuit using No. 14 AWG copper supplies receptacles. The maximum continuous load should not exceed:

- A. 12 A
- B. 15 A
- C. 18 A
- D. 20 A

44. Tamper-resistant receptacles are required in dwelling units primarily to:

- A. Improve receptacle appearance

- B. Increase the available current
- C. Prevent insertion of foreign objects by children
- D. Reduce the cost of installation

45. When installing electric baseboard heating, the thermostat must be rated for the:

- A. Colour of the wall finish
- B. Length of the supply feeder only
- C. Number of windows in the room
- D. Load current and voltage of the heater

46. Exit and emergency lighting must remain illuminated during a power failure for a minimum duration determined by the:

- A. Manufacturer's paint colour
- B. Applicable building/electrical code
- C. Number of occupants present
- D. Outdoor temperature

47. A cable installed through a stud must be protected from nails by:

- A. A steel plate or sufficient setback from the edge
- B. Painting the cable a bright colour
- C. Increasing the conductor size
- D. Adding a second cable beside it

48. HVAC equipment requiring a disconnecting means must have it located:

- A. In a remote electrical room only

- B. Inside the sealed compressor housing
- C. Within sight of and readily accessible to the equipment
- D. At the main service panel exclusively

49. The minimum bending radius of a cable is specified to:

- A. Reduce installation labour
- B. Match the conduit colour
- C. Increase the conductor count
- D. Prevent damage to the conductor insulation

50. A box containing three No. 12 AWG conductors, one device, and equipment bonding conductors requires box-fill calculation that counts the device as:

- A. Two conductor volumes
- B. One conductor volume
- C. Zero conductor volume
- D. Four conductor volumes

51. Cathodic protection systems are installed to:

- A. Increase the structure's electrical load
- B. Provide emergency lighting
- C. Prevent corrosion of metallic structures
- D. Step up the supply voltage

52. When installing PVC conduit in a cold environment, expansion fittings are used to accommodate:

- A. Increased conductor ampacity

- B. Thermal expansion and contraction
- C. Higher fault current
- D. Improved appearance

53. A dedicated branch circuit for a fixed appliance is required when the appliance:

- A. Is painted a dark colour
- B. Has a cord shorter than 1 m
- C. Is located near a window
- D. Draws a significant continuous load per Code

54. Electric heating cable embedded in a floor must not be installed under:

- A. Permanent fixtures or cabinets
- B. Any tile surface
- C. Insulated subfloors
- D. Standard floor finishes

55. When two conductors are spliced in a box, the connector used must be:

- A. Any available wire nut regardless of size
- B. Soldered without a connector
- C. Rated for the conductor size and material
- D. Wrapped only with electrical tape

56. Emergency lighting unit batteries should be tested:

- A. Only at the time of installation

- B. Periodically per code and manufacturer requirements
- C. Never, since they are sealed
- D. Only when the building is occupied

57. A raceway entering an enclosure in a wet location requires fittings that are:

- A. Painted to match the wall
- B. Made of plastic only
- C. Larger than the conduit diameter
- D. Rated for wet-location use

58. The grounding (bonding) conductor in a branch circuit is sized based on the:

- A. Rating of the overcurrent device protecting the circuit
- B. Colour of the conductor insulation
- C. Length of the circuit only
- D. Number of devices on the circuit

59. When installing recessed luminaires in insulated ceilings, the fixture must be rated:

- A. For outdoor use only
- B. As a sealed pendant
- C. IC (insulation contact)
- D. For high-voltage service

60. Conductors of different systems (e.g., line voltage and low-voltage signalling) in the same raceway must be:

- A. Always combined to save space

- B. Twisted together for strength
- C. The same colour
- D. Separated or insulated per Code requirements

61. A branch circuit serving a bathroom receptacle in a dwelling must be protected by:

- A. A standard thermal breaker only
- B. A GFCI device
- C. A time-delay fuse only
- D. No special protection

62. When pulling conductors into a conduit, lubricant is used to:

- A. Increase the conductor ampacity
- B. Improve the insulation rating
- C. Reduce friction and prevent insulation damage
- D. Change the conductor colour

63. An AFCI device on a bedroom circuit is designed to detect:

- A. Dangerous arcing faults in the wiring
- B. Low power factor at the panel
- C. Overvoltage from the utility
- D. Reverse phase rotation

64. The ampacity of a conductor is reduced when:

- A. The circuit length is shortened

- B. The voltage is increased
- C. The conductor colour changes
- D. Several current-carrying conductors share a raceway

65. Where a cable passes through a fire-rated wall, the penetration must be:

- A. Left open for ventilation
- B. Firestopped to maintain the rating
- C. Enlarged to ease future pulls
- D. Painted with conductive paint

66. A 240 V single-phase electric heater rated 4000 W draws a current of approximately:

- A. 10 A
- B. 12 A
- C. 16.7 A
- D. 24 A

67. Outlet boxes mounted in finished masonry must be:

- A. Securely supported and flush or recessed as permitted
- B. Left protruding 50 mm from the surface
- C. Filled with insulation before wiring
- D. Wired before being secured

68. When installing raceway in a concrete slab, the conduit must be:

- A. Left loose to move during the pour

- B. Coated with grease for removal later
- C. Painted bright orange for visibility only
- D. Properly secured and protected during the pour

69. Exit signs in a commercial building are typically connected to:

- A. The largest motor circuit
- B. An unprotected branch circuit
- C. An emergency or normal supply with battery backup
- D. The HVAC control transformer

70. A magnetic motor starter's holding (seal-in) contact is used to:

- A. Reverse the motor rotation
- B. Maintain the coil circuit after the start button is released
- C. Provide overload protection
- D. Step down the control voltage

71. Overload relays in a motor starter protect the motor against:

- A. Short-circuit faults only
- B. Overvoltage transients
- C. Reverse phase sequence only
- D. Sustained excessive current (overheating)

72. A variable frequency drive (VFD) controls motor speed by varying the:

- A. Frequency and voltage supplied to the motor

- B. Number of motor poles physically
- C. Conductor colour to the motor
- D. Mechanical load only

73. The full-load current of a 10 hp, 600 V, 3-phase motor is approximately (using nameplate/Code tables):

- A. 28 A
- B. 14 A
- C. 11 A
- D. 9 A

74. A three-phase induction motor that runs in the wrong direction can be corrected by:

- A. Reversing the supply voltage polarity
- B. Interchanging any two of the three line conductors
- C. Increasing the supply frequency
- D. Replacing the overload relay

75. When a PLC input module receives a signal from a limit switch, the module:

- A. Drives the motor directly
- B. Steps up the control voltage
- C. Generates AC power for the load
- D. Converts the field signal for the processor

76. Reduced-voltage starting of a large motor is used primarily to:

- A. Limit inrush current and mechanical stress at start

- B. Increase the running speed
- C. Eliminate the overload relay
- D. Reverse rotation automatically

77. A motor control centre (MCC) bucket typically contains:

- A. Only terminal blocks
- B. The building service transformer
- C. A combination starter with disconnect and overloads
- D. The emergency lighting battery

78. The slip of an induction motor is the difference between:

- A. Line voltage and phase voltage
- B. Synchronous speed and rotor speed
- C. Starting and running torque
- D. Primary and secondary current

79. A control transformer in a starter circuit is used to:

- A. Increase the motor's horsepower
- B. Provide overload protection
- C. Correct the system power factor
- D. Supply a lower control voltage to the coil

80. When troubleshooting a motor that hums but will not start, a likely cause is:

- A. A loss of one phase (single-phasing)

- B. An oversized control transformer
- C. Excessive ambient cooling
- D. A correctly sized overload relay

81. A normally open (NO) held-closed contact on a pressure switch will:

- A. Open when the set pressure is reached
- B. Remain open permanently
- C. Reverse the motor rotation
- D. Provide short-circuit protection

82. A soft starter differs from a VFD in that the soft starter primarily controls:

- A. The motor frequency continuously while running
- B. The number of poles
- C. The load torque mechanically
- D. The starting voltage ramp only

83. When commissioning an automated control system, the electrician verifies that the program logic:

- A. Matches the conductor colour scheme
- B. Increases the supply voltage
- C. Performs the sequence per the design specification
- D. Eliminates the need for overload protection

84. Motor branch-circuit conductors are typically sized at a minimum of:

- A. 100% of the motor full-load current

- B. 125% of the motor full-load current
- C. 80% of the motor full-load current
- D. 250% of the motor full-load current

85. A jogging (inching) control circuit allows the operator to:

- A. Run the motor in short bursts without sealing in
- B. Permanently lock the motor running
- C. Reverse the supply phase rotation
- D. Bypass all overload protection

86. A drive's regenerative braking returns energy to the:

- A. Motor shaft as heat only
- B. Overload relay
- C. Control transformer
- D. Supply or a resistor bank

87. A thermistor embedded in a motor winding provides:

- A. Speed feedback to the drive
- B. Direct temperature protection of the winding
- C. Power factor correction
- D. Phase rotation indication

88. In a reversing starter, mechanical and electrical interlocks are used to:

- A. Increase the starting torque

- B. Reduce the control voltage
- C. Prevent both contactors from closing simultaneously
- D. Eliminate the overload relays

89. A PLC output relay energizing a contactor coil must be rated for the:

- A. Coil's voltage and current draw
- B. Motor's full horsepower directly
- C. Conductor's colour
- D. Supply transformer's kVA

90. When a motor's measured running current exceeds nameplate FLA, the electrician should first check for:

- A. The colour of the supply conductors
- B. An undersized control transformer
- C. The number of PLC inputs
- D. Mechanical overload or supply voltage problems

91. A fire alarm initiating device circuit (IDC) is monitored for integrity using:

- A. A power factor meter
- B. A phase rotation tester
- C. An end-of-line resistor
- D. A grounding electrode

92. Category-rated structured cabling for data must observe a maximum horizontal run length of approximately:

- A. 50 m

- B. 90 m
- C. 150 m
- D. 305 m

93. When terminating twisted-pair data cable, the amount of untwist at the connector should be:

- A. Kept to a minimum to preserve performance
- B. Maximized for easier termination
- C. Irrelevant to performance
- D. At least 50 mm per pair

94. A passive infrared (PIR) sensor in a security system detects:

- A. Changes in line voltage
- B. Power factor variations
- C. Audio frequency only
- D. Changes in infrared (heat) signatures from movement

95. An integrated control system (e.g., building automation) communicates between devices using:

- A. The grounding electrode conductor
- B. A defined communication protocol/network
- C. Line-voltage power conductors only
- D. The neutral conductor exclusively

96. Coaxial cable used for CATV must maintain a consistent characteristic impedance to:

- A. Increase the supply voltage

- B. Reduce installation cost
- C. Minimize signal reflection and loss
- D. Eliminate the need for grounding

97. A nurse-call or signalling system's audible/visible annunciator is intended to:

- A. Correct the system power factor
- B. Provide overcurrent protection
- C. Step down the supply voltage
- D. Alert staff to a call or alarm condition

98. Low-voltage signalling conductors run alongside power conductors should be:

- A. Separated to avoid electromagnetic interference
- B. Bundled tightly with the power conductors
- C. Connected to the same overcurrent device
- D. Spliced into the line voltage circuit

99. A fibre-optic communication link transmits data using:

- A. Modulated 120 V AC signals
- B. Pulses of light through a glass/plastic core
- C. The building grounding system
- D. Magnetic induction along the conduit

100. When commissioning a fire alarm system, the electrician must verify that activating an initiating device:

- A. Increases the building supply voltage

- B. Disconnects the grounding electrode
- C. Produces the correct signal at the annunciator panel
- D. Reverses the phase rotation of the supply

Practice Exam 7: Answer Key and Explanations

1. C — Energized work inside a vault requires arc flash hazard assessment before approach. Establishing the arc flash boundary and confirming the correct PPE protects against incident energy if a fault occurs. De-energizing isn't possible here, so controlling the arc flash risk is the first safety step.
2. A — A megohmmeter applies a high DC voltage to measure insulation resistance in megohms. It verifies that conductor insulation is intact before energizing, detecting moisture or damage that an ammeter or wattmeter cannot. This prevents faults and ground leakage on the new panelboard.
3. D — A 40 kg load lifted to 1.5 m exceeds safe single-person limits and invites musculoskeletal injury. A mechanical aid or a coordinated team lift with proper body mechanics distributes the load and keeps the spine neutral. This is the controlling principle of safe manual material handling.
4. B — Lockout requires de-energizing first, then applying the lock and tag, and finally verifying zero energy by testing. Verification confirms the isolation actually worked before any contact with the circuit. Skipping or reordering these steps is a leading cause of electrocution.
5. A — The multiplier for a 30° bend is 2.0 ($1 \div \sin 30^\circ = 1 \div 0.5$). Multiplying the offset depth by 2.0 gives the distance between bend marks. Knowing standard offset multipliers lets an electrician fabricate accurate raceway offsets without trial and error.
6. D — As-built drawings record the installation exactly as constructed, including field changes. Comparing them to the approved design during commissioning confirms the system was built correctly and documents deviations. This is essential for verification, maintenance, and future modifications.
7. B — An unsafe practice is an immediate hazard, so the task is stopped and the correct method demonstrated on the spot. Stopping work prevents injury, and hands-on demonstration reinforces the right technique while the situation is fresh. Delaying correction leaves the apprentice exposed to risk.

8. C — A safety data sheet provides hazard identification, safe handling, storage, and first-aid measures for a product. Consulting it lets a worker control exposure and respond to spills or contact. This is the core purpose of WHMIS-required SDS documentation.

9. A — Rigid metal conduit must be supported within a short distance of each box or fitting and at regular intervals per Code. This prevents strain on connections and sagging that could damage conductors. Proper support maintains the mechanical and electrical integrity of the raceway.

10. D — Decommissioned conductors must be identified, isolated, and made safe so they cannot be inadvertently energized or mistaken for live circuits. Leaving abandoned wiring energized or unmarked creates a serious shock and confusion hazard. Safe isolation is the controlling requirement when removing systems from service.

11. B — Distributing the revised drawing puts the change into a single authoritative source every crew member can reference. Word-of-mouth, an unposted change, or a single lunchroom note all allow errors and omissions to propagate. Controlled documentation is the reliable way to communicate design changes and prevent costly rework.

12. C — In a 120/240 V service the neutral is the grounded conductor and is bonded to ground at the service. This establishes the reference point and provides a return path for line-to-neutral loads and fault current. Proper bonding at the service is fundamental to system grounding.

13. A — $I = VA \div (E \times \sqrt{3}) = 75,000 \div (600 \times 1.73) = 75,000 \div 1038 \approx 72 \text{ A}$. The $\sqrt{3}$ factor accounts for the three-phase relationship between line and phase quantities. Correct current calculation drives conductor and overcurrent device sizing.

14. D — Class J fuses are current-limiting, meaning they open very quickly and restrict the peak let-through current during a fault. This reduces thermal and magnetic stress on downstream equipment. Current limitation, not size or cost, is the defining selection feature.

15. B — A surge protective device clamps and diverts transient overvoltages safely to ground. This protects connected equipment from lightning- and switching-induced surges. SPDs do not change power factor or service voltage; their function is transient diversion.

16. C — In double-conversion online mode the load is continuously supplied through the inverter, fully isolating it from utility disturbances. The rectifier charges the battery and feeds the inverter at all times, so there is no transfer delay on utility loss. This provides the highest level of power quality protection.

17. D — The grounding electrode conductor bonds the service neutral to the grounding electrode system (such as ground rods or a concrete-encased electrode). This connects the system to earth and stabilizes voltage to ground. It is the link between the electrical system and the planet itself.

18. A — A CT secondary must never be left open while the primary is energized because dangerously high voltage develops across the open terminals. The secondary must be shorted or connected to a burden before opening any meter. This protects both personnel and the CT insulation.

19. B — Rapid shutdown reduces PV conductor voltage to a safe level within a defined time after initiation. This protects firefighters and responders working around an array during an emergency. It addresses the unique hazard that PV modules produce voltage whenever exposed to light.

20. C — A delta-wye transformer creates a neutral on the wye secondary, allowing line-to-neutral loads and a grounding reference. This is why it is widely used to derive 120/208 V from a delta supply. The configuration provides both phase-to-phase and phase-to-neutral voltages.

21. A — A neutral grounding resistor limits ground-fault current to a controlled value rather than letting it rise to full bolted-fault levels. This reduces equipment damage and arc flash energy while still allowing fault detection. It is a key strategy in resistance-grounded industrial systems.

22. D — Stress cones relieve and distribute the concentrated electrical field at a high-voltage cable termination where the shield ends. Without stress control the field intensifies and degrades the insulation, leading to failure. They are essential for reliable HV terminations.

23. B — One cell reading significantly below the others indicates a weak or failing cell within the bank. A failing cell reduces overall capacity and can compromise the UPS during a transfer. Identifying and replacing it preserves backup runtime and reliability.

24. C — Transformer secondary conductors are sized to carry the secondary full-load current safely. This current is set by the transformer kVA and secondary voltage, not by primary length or insulation colour. Correct sizing prevents overheating under rated load.

25. A — Ground-fault protection of equipment operates when current returns through an unintended ground path rather than the normal conductors. Detecting this imbalance trips the device before the fault escalates. GFP limits damage from arcing line-to-ground faults on solidly grounded systems.

26. D — An automatic transfer switch must prevent the utility and generator from being inadvertently paralleled, which would create dangerous back-feed and out-of-phase connection. The ATS transfers the load to one source at a time. This isolation protects utility workers and equipment.

27. C — Bonding ties non-current-carrying metal parts together so they remain at the same electrical potential. This ensures fault current returns to trip the overcurrent device and prevents dangerous touch voltages. Equal potential is the protective purpose of bonding.

28. B — In a 120/208 V wye system the line-to-neutral voltage is 120 V and the line-to-line voltage is 208 V ($120 \times \sqrt{3}$). The neutral allows single-phase 120 V loads. Understanding this relationship is essential for load connection and balancing.

29. A — Additive polarity is confirmed when the voltage measured across the outer terminals equals the sum of the two winding voltages. This indicates the windings aid each other and identifies terminal orientation. Polarity must be known before paralleling transformers.

30. D — Let-through (clamping) voltage is the voltage the SPD allows to pass to the load during a surge event. A lower let-through value means better protection for downstream equipment. It characterizes performance during the surge, not continuous operation.

31. B — A battery management system protects cells against over-charge and over-discharge, balancing them and monitoring temperature. This prevents thermal runaway and prolongs battery life in a storage system. It is essential for safe lithium-based PV storage.

32. C — A demand register records peak power usage averaged over a defined interval. Utilities use this to bill demand charges that reflect the customer's maximum load on the system. It captures more than simple instantaneous voltage or energy.

33. A — Power conditioning equipment delivers clean, stable voltage by filtering noise, sags, and transients before they reach sensitive electronics. This protects equipment from malfunction and data loss. Stabilizing power quality is its sole purpose.

34. D — Minimum approach distances for high-voltage work are determined by the system voltage and the worker's qualification level. Higher voltages require greater clearances to prevent flashover. These distances are a core electrical safety control around HV equipment.

35. C — $I = VA \div E = 25,000 \div 240 \approx 104$ A. For a single-phase transformer the secondary current equals the kVA divided by the secondary voltage. This determines the secondary conductor and overcurrent device sizing.

36. B — A protective device's interrupting rating must equal or exceed the available fault current at its location. If it is lower, the device can fail violently while trying to clear a fault. Adequate interrupting rating is a fundamental safety requirement.

37. A — Synchronizing equipment aligns the generator's voltage, frequency, and phase with the bus before closing the breaker. Connecting out of sync causes severe mechanical and electrical shock to the machine. Matching all three parameters allows smooth paralleling.

38. D — Sub-panel SPDs provide localized protection closer to sensitive equipment, catching surges that develop or remain downstream of the main device. A layered (cascaded) approach improves overall protection. It supplements rather than replaces the service SPD.

39. C — Service-entrance conductor ampacity must be coordinated with the calculated load and the overcurrent protection. The conductors must safely carry the load and be protected by an appropriately rated device. This coordination prevents overheating and ensures Code compliance.

40. B — Conduit with more than two conductors is generally limited to 40% fill of its cross-sectional area. This allows heat dissipation and permits the conductors to be pulled without damage. The 40% limit is the standard maximum for typical raceway installations.

41. D — Junction boxes must remain accessible so splices can be inspected and maintained over the life of the installation. Burying connections in inaccessible locations violates Code and prevents servicing. Accessibility protects against undetected loose or failing splices.

42. B — Ambient temperature correction factors are applied to conductor ampacity, reducing the allowable current as temperature rises. Higher heat reduces a conductor's ability to dissipate its own losses. Applying the correction prevents insulation damage from overheating.

43. A — A continuous load on a 15 A circuit is limited to 80% of the rating, or 12 A. The 80% rule provides a thermal margin because continuous loads heat the conductors and devices for extended periods. This prevents nuisance tripping and overheating.

44. C — Tamper-resistant receptacles use internal shutters that block insertion of a single foreign object, protecting children from shock. Both blades must be inserted simultaneously for the shutters to open. Child safety is the reason they are mandated in dwellings.

45. D — A heating thermostat must be rated for the load current and voltage of the heater it controls. An undersized thermostat will overheat and fail at its contacts. Matching the rating ensures safe, reliable switching of the heating load.

46. B — Emergency and exit lighting must remain illuminated for a minimum duration set by the applicable building and electrical code. This ensures occupants can evacuate safely during a power failure. Code, not the manufacturer or occupancy, governs the required runtime.

47. A — A cable through a stud is protected from nails by a steel plate or by maintaining sufficient setback from the framing edge. This prevents fasteners from piercing the conductor and creating a shock or fire hazard. Mechanical protection of concealed cable is a Code requirement.

48. C — A disconnecting means for HVAC equipment must be within sight of and readily accessible to the equipment. This lets a technician safely isolate power before servicing without leaving the work area. Line-of-sight disconnection is a key maintenance safety provision.

49. D — The minimum bending radius prevents kinking that would damage conductor insulation and the conductor itself. Bending too tightly can crack insulation or deform strands, leading to faults. Respecting the radius preserves the cable's integrity and rating.

50. A — In box-fill calculations each yoke or device (such as a receptacle or switch) counts as two conductor volumes based on the largest conductor connected to it. This accounts for the space the device occupies. Proper counting ensures the box is not overfilled.

51. C — Cathodic protection prevents corrosion of buried or submerged metallic structures by making them the cathode of an electrochemical cell. This is achieved with sacrificial anodes or impressed current. It protects pipelines, tanks, and similar structures from deterioration.

52. B — PVC conduit expands and contracts substantially with temperature, so expansion fittings absorb that movement. Without them the conduit can buckle, pull apart at joints, or stress boxes. Expansion fittings preserve raceway integrity in cold climates.

53. D — A fixed appliance with a significant continuous load requires a dedicated branch circuit per Code. Sharing the circuit would risk overloading and nuisance tripping. A dedicated circuit ensures the appliance has adequate, protected capacity.

54. A — Floor heating cable must not be installed under permanent fixtures or cabinets where trapped heat cannot dissipate. Covering the cable causes localized overheating and possible insulation failure. Keeping it clear of obstructions ensures safe heat distribution.

55. C — A splice connector must be rated for the size and material (copper or aluminum) of the conductors being joined. An improperly rated or taped-only connection overheats and loosens over time. A correctly rated connector ensures a reliable, code-compliant splice.

56. B — Emergency lighting batteries must be tested periodically per code and manufacturer requirements to confirm they will perform during an outage. Batteries degrade silently, so scheduled testing verifies capacity. Regular testing is essential to life-safety reliability.

57. D — Fittings entering an enclosure in a wet location must be rated for wet-location use to keep moisture out. Standard indoor fittings allow water ingress that causes corrosion and faults. Proper wet-rated fittings maintain the enclosure's protection.

58. A — The branch-circuit bonding (grounding) conductor is sized based on the rating of the overcurrent device protecting the circuit. A larger breaker requires a larger bonding conductor to safely carry fault current. This ensures the fault path can trip the device.

59. C — Recessed luminaires in insulated ceilings must be IC (insulation contact) rated so insulation can touch the fixture without creating a fire hazard. Non-IC fixtures trap heat and can ignite surrounding material. The IC rating is a fire-safety requirement.

60. D — Conductors of different systems sharing a raceway must be separated or insulated as required by Code. This prevents interference and the dangerous coupling of line voltage into low-voltage signalling. Proper segregation protects both signal integrity and safety.

61. B — A dwelling-unit bathroom receptacle must be protected by a GFCI to guard against shock in this wet location. The GFCI trips on small ground-fault currents before they become lethal. This is a core personnel-protection requirement near water.

62. C — Pulling lubricant reduces friction between conductors and the conduit wall during installation. This prevents insulation abrasion and lets conductors be pulled with less tension. Reduced friction protects the wire and eases long or complex pulls.

63. A — An arc-fault circuit interrupter detects the unique current signature of dangerous arcing faults in wiring and devices. It interrupts the circuit before the arc can ignite surrounding materials. AFCIs reduce the risk of electrical fires in bedrooms and similar areas.

64. D — Conductor ampacity is reduced when several current-carrying conductors share a raceway because mutual heating limits cooling. Code requires derating in proportion to the number of conductors. Ignoring this leads to overheating and insulation damage.

65. B — A cable penetration through a fire-rated wall must be firestopped to maintain the wall's fire rating. Approved firestop seals the opening against the passage of flame and smoke. This preserves the building's compartmentalization and life safety.

66. C — $I = P \div E = 4000 \div 240 \approx 16.7$ A. A purely resistive heater's current equals its wattage divided by its voltage. This determines the conductor and breaker sizing for the heating circuit.

67. A — Outlet boxes in finished masonry must be securely supported and set flush or recessed as permitted so devices mount properly and combustible gaps are avoided. A protruding or loose box stresses connections and creates hazards. Secure, proper mounting is a Code requirement.

68. D — Conduit cast in a concrete slab must be properly secured and protected during the pour so it does not shift, crush, or fill with concrete. Movement during the pour ruins alignment and can block the raceway. Securing it ensures a usable, intact pathway.

69. C — Exit signs are connected to an emergency or normal supply with battery backup so they remain illuminated if normal power fails. This guarantees occupants can find egress during an outage. Reliable backup power is the defining requirement for exit signage.

70. B — The holding (seal-in) contact maintains the coil circuit after the momentary start button is released. This keeps the contactor energized so the motor continues to run until a stop command opens the circuit. It is the basis of standard three-wire control.

71. D — Overload relays protect a motor from sustained excessive current that causes overheating, such as from mechanical overload. They allow brief starting inrush but trip on prolonged overcurrent. This thermal protection prevents winding insulation damage.

72. A — A VFD controls motor speed by varying both the frequency and voltage supplied to the motor. Changing frequency changes synchronous speed, while voltage is adjusted to maintain proper flux. This provides smooth, efficient speed control.

73. C — A 10 hp, 600 V, 3-phase motor has a full-load current of about 11 A per Code motor tables. These tabulated values, not raw calculation, govern motor circuit sizing. Using the table ensures conductors and protection are correctly rated.

74. B — Reversing any two of the three line conductors reverses the rotation of a three-phase induction motor. This changes the phase sequence applied to the windings. It is the standard, simple method to correct direction of rotation.

75. D — A PLC input module converts a field device's signal (such as a limit switch closure) into a form the processor can read. It isolates and conditions the incoming signal for the logic program. This is how field conditions enter the control system.

76. A — Reduced-voltage starting limits the high inrush current and mechanical stress that occur when a large motor starts across the line. Lower starting current reduces voltage dip and protects the driven equipment. It extends equipment life and stabilizes the supply.

77. C — An MCC bucket typically houses a combination starter with a disconnect, overload relays, and short-circuit protection in one removable unit. This standardizes and centralizes motor control. The bucket design simplifies installation and maintenance.

78. B — Slip is the difference between the synchronous speed of the rotating field and the actual rotor speed. The rotor must lag the field to induce current and produce torque. Slip is fundamental to how an induction motor develops torque.

79. D — A control transformer supplies a lower control voltage (such as 120 V) to the contactor coil from a higher supply voltage. This provides safer, standardized control circuit voltage. It isolates and steps down power for the control components.

80. A — A motor that hums but will not start often indicates the loss of one phase (single-phasing), leaving insufficient torque to rotate. The motor draws high current and can overheat quickly. Single-phasing is a classic cause and must be cleared before restarting.

81. A — A held-closed normally open contact on a pressure switch will open when the set pressure is reached. The switch responds to the process variable to control the connected circuit. This is how pressure switches provide automatic control or protection.

82. D — A soft starter primarily controls the starting voltage ramp, gradually increasing voltage to limit inrush during start. Unlike a VFD, it does not vary frequency for continuous speed control. Its role is smooth starting, then it runs the motor at line conditions.

83. C — During commissioning the electrician verifies the program logic performs the operating sequence exactly as the design specification requires. Testing the logic confirms inputs and outputs behave correctly before live operation. This prevents unsafe or incorrect machine behaviour.

84. B — Motor branch-circuit conductors are sized at a minimum of 125% of the motor full-load current. The extra margin accounts for continuous operation and heating. This sizing prevents conductor overheating during normal running.

85. A — A jogging (inching) circuit lets the operator run the motor in short bursts without the seal-in contact latching it on. Releasing the jog button immediately stops the motor. This allows precise positioning of driven equipment.

86. D — Regenerative braking returns the motor's kinetic energy to the supply or dissipates it in a resistor (dynamic braking) bank. This provides controlled, rapid deceleration. It manages the energy a decelerating motor generates as a temporary generator.

87. B — A thermistor embedded in a motor winding provides direct temperature protection by changing resistance sharply at a threshold. The control system trips the motor before the winding overheats. This protects insulation more directly than current-sensing alone.

88. C — Mechanical and electrical interlocks in a reversing starter prevent both the forward and reverse contactors from closing at the same time. Simultaneous closure would create a phase-to-phase short across the line. Interlocking is an essential safety feature.

89. A — A PLC output relay driving a contactor coil must be rated for the coil's voltage and current draw. Undersizing the output causes contact damage and unreliable operation. Matching the rating ensures the output can safely switch the coil load.

90. D — When running current exceeds nameplate FLA, the electrician first checks for mechanical overload or supply voltage problems such as low or unbalanced voltage. Both cause the motor to draw excess current. Identifying the root cause prevents overheating and trips.

91. C — A fire alarm initiating device circuit is supervised using an end-of-line resistor that maintains a small monitored current. A break in the wiring changes that current and signals a trouble condition. This integrity monitoring is essential to life-safety reliability.

92. B — Category-rated structured cabling limits a horizontal run to approximately 90 m, with the remaining length budget reserved for patch cords. Exceeding this degrades signal performance. The 90 m channel limit is a fundamental structured-cabling rule.

93. A — Untwisting of twisted-pair conductors at the termination must be kept to a minimum to preserve cancellation of interference. Excess untwist increases crosstalk and degrades high-frequency performance. Maintaining twist right to the connector ensures rated performance.

94. D — A passive infrared sensor detects changes in infrared (heat) signatures caused by a moving body. It reacts to the difference between a warm intruder and the background. This makes PIR sensors effective for motion-based security detection.

95. B — Integrated building control devices communicate over a defined communication protocol or network, not over the power conductors. The protocol standardizes how devices exchange data and commands. This interoperability is the basis of building automation systems.

96. C — Coaxial CATV cable must maintain consistent characteristic impedance to minimize signal reflection and loss along the run. Impedance mismatches cause reflections that degrade picture and data quality. Consistency preserves signal integrity end to end.

97. D — A signalling system's annunciator provides an audible and visible indication to alert staff to a call or alarm condition. It directs responders to the location or nature of the event. Clear annunciation is the core function of the signalling system.

98. A — Low-voltage signalling conductors should be separated from power conductors to avoid electromagnetic interference coupling into the signal. Induced noise corrupts data and control signals. Maintaining separation preserves signal quality and meets Code segregation rules.

99. B — A fibre-optic link transmits data as pulses of light through a glass or plastic core. Because it carries light, not current, it is immune to electromagnetic interference and offers high bandwidth over long distances. This makes fibre ideal for high-speed communication.

100. C — Commissioning a fire alarm system requires verifying that activating an initiating device produces the correct signal at the annunciator panel. This confirms the detection-to-notification path works end to end. Functional verification is essential before the system is relied upon for life safety.