

# **PRACTICE EXAM 6: CONSTRUCTION ELECTRICIAN SIMULATION (100 QUESTIONS)**

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1. A worker must enter a 1500 mm deep trench to install underground conduit in clay-type soil. Before entering, what is the minimum protective requirement the worker must verify is in place?

- A. A spotter is positioned at the trench edge to monitor the worker
- B. The trench walls have been sprayed with water to keep dust down
- C. The trench is sloped, shored, or supported by an approved protective system
- D. A warning sign is posted at least 3 m back from the trench opening

2. You are about to use a cordless hammer drill that has a frayed section on the battery charger cord, though the tool itself appears undamaged. What is the correct action?

- A. Remove the charger from service and tag it; the tool may still be used until its charge depletes
- B. Continue using the tool and charger since the drill body shows no damage
- C. Wrap the frayed section with electrical tape and resume charging immediately
- D. Use the charger only when no one else is in the immediate work area

3. When lifting a 25 kg box of conduit fittings from the floor to a workbench, which technique minimizes the risk of back injury?

- A. Bend at the waist with straight legs and pull the load upward quickly
- B. Twist the torso while lifting to swing the load onto the bench in one motion
- C. Hold the load away from the body to keep it clear of the legs
- D. Keep the back straight, bend the knees, and hold the load close to the body

4. A safety data sheet (SDS) for a solvent lists its flash point and recommended PPE. Under which section heading would first-aid measures be found?

- A. Section 2
- B. Section 4
- C. Section 8
- D. Section 14

5. During commissioning of a newly installed distribution panel, what is the FIRST step before energizing the equipment?

- A. Verify all connections are torqued to specification and no tools or debris remain
- B. Apply power and immediately measure phase-to-phase voltage at the main lugs
- C. Label each branch circuit breaker according to the panel schedule
- D. Notify the building occupants that power restoration is complete

6. A journeyman is mentoring an apprentice who repeatedly skips lockout steps to save time. What is the most appropriate response?

- A. Report the apprentice to the licensing authority for a safety violation
- B. Allow the practice to continue since the apprentice has not yet been injured
- C. Stop the work, explain the hazard, and demonstrate the correct lockout procedure
- D. Complete the lockout yourself each time without involving the apprentice

7. Which document must be reviewed to confirm the maximum permitted load rating of a scaffold before use?

- A. The Canadian Electrical Code installation tables
- B. The manufacturer's scaffold data plate and assembly instructions
- C. The site's electrical single-line diagram

D. The project's general arrangement drawings

8. A fire breaks out in an electrical panel that is still energized. Which fire extinguisher class is appropriate?

A. Class A only

B. Class B only

C. Class K

D. Class C

9. When organizing a multi-trade work area, what is the primary purpose of a job hazard analysis (JHA) completed before work begins?

A. To identify task-specific hazards and the controls needed to eliminate or reduce them

B. To assign blame in advance should an incident occur during the task

C. To estimate the total material cost of the electrical portion of the work

D. To record the names of all workers for payroll verification purposes

10. A support strut (strut channel) is being installed to carry a horizontal run of EMT across a ceiling. Why must the strut be fastened to structural members rather than to the ceiling tile grid?

A. The ceiling grid is easier to relocate during future renovations

B. Strut channel cannot be cut to fit between grid members

C. The structural members provide adequate load-bearing support; the grid is not rated for it

D. Fastening to the grid would void the strut manufacturer's paint warranty

11. Before decommissioning an old motor control centre, what must be confirmed regarding stored electrical energy?

A. The MCC nameplate horsepower rating matches the connected motors

- B. Capacitors and other energy-storage devices have been safely discharged
- C. The incoming feeder is rated for at least 125% of the connected load
- D. The control transformer secondary is fused on both ungrounded conductors

12. A single-phase 120/240 V residential service uses a kilowatt-hour meter. What does the meter primarily measure for billing purposes?

- A. Peak instantaneous current draw over the billing period
- B. The power factor of the connected residential load
- C. Voltage stability at the service entrance over time
- D. Real energy consumed in kilowatt-hours over time

13. A 200 A service entrance uses copper conductors. According to CEC ampacity principles, why is the conductor's insulation temperature rating relevant to its allowable ampacity?

- A. Higher temperature-rated insulation generally permits higher conductor ampacity
- B. Insulation temperature rating has no effect on permitted ampacity
- C. Lower temperature-rated insulation always allows higher ampacity
- D. Ampacity depends only on the conductor metal, not the insulation

14. A fuse and a circuit breaker both protect a feeder. Which statement correctly distinguishes their fundamental operating behaviour?

- A. A circuit breaker must be replaced after each operation, while a fuse can be reset
- B. Both devices can only interrupt overload currents, not short-circuit currents
- C. A fuse operates by melting a metal element, while a breaker uses a reusable mechanism
- D. A fuse responds only to voltage, while a breaker responds only to current

15. A three-phase 600 V feeder supplies a balanced load drawing 50 A per phase at a power factor of 0.85. Using the formula  $P = E \times I \times \sqrt{3} \times PF$ , what is the approximate total real power?

- A. 44 200 W
- B. 51 900 W
- C. 30 000 W
- D. 25 500 W

16. Why must the line and load terminals of a molded-case circuit breaker be connected in the orientation specified by the manufacturer?

- A. Reversed connection can compromise the arc-interruption and may damage the device
- B. The breaker will trip at exactly half its rated current if reversed
- C. Reversed connection increases the breaker's interrupting rating
- D. Terminal orientation only affects the appearance of the panel wiring

17. A UPS system is installed to protect a server room. What is the primary function of the UPS during a complete utility power loss?

- A. To permanently power the load until utility service is fully restored
- B. To increase the incoming voltage to compensate for line losses
- C. To correct the power factor of the connected computing equipment
- D. To supply backup power for a limited time, allowing orderly shutdown or generator start

18. During servicing of a surge protective device (SPD) on a 120/208 V panel, what indication typically confirms that the SPD's protective elements have degraded and require replacement?

- A. The SPD emits a continuous audible tone during normal operation
- B. The SPD's status indicator shows a fault or end-of-life condition
- C. The downstream loads draw measurably more current than rated
- D. The panel's main breaker trips each time the SPD is energized

19. A bonding conductor connects non-current-carrying metal parts of an electrical system. What is the primary safety purpose of this bonding?

- A. To improve the power factor of the overall electrical installation
- B. To reduce the resistance of the service neutral conductor
- C. To increase the available short-circuit current at the panel
- D. To provide a low-impedance path so faults clear quickly and surfaces stay at safe potential

20. A ground fault protection system is required on a solidly grounded wye service exceeding a certain voltage and ampacity. What does this ground fault protection primarily detect?

- A. Current flowing to ground that does not return through the normal circuit conductors
- B. An open neutral on the secondary of the service transformer
- C. Excess current shared equally among all three phase conductors
- D. A reduction in the system power factor below a preset threshold

21. A standby generator is connected to a building through a transfer switch. Why must the transfer switch prevent simultaneous connection of the generator and the utility?

- A. To allow the generator to charge its own starting battery from the utility
- B. To reduce fuel consumption while the generator is running
- C. To prevent backfeeding the utility, protecting line workers and equipment
- D. To equalize the voltage between the two sources before transfer

22. A photovoltaic (PV) renewable energy system feeds a battery storage bank. What is the primary function of the charge controller between the array and the batteries?

- A. To convert the DC output of the array directly into utility-grade AC
- B. To regulate charging current and voltage to protect the batteries from overcharge
- C. To disconnect the array whenever the building load exceeds generation
- D. To step up the array voltage to match the utility distribution voltage

23. When servicing a high-voltage (over 750 V) system, why must specific approach distances and additional PPE be observed beyond those used for low-voltage work?

- A. High-voltage conductors are always larger and physically heavier to handle
- B. The risk of arc flash and arc blast increases substantially at higher voltages
- C. High-voltage systems always operate at a lower frequency than low-voltage systems
- D. Low-voltage PPE is more expensive and is reserved for routine tasks

24. A dry-type transformer is rated 45 kVA, 600 V delta primary to 208Y/120 V secondary. Using the formula  $I = VA \div (E \times \sqrt{3})$ , what is the approximate rated primary line current?

- A. 43 A
- B. 125 A
- C. 75 A
- D. 216 A

25. Why is a transformer's secondary often bonded to ground at a single point rather than at multiple locations?

- A. A single bonding point prevents objectionable current from flowing on parallel paths
- B. Multiple bonding points reduce the transformer's kVA capacity
- C. Single-point bonding increases the secondary voltage available to the load
- D. Multiple grounding points are required to meet minimum efficiency standards

26. A power distribution panel feeds several branch circuits. What is the primary reason for maintaining the manufacturer-specified torque on the bus and lug connections?

- A. To make future disassembly of the panel quicker and easier
- B. To reduce the overall weight of the completed installation
- C. To minimize connection resistance and prevent heating, arcing, and failure
- D. To allow the use of smaller conductors than the load would normally require

27. A renewable energy storage system uses lithium-based batteries. What is a key servicing consideration that distinguishes them from traditional lead-acid batteries?

- A. Lithium batteries require regular topping up with distilled water
- B. Lithium batteries must always be installed in a horizontal orientation
- C. Lithium batteries can be deep-discharged indefinitely without any damage
- D. Lithium batteries require a battery management system to monitor cell condition

28. During servicing of metering equipment on a three-phase service, why must current transformer (CT) secondary circuits never be left open while energized?

- A. An open CT secondary reduces the accuracy of the kWh meter only slightly
- B. An open CT secondary can develop a dangerously high voltage across its terminals
- C. An open CT secondary causes the primary current to drop to zero immediately
- D. An open CT secondary has no effect because the primary current is unchanged

29. A consumer service is being upgraded. Why must the service conductors be sized to carry the calculated load without exceeding their allowable ampacity?

- A. Undersized conductors overheat, degrade insulation, and create a fire hazard
- B. Oversized conductors are prohibited by the electrical code in all cases
- C. Conductor size has no effect on voltage drop over the service length
- D. Smaller conductors always produce a higher service power factor

30. A power conversion system uses a rectifier. What is the function of a rectifier in this context?

- A. It increases the frequency of an AC supply to drive high-speed motors
- B. It stores electrical energy for release during peak demand periods
- C. It steps an AC voltage up or down without changing its frequency
- D. It converts alternating current (AC) into direct current (DC)

31. A ground fault detection system on an ungrounded distribution system typically alerts personnel to the first ground fault. Why is locating and clearing it promptly important?

- A. The first ground fault immediately de-energizes the entire system
- B. A second ground fault on another phase can create a damaging phase-to-phase fault
- C. The first ground fault doubles the system voltage to ground
- D. The first ground fault reverses the phase rotation of the system

32. A transformer is humming louder than normal and running hot under a steady load. Which condition is the most likely cause to investigate first?

- A. Overload beyond the transformer's kVA rating or loose internal laminations
- B. The transformer is operating below its rated voltage
- C. The ambient temperature in the room is below freezing
- D. The transformer secondary is open-circuited with no load

33. When installing a power distribution transformer, why are clearances around the unit specified by the manufacturer and code?

- A. Clearances make the transformer easier to repaint during maintenance
- B. Clearances reduce the transformer's no-load losses
- C. Clearances allow adequate ventilation for cooling and safe access for service
- D. Clearances increase the transformer's turns ratio under load

34. A 13.8 kV high-voltage cable termination is being prepared. Why is proper stress-cone or stress-relief termination critical at high voltage?

- A. It increases the cable's current-carrying capacity
- B. It reduces the cable's overall length requirement
- C. It changes the cable's voltage rating to a lower class

D. It controls electrical stress concentration to prevent insulation breakdown

35. A standby diesel generator is tested monthly under load. What is the primary reason for performing periodic load testing rather than no-load running?

A. No-load testing consumes more fuel than load testing

B. Load testing exercises the engine and verifies the unit can carry rated load

C. No-load running permanently damages the alternator windings

D. Load testing is required only to satisfy the fuel supplier's warranty

36. A metering installation uses a potential transformer (PT). What is the primary purpose of a PT in a high-voltage metering circuit?

A. To step the high primary voltage down to a safe, standard metering voltage

B. To step the metering voltage up to match the primary circuit

C. To convert the AC metering signal into a DC signal

D. To limit the short-circuit current available at the meter

37. Why is a neutral grounding resistor (NGR) sometimes installed in the neutral connection of a generator or transformer?

A. To raise the system voltage during light-load conditions

B. To increase the available ground fault current for faster tripping

C. To limit ground fault current to a controlled, lower value

D. To improve the system power factor under normal operation

38. A surge suppression system protects sensitive electronics. Why must the SPD be installed with the shortest possible lead length to the panel busbar and ground?

A. Longer leads improve the SPD's clamping performance

- B. Lead length affects only the cost of the installation
- C. Excess lead length adds inductance, reducing the SPD's effectiveness during a surge
- D. Short leads are required only for aesthetic reasons in the panel

39. A three-phase delta-connected source supplies a balanced load. How does the line current relate to the phase current in a delta configuration?

- A. Line current equals phase current in a delta system
- B. Line current is  $\sqrt{3}$  times the phase current
- C. Line current is one-third of the phase current
- D. Line current is equal to the phase voltage divided by impedance

40. A run of EMT passes through a wet location outdoors. Which fitting type must be used to maintain the integrity of the wiring method in this environment?

- A. Set-screw connectors rated for dry locations only
- B. Standard indoor compression couplings without gaskets
- C. Insulated bushings intended for indoor panel use
- D. Raintight compression fittings listed for wet locations

41. A 1 1/2 in.  $\times$  4 in. octagonal box (no internal volume markings) contains one fixture stud and several wire connectors. According to box-fill principles, why must these devices be counted in the box-fill calculation?

- A. Internal devices like studs and clamps displace volume and reduce conductor space
- B. Studs and connectors add ampacity to the conductors in the box
- C. They are counted only when the box is installed outdoors
- D. They reduce the temperature rating of the conductor insulation

42. When installing branch-circuit conductors in a raceway, what is the primary reason the CEC limits the total fill (number and size of conductors) in a conduit?

- A. To reduce the cost of the conduit material used on the job
- B. To make the conductors easier to colour-code at terminations
- C. To ensure the conduit can be bent without special tools
- D. To allow heat dissipation and permit conductor pulling without damage

43. A branch circuit feeds receptacles in a residential kitchen counter area. Which protective device is required to protect personnel against shock at these receptacles?

- A. An arc-fault circuit interrupter only, with no ground-fault protection
- B. A ground-fault circuit interrupter (GFCI) protecting the receptacles
- C. A standard thermal-magnetic breaker with no special protection
- D. A surge protective device installed at the receptacle outlet

44. A flexible metal conduit (FMC) connects to a vibrating piece of equipment. Why is FMC chosen over rigid conduit for this final connection?

- A. FMC has a higher ampacity rating than rigid conduit of the same size
- B. FMC is always less expensive than rigid conduit for any run
- C. FMC accommodates movement and vibration without transmitting stress to the equipment
- D. FMC does not require any fittings or connectors at its ends

45. An electric baseboard heater is controlled by a line-voltage thermostat. Why must the thermostat be rated for the connected load current and voltage?

- A. An underrated thermostat can overheat, fail, and create a fire hazard
- B. An underrated thermostat improves temperature control accuracy
- C. The thermostat rating affects the heater's resistance value

D. A higher-rated thermostat reduces the heater's energy consumption

46. When installing an HVAC unit's electrical supply, why is a disconnecting means required within sight of the unit?

A. To improve the airflow performance of the HVAC unit

B. To reduce the length of conductor required for the circuit

C. To allow the unit to draw less current during startup

D. To allow service personnel to safely isolate power while working on the unit

47. A heating cable is installed for roof de-icing. Why must the cable not be installed in a length shorter or longer than the manufacturer specifies for a given voltage?

A. Cable length affects only the appearance of the installation

B. Longer cable always trips the branch circuit breaker immediately

C. Incorrect length changes the wattage density, risking overheating or insufficient heat

D. Shorter cable increases the supply voltage to the circuit

48. Exit and emergency lighting must illuminate the means of egress during a power failure. What feature ensures the lighting operates when normal power is lost?

A. The fixtures are connected to a dedicated GFCI-protected circuit

B. The fixtures include a battery or are fed from an emergency power source

C. The fixtures use higher-wattage lamps than normal lighting

D. The fixtures are wired with larger conductors than standard lighting

49. When terminating conductors in a device such as a receptacle, why must the conductor be connected under the screw terminal in the direction the screw tightens?

A. It allows the use of a smaller conductor than the circuit requires

- B. It improves the colour identification of the conductor
- C. It increases the device's voltage rating
- D. It ensures the conductor is drawn in and held securely as the screw tightens

50. A cathodic protection system protects a buried metal structure from corrosion. What is the basic operating principle of an impressed-current cathodic protection system?

- A. A DC source forces current onto the structure, making it the cathode to prevent corrosion
- B. An AC source heats the structure to drive off moisture and prevent rust
- C. The structure is coated with a non-conductive paint that blocks all current
- D. The structure is connected directly to the building's neutral conductor

51. A conductor is pulled through a conduit with several bends. Why does the CEC limit the total degrees of bends between pull points (typically to 360°)?

- A. Bends beyond the limit change the conductor's voltage rating
- B. Excess bends reduce the conduit's resistance to corrosion
- C. Excess bends make pulling difficult and risk damaging conductor insulation
- D. Bends have no effect on the difficulty of pulling conductors

52. A branch circuit supplies a continuous load. Why must the conductor and overcurrent device be sized for at least 125% of the continuous load current?

- A. To reduce the cost of the overcurrent protective device
- B. To prevent overheating from sustained current near the device's rating
- C. To increase the available short-circuit current at the load
- D. To allow the use of a smaller conductor than normally required

53. When installing armoured cable (AC90) through wood studs, why must the cable be protected where it passes through bored holes near the stud edge?

- A. To prevent screws or nails from penetrating and damaging the cable
- B. To increase the cable's ampacity through the framing
- C. To improve the cable's colour identification
- D. To reduce the number of staples required along the run

54. An HVAC condensing unit has a nameplate minimum circuit ampacity (MCA) of 24 A and a maximum overcurrent protection (MOP) of 40 A. Which combination is acceptable?

- A. A conductor rated for 20 A with a 50 A breaker
- B. A conductor rated for 15 A with a 40 A breaker
- C. A conductor rated for 20 A with a 40 A breaker
- D. A conductor rated for at least 24 A with a breaker not exceeding 40 A

55. Why must electric heating circuits in a dwelling generally be calculated as continuous loads?

- A. Electric heat operates only intermittently for brief periods
- B. Continuous calculation lowers the required conductor size
- C. Heating loads typically operate for three hours or more, requiring the 125% factor
- D. Heating loads have a leading power factor that must be corrected

56. When installing a raceway that crosses a building expansion joint, what fitting is required?

- A. A standard rigid coupling with locknuts on each side
- B. An expansion fitting that allows the raceway to move with the building
- C. A sealing fitting filled with compound to block moisture
- D. An insulated throat connector to protect the conductors

57. A receptacle in a damp outdoor location requires a cover. What type of cover is required while a cord is plugged in?

- A. A weatherproof "in-use" (bubble) cover that protects the receptacle with a cord inserted
- B. A flat snap cover that closes only when no cord is present
- C. A standard indoor decorator-style cover plate
- D. A blank cover with no openings for any device

58. Why are exit signs and emergency lighting tested periodically (e.g., monthly function and annual duration tests)?

- A. Testing increases the brightness of the lamps over time
- B. Testing reduces the building's overall energy consumption
- C. Testing recharges the building's main service batteries
- D. Testing verifies the units will operate for the required duration during an actual failure

59. A non-metallic-sheathed cable (NMD90) is run in a location subject to physical damage. Why is this generally not permitted without additional protection?

- A. NMD90 has a higher temperature rating than required for the location
- B. The cable sheath provides limited mechanical protection and can be easily damaged
- C. NMD90 is rated only for wet underground locations
- D. The cable's conductors are aluminum and cannot be spliced

60. When installing branch circuitry, why must the grounded (neutral) conductor be identified by white or natural grey colour?

- A. White conductors carry more current than coloured conductors
- B. Colour identification changes the conductor's ampacity
- C. Consistent identification prevents dangerous miswiring of the grounded conductor
- D. White insulation has a higher temperature rating than coloured insulation

61. A conduit body (such as an LB) is used on a raceway run. What is its primary purpose?

- A. To provide access for pulling conductors and to change direction of the run
- B. To increase the ampacity of the conductors passing through it
- C. To serve as the main overcurrent protection point for the circuit
- D. To act as a grounding electrode for the raceway system

62. When installing electric heating panels in a ceiling, why must they be kept clear of insulation and combustible materials per the manufacturer's instructions?

- A. Insulation contact improves the panel's heat output efficiency
- B. Combustible clearances apply only to gas appliances, not electric
- C. Trapped heat against insulation or combustibles can create a fire hazard
- D. Clearances are required only to ease future panel replacement

63. A branch circuit serving a bathroom in a dwelling must include which type of protection for the receptacles?

- A. Arc-fault protection only, with no other requirement
- B. Surge protection at the panel feeding the circuit
- C. A dedicated isolated-ground receptacle with no GFCI
- D. Ground-fault circuit interrupter (GFCI) protection

64. When sizing a junction box for conductors that are spliced (not pulled straight through), why is adequate box volume important?

- A. Larger boxes increase the circuit's voltage rating
- B. Sufficient volume prevents conductor crowding, overheating, and insulation damage
- C. Box volume determines the colour coding of the conductors

D. Smaller boxes always improve heat dissipation from splices

65. A cathodic protection rectifier output is being adjusted. Why is it important not to apply excessive protective current to the structure?

A. Overprotection can cause coating disbondment and hydrogen damage to the structure

B. Excessive current increases the structure's resistance to corrosion indefinitely

C. Higher current always extends the rectifier's service life

D. Overprotection reverses the polarity of the buried structure permanently

66. When installing raceways in a concrete slab, why must the conduit be adequately supported and protected before the pour?

A. Concrete improves the conduit's resistance to corrosion automatically

B. Unsupported conduit increases the conductors' ampacity in the slab

C. Conduit in concrete never requires any support during the pour

D. Movement during the pour can crush, displace, or block the raceway

67. Why must emergency lighting in a stairwell be positioned to illuminate the path of travel and any change in floor level?

A. To increase the building's normal lighting levels during daytime use

B. To provide visibility of steps and direction during an evacuation when normal power fails

C. To reduce the wattage of the building's standard lighting circuits

D. To serve as the primary lighting for routine stairwell use

68. A flexible cord is used to connect a portable piece of equipment. Why is flexible cord generally not permitted as a substitute for fixed wiring run through a building structure?

A. Flexible cord has a higher ampacity than fixed wiring of the same size

- B. Flexible cord is always more expensive than fixed wiring methods
- C. Flexible cord is more prone to damage and is not rated for permanent concealed installation
- D. Flexible cord cannot be connected to any overcurrent device

69. When installing branch-circuit devices, why must receptacles on a 20 A small-appliance branch circuit in a kitchen be of the correct ampere rating?

- A. The receptacle rating must be compatible with the circuit to safely carry the load
- B. Higher-rated receptacles reduce the circuit's voltage drop
- C. The receptacle rating determines the colour of the circuit conductors
- D. Lower-rated receptacles increase the circuit's available current

70. A three-phase motor that is not thermally protected requires overload protection. Where are the overload relays typically placed in the control circuit?

- A. At the distribution panel feeding the motor branch circuit
- B. In the emergency stop station enclosure only
- C. In a separate enclosure remote from the motor controller
- D. In the motor starter (contactor) enclosure, in series with the motor windings

71. A magnetic motor starter uses a holding (seal-in) contact. What is the function of this contact in a standard start-stop control circuit?

- A. To reverse the direction of motor rotation when pressed
- B. To maintain the coil circuit after the start button is released
- C. To provide overload protection for the motor windings
- D. To step down the control voltage to the coil

72. A variable frequency drive (VFD) controls the speed of an AC induction motor. What does the VFD primarily vary to change motor speed?

- A. The frequency (and voltage) supplied to the motor
- B. The resistance in series with the motor windings
- C. The number of poles physically in the motor
- D. The mechanical load coupled to the motor shaft

73. A three-phase induction motor runs in the wrong direction after installation. What is the standard corrective action?

- A. Replace the motor with one wound for the opposite rotation
- B. Increase the supply voltage to reverse the rotating field
- C. Interchange any two of the three line conductors at the motor
- D. Reduce the supply frequency until the motor reverses

74. A motor's nameplate lists a service factor of 1.15. What does this service factor indicate?

- A. The motor must always be operated at 115% of its rated voltage
- B. The motor efficiency is fixed at exactly 115% under all loads
- C. The motor can carry 115% of rated load continuously without immediate damage
- D. The motor draws 15% less current than a unit without a service factor

75. A reduced-voltage starter is used for a large motor. Why is reduced-voltage starting employed instead of full-voltage (across-the-line) starting?

- A. It permanently increases the motor's running torque
- B. It limits the high inrush current and mechanical shock during starting
- C. It eliminates the need for any overload protection
- D. It allows the motor to run at twice its rated speed

76. An automated control system uses a programmable logic controller (PLC). What is the function of the PLC's input module?

- A. To supply control voltage directly to the motor windings
- B. To provide overcurrent protection for the control circuit
- C. To store the program permanently if all power is removed
- D. To receive signals from field devices such as switches and sensors

77. A motor control centre (MCC) houses multiple motor starters. What is a primary advantage of using an MCC rather than individual scattered starters?

- A. Centralized location simplifies control wiring, protection, and maintenance access
- B. An MCC eliminates the need for any overload protection on motors
- C. An MCC allows motors to run without any disconnecting means
- D. An MCC increases the horsepower output of each connected motor

78. A drive (VFD) is generating harmonics that affect other equipment. What device is commonly added to reduce these harmonics?

- A. A larger overload relay on the motor circuit
- B. A higher-rated control transformer in the starter
- C. A line reactor or harmonic filter on the drive input
- D. An additional emergency stop pushbutton in the circuit

79. A motor starter coil is rated 120 V but the supply is 600 V three-phase. What component provides the correct coil voltage?

- A. A current transformer in the main power circuit
- B. A control (step-down) transformer in the starter
- C. An overload relay sized for the coil current

D. A potential transformer on the motor secondary

80. When servicing a motor, an electrician measures the winding insulation resistance with a megohmmeter. A very low reading indicates what condition?

A. The motor windings have excellent insulation and are ready for service

B. The motor will run more efficiently than a unit with a high reading

C. The supply voltage to the motor is too high for the windings

D. The winding insulation is deteriorated or contaminated, risking a fault

81. A PLC-based control system requires a sensor to detect the presence of a metallic part on a conveyor. Which sensor type is most appropriate?

A. An inductive proximity sensor that detects metal without contact

B. A line-voltage thermostat measuring ambient temperature

C. A pressure switch monitoring hydraulic line pressure

D. A photoelectric smoke detector mounted on the ceiling

82. A three-phase motor draws significantly unequal current on the three line conductors while running. What is a likely cause to investigate?

A. The motor is simply operating at its rated efficiency

B. The supply frequency is slightly above 60 Hz

C. A voltage imbalance between phases or a developing winding fault

D. The motor service factor is higher than 1.0

83. In a two-wire control scheme using a maintained-contact device, what happens to the motor after a power loss and restoration?

A. The motor remains off until the start button is pressed again

- B. The motor restarts automatically when power returns (a safety concern)
- C. The motor runs in the reverse direction upon power restoration
- D. The motor draws no inrush current when power returns

84. A drive is programmed with an acceleration ramp time. What is the purpose of setting an appropriate acceleration ramp?

- A. To permanently increase the motor's maximum torque output
- B. To eliminate the need for a motor disconnecting means
- C. To reduce the motor's nameplate full-load current rating
- D. To control the rate of speed increase, reducing mechanical and electrical stress

85. A motor's bearings are being serviced. Why is correct shaft alignment between the motor and the driven load important?

- A. Misalignment causes vibration, accelerated bearing wear, and possible failure
- B. Misalignment increases the motor's efficiency under load
- C. Alignment affects only the colour coding of the motor leads
- D. Misalignment reduces the current drawn by the motor windings

86. A control circuit uses a normally open (NO) pushbutton for "start" and a normally closed (NC) pushbutton for "stop." Why is the stop button wired normally closed?

- A. A normally closed button reduces the control voltage to the coil
- B. A normally closed button increases the motor's starting torque
- C. So that a broken wire or open contact stops the motor, providing fail-safe operation
- D. A normally closed button is less expensive than a normally open button

87. A soft starter is used in place of a VFD for a pump motor that only needs controlled starting. What is the main difference between a soft starter and a VFD?

- A. A soft starter provides full variable-speed control during running
- B. A VFD can only start motors but cannot vary running speed
- C. A soft starter steps the motor voltage up above the line voltage
- D. A soft starter controls starting voltage but does not provide continuous speed control

88. When commissioning an automated control system, why is it important to verify the wiring against the control schematic before applying power?

- A. Verification increases the control transformer's output voltage
- B. Incorrect wiring can cause unsafe operation, equipment damage, or injury
- C. Verification reduces the number of input devices required
- D. Wiring verification changes the PLC's scan time

89. A motor overload relay has tripped repeatedly. Before simply resetting it again, what is the correct troubleshooting approach?

- A. Investigate the cause, such as mechanical overload, low voltage, or a winding fault
- B. Replace the overload relay with one of a higher current rating immediately
- C. Bypass the overload relay so the motor can run continuously
- D. Increase the supply voltage to reduce the motor current draw

90. A PLC output module energizes a motor contactor coil. Why is an interposing relay sometimes used between the PLC output and the contactor coil?

- A. To slow down the PLC's program scan time deliberately
- B. To convert the motor from three-phase to single-phase operation
- C. To handle the coil's current and isolate the PLC output from the higher load
- D. To provide the motor's primary overload protection

91. A fire alarm system uses an end-of-line resistor on an initiating device circuit. What is the primary purpose of this resistor?

- A. To increase the voltage available to the initiating devices
- B. To limit the current drawn by each smoke detector
- C. To convert the circuit signal from analog to digital
- D. To allow the panel to supervise the circuit and detect a break in the wiring

92. When installing communication (data) cabling, why must it be kept separated from power conductors where they run parallel?

- A. Separation increases the data cable's bandwidth automatically
- B. To minimize electromagnetic interference (EMI) coupling onto the data signals
- C. Power conductors cannot physically fit in the same pathway
- D. Separation is required only for fibre-optic cabling, not copper

93. A category (Cat) twisted-pair cable relies on the twisting of conductor pairs. What is the primary purpose of the twists?

- A. To reduce crosstalk and improve noise rejection between pairs
- B. To increase the cable's tensile strength during pulling
- C. To raise the voltage rating of the communication cable
- D. To allow the cable to carry higher current safely

94. An integrated control system links HVAC, lighting, and security through a building automation network. What is a key benefit of integrating these systems?

- A. Integration eliminates the need for any overcurrent protection
- B. Integration allows each system to operate at a higher voltage
- C. Integration removes the requirement for any field sensors

D. Coordinated control improves efficiency and centralizes monitoring

95. A nurse-call or signalling system uses a normally supervised circuit. If a wire breaks, what should a properly designed supervised system do?

- A. Continue to operate normally with no indication of the break
- B. Indicate a trouble or fault condition to alert maintenance
- C. Increase the system voltage to overcome the break
- D. Automatically reroute the signal through the power conductors

96. When terminating fibre-optic cable, why must the fibre end face be clean and properly polished or cleaved?

- A. Contamination or a poor end face causes signal loss and reflection at the joint
- B. A dirty end face increases the fibre's current-carrying capacity
- C. Polishing changes the fibre's colour code for identification
- D. A rough end face raises the voltage rating of the connection

97. A communication system uses a structured cabling approach with a telecommunications room. Why are cable length limits (e.g., 90 m horizontal for Cat cabling) specified?

- A. Longer cables increase the system's supply voltage
- B. Length limits apply only to the building's power wiring
- C. Signal degradation and timing errors occur beyond the rated length
- D. Shorter cables always carry more current than longer ones

98. A signalling system's low-voltage Class 2 circuit is being installed. Why are Class 2 circuits limited in voltage and power?

- A. To increase the data rate of the connected devices

- B. To allow the use of larger conductors than normally required
- C. To raise the operating temperature of the wiring
- D. The power limitation reduces fire and shock hazard, allowing relaxed wiring methods

99. When installing a coaxial cable for a CATV signal, why must the correct characteristic impedance (e.g., 75  $\Omega$ ) be maintained throughout?

- A. Higher impedance always improves the picture quality
- B. Impedance mismatches cause signal reflections and degraded performance
- C. The impedance determines the cable's current rating
- D. Impedance only matters for fibre-optic systems, not coaxial

100. An integrated control system uses a communication protocol to allow devices from different manufacturers to exchange data. What is the primary benefit of using a standard open protocol?

- A. It permanently increases the operating voltage of all devices
- B. It eliminates the need for any system commissioning
- C. It allows interoperability between equipment from different vendors
- D. It removes the requirement for surge protection on the network

## Practice Exam 6: Answer Key and Explanations

1. C — A trench 1.2 m or deeper must be protected against collapse by sloping, shoring, or an approved support system before entry. Soil cannot be trusted to hold, and a cave-in is the leading cause of trenching fatalities. A spotter, water, or signage does not prevent the wall from failing.

2. A — Defective electrical equipment must be removed from service and tagged; the charger cord is the hazard, so it is locked out. The tool itself is undamaged and may run on its existing charge. Taping a frayed cord or limiting bystanders does not eliminate the shock and fire risk.

3. D — Proper lifting keeps the back straight, bends the knees, and holds the load close to the body so the legs and not the spine carry the weight. Bending at the waist, twisting, or holding loads away from the body concentrates force on the lumbar discs and causes injury.
4. B — First-aid measures appear in Section 4 of a standardized 16-section SDS. Knowing the fixed section order lets a worker reach critical information fast in an emergency. Section 2 is hazards, Section 8 is exposure controls/PPE, and Section 14 is transport.
5. A — Before energizing, confirm all connections are torqued to specification and the enclosure is clear of tools and debris. Loose terminations cause arcing and fires, and forgotten tools create dead shorts. Voltage measurement, labelling, and occupant notification all follow safe energization, not precede it.
6. C — The journey person must stop the unsafe work, explain the lockout hazard, and demonstrate the correct procedure. Mentoring corrects behaviour before an injury occurs, and skipped lockout exposes the apprentice to lethal energy. Ignoring it or silently doing the work yourself teaches nothing and leaves the hazard unaddressed.
7. B — The scaffold manufacturer's data plate and assembly instructions specify the rated load capacity. Exceeding it risks structural collapse, so the rating must be confirmed before use. The CEC, single-line diagrams, and arrangement drawings do not address scaffold load ratings.
8. D — A Class C extinguisher is rated for fires in energized electrical equipment because its agent is non-conductive. Using a water-based Class A unit on a live panel risks electrocuting the operator. Class B targets flammable liquids and Class K targets cooking oils.
9. A — A job hazard analysis identifies task-specific hazards and the controls needed to eliminate or reduce them before work begins. It is a proactive safety planning tool, not a blame, costing, or payroll record. Anticipating hazards lets the crew put controls in place rather than react after an incident.
10. C — Strut must be fastened to structural members because they are rated to carry the load; the ceiling tile grid is not and would fail under the conduit weight. Securing raceway to suspended grid is a common code violation that risks collapse onto occupants below.

11. B — Before decommissioning an MCC, confirm that capacitors and other energy-storage devices have been safely discharged. Stored charge can deliver a lethal shock long after the feeder is opened. Nameplate, feeder sizing, and fuse details are unrelated to the stored-energy hazard.

12. D — A kilowatt-hour meter measures real energy consumed over time, which is the basis for billing. It integrates power across the billing period rather than capturing instantaneous current, power factor, or voltage stability. Real energy in kWh is what the utility sells.

13. A — Higher insulation temperature ratings generally permit higher allowable ampacity because the conductor can run hotter without degrading the insulation. Ampacity tables are organized by insulation temperature column for this reason. The conductor metal alone does not set the limit; the insulation's heat tolerance does.

14. C — A fuse interrupts by melting a sacrificial metal element and must then be replaced, whereas a breaker uses a reusable trip mechanism that can be reset. Both clear overloads and short circuits, and both respond to current, so the distinguishing factor is the one-time versus resettable operation.

15. A — Three-phase real power =  $E \times I \times \sqrt{3} \times \text{PF} = 600 \times 50 \times 1.73 \times 0.85 \approx 44\,200 \text{ W}$ . The  $\sqrt{3}$  factor accounts for the three-phase relationship and the 0.85 power factor reduces apparent power to real power. Option B (51 900 W) omits the power factor, C (30 000 W) omits both  $\sqrt{3}$  and PF, and D applies PF incorrectly.

16. A — Reversing a molded-case breaker's line and load connections can compromise arc interruption and damage the device, since many breakers are designed for a specific current direction through the arc chute. It does not change the trip current or interrupting rating; correct orientation is a safety requirement, not cosmetic.

17. D — A UPS supplies backup power for a limited time, bridging the gap so equipment can shut down in an orderly way or a generator can start. Its battery cannot run the load indefinitely. It is not a voltage booster or a power-factor correction device.

18. B — A degraded SPD is confirmed by its status indicator showing a fault or end-of-life condition, since the internal MOVs wear out after absorbing surges. An audible tone, downstream current, or main-breaker tripping are not the standard end-of-life indications and point to other problems.

19. D — Bonding provides a low-impedance fault-return path so overcurrent devices clear quickly and exposed metal stays near earth potential, preventing dangerous touch voltage. It does not correct power factor, lower neutral resistance, or raise available fault current as its purpose.

20. A — Ground fault protection detects current leaking to ground that does not return through the normal circuit conductors, indicating an insulation failure. On large solidly grounded wye services this protects against arcing ground faults that an overcurrent device alone may not clear. It is unrelated to neutral integrity or power factor.

21. C — The transfer switch must prevent paralleling the generator with the utility to stop backfeed onto de-energized utility lines, which would electrocute line workers and damage equipment. Battery charging, fuel economy, and voltage matching are not the safety reason for the interlock.

22. B — A charge controller regulates the charging current and voltage from the array to protect the batteries from overcharge and damage. It does not invert DC to AC (that is the inverter's job) or step voltage up to the grid. Proper charge regulation extends battery life and prevents thermal runaway.

23. B — Higher voltages dramatically increase arc-flash and arc-blast energy, so greater approach distances and arc-rated PPE are mandatory above 750 V. The hazard scales with voltage, not conductor weight or frequency. Treating high voltage with low-voltage precautions risks fatal burns and blast injury.

24. A — Primary line current =  $kVA \div (E \times \sqrt{3}) = 45\,000 \div (600 \times 1.73) \approx 43$  A. The  $\sqrt{3}$  factor applies because it is a three-phase line current referenced to line voltage. Option D (216 A) wrongly uses 208 V, C (75 A) divides by line voltage only, and B (125 A) misapplies the  $\sqrt{3}$  factor.

25. A — Single-point bonding of a transformer secondary prevents objectionable neutral current from flowing on multiple parallel paths such as conduit and building steel. Multiple bonding points create circulating currents and stray voltage. Bonding location does not change kVA, secondary voltage, or efficiency.

26. C — Manufacturer-specified torque minimizes connection resistance, preventing localized heating, arcing, and eventual failure at bus and lug joints. Loose connections are a leading cause of panel fires. Torque is about reliable low-resistance contact, not weight, disassembly ease, or conductor downsizing.

27. D — Lithium-based storage batteries require a battery management system to monitor cell voltage, temperature, and balance, preventing thermal runaway. Unlike lead-acid, they are sealed (no watering), are orientation-flexible, and must not be deep-discharged carelessly. The BMS is the defining servicing consideration.

28. B — An open current-transformer secondary under load develops a dangerously high voltage across its terminals because the primary ampere-turns are no longer balanced by secondary current. This can injure personnel and destroy the CT, so secondaries are shorted before opening the circuit.

29. A — Service conductors sized below the calculated load overheat, degrading insulation and creating a fire hazard. Ampacity must meet or exceed the load so conductors run within their thermal rating. Oversizing is generally permitted, and conductor size strongly affects voltage drop.

30. D — A rectifier converts alternating current into direct current, commonly using diodes. It is not a frequency changer, energy-storage device, or transformer. Rectification is the essential first stage in DC power supplies, battery chargers, and the front end of many drives.

31. B — On an ungrounded system the first ground fault does not trip, but a second fault on a different phase creates a phase-to-phase fault with high current and damage. Locating and clearing the first fault promptly preserves the system's fault-tolerant advantage and prevents the destructive second event.

32. A — Excessive humming and heat under steady load most likely indicate an overload beyond the kVA rating or loose core laminations. Both produce heating and acoustic noise. Low voltage, freezing ambient, or an open secondary would not produce sustained overheating under load.

33. C — Manufacturer and code clearances around a transformer allow adequate ventilation for cooling and safe access for servicing. Restricting airflow causes overheating and shortens insulation life. Clearances do not affect repainting, no-load losses, or turns ratio.

34. D — A stress cone or stress-relief termination controls the concentration of electrical stress where the cable shield ends, preventing insulation breakdown at high voltage. Without it, the field intensifies at the cutback and tracks or punctures the insulation. It does not change ampacity, length, or voltage class.

35. B — Periodic load testing exercises the engine and verifies the generator can actually carry its rated load, something no-load running cannot prove. It also burns off fuel and prevents wet-stacking in diesels. No-load testing does not damage windings, and load testing is a reliability requirement, not a fuel-warranty term.

36. A — A potential transformer steps a high primary voltage down to a safe standard metering voltage (commonly 120 V) for instruments. This isolates and scales the signal so meters can read high-voltage circuits safely. It does not step up, rectify, or limit fault current.

37. C — A neutral grounding resistor limits ground-fault current to a controlled lower value, reducing equipment damage and arc energy while still allowing detection. It does not raise voltage, increase fault current for faster tripping, or correct power factor. Current limiting is its defining role.

38. C — Excess SPD lead length adds inductance, which develops voltage during the fast rise of a surge and reduces the device's clamping effectiveness. Keeping leads short and straight preserves protection. Long leads degrade, not improve, performance and are a functional, not aesthetic, concern.

39. B — In a delta configuration the line current equals  $\sqrt{3}$  times the phase current, while line and phase voltages are equal. This relationship is the reciprocal of the wye case. Recognizing it is essential for correctly sizing delta-connected loads and conductors.

40. D — Outdoor wet locations require raintight compression fittings listed for wet use to keep moisture out of the EMT system. Set-screw connectors and ungasketed indoor couplings admit water, causing corrosion and faults. The fitting listing must match the environment.

41. A — Internal devices such as fixture studs and wire connectors displace volume, so box-fill rules require counting them to ensure adequate space for conductors. Overcrowding damages insulation and traps heat. These devices reduce available volume; they add neither ampacity nor outdoor-only relevance.

42. D — Conduit fill is limited primarily to allow heat dissipation and to permit pulling conductors without damaging their insulation. Overfilled raceways trap heat and cause jacket abrasion during the pull. The limit is about thermal and mechanical protection, not cost, colour-coding, or bending ease.

43. B — Kitchen counter receptacles require GFCI protection to guard personnel against shock in this damp, grounded environment. A GFCI opens on small leakage currents before they become lethal. Arc-fault protection addresses fire from arcing, and a standard breaker offers no shock protection.

44. C — Flexible metal conduit is used for final connections to vibrating equipment because it accommodates movement without transmitting stress to terminals or the raceway. Rigid conduit would crack or loosen connections. FMC's flexibility, not ampacity or cost, is the reason for the choice.

45. A — A line-voltage thermostat must be rated for the heater's current and voltage; an underrated device overheats, fails, and can ignite. The rating ensures the contacts safely switch the load. It does not change the heater's resistance or reduce energy use.

46. D — A disconnecting means within sight of HVAC equipment lets service personnel positively isolate power while working, preventing unexpected energization. It is a worker-safety requirement. It does not affect airflow, conductor length, or startup current.

47. C — Resistance heating cable must be installed at its specified length for the voltage because changing the length alters the wattage density, causing overheating if too short or insufficient heat if too long. The cable is engineered for a fixed length-to-voltage relationship; deviating from it is a fire risk.

48. B — Exit and emergency lighting operates during a power failure because each unit contains a battery or is fed from an emergency power source. This guarantees illumination of the egress path when normal power is lost. GFCI circuits, larger lamps, or bigger conductors do not provide that backup.

49. D — Looping a conductor under a screw terminal in the direction the screw tightens draws the wire in and clamps it securely as the screw turns. A backward loop pushes the conductor out and loosens. Correct termination direction ensures a reliable, low-resistance connection.

50. A — In impressed-current cathodic protection a DC source drives current onto the buried structure, making it the cathode so that corrosion is suppressed. The current opposes the natural corrosion cell. It is a DC, not AC, process and does not use the building neutral.

51. C — The CEC limits bends between pull points to roughly 360° because excess bends make conductors hard to pull and risk scraping and damaging insulation. Friction rises sharply with each bend. The limit protects the conductor jacket and eases installation, not the conduit's voltage rating.

52. B — Continuous loads require conductors and overcurrent devices sized to at least 125% of the load to prevent overheating from current sustained near the device rating. Breakers and conductors are rated for continuous operation only to 80% of their marking, so the 125% factor restores margin.

53. A — Cable through bored holes near a stud edge must be protected (typically by a steel plate) to prevent screws or nails from penetrating and damaging the conductors. This guards against later shock and fire hazards from hidden punctures. It does not affect ampacity or colour identification.

54. D — A conductor rated for at least the 24 A minimum circuit ampacity, protected by an overcurrent device not exceeding the 40 A maximum, satisfies the nameplate. MCA sets the conductor floor and MOP sets the breaker ceiling. The other options either undersize the conductor or exceed the MOP.

55. C — Electric heating loads typically run three hours or more, so they are treated as continuous and sized with the 125% factor. This prevents the conductors and breaker from overheating during long heating cycles. Heating is not intermittent, and the factor increases, not decreases, the required conductor size.

56. B — Where a raceway crosses a building expansion joint, an expansion fitting is required so the conduit can move with the structure without breaking connections or shearing conductors. A rigid coupling would transfer movement and fail. Sealing and insulating fittings serve different purposes.

57. A — A receptacle in a damp or wet outdoor location needs a weatherproof "in-use" bubble cover that keeps the outlet protected even with a cord plugged in. A flat cover only seals when nothing is connected. The in-use cover maintains weather protection during actual use.

58. D — Periodic function and duration testing verifies that emergency lighting and exit signs will actually operate for the required time during a real power failure. Batteries degrade silently, so testing confirms readiness. It does not brighten lamps, save energy, or recharge service batteries.

59. B — NMD90's sheath offers limited mechanical protection and is easily damaged, so it is not permitted where exposed to physical damage without added protection such as conduit. The vulnerability of the jacket, not its temperature rating or conductor material, drives this restriction.

60. C — The grounded (neutral) conductor must be identified white or natural grey so it is consistently recognizable, preventing dangerous miswiring that could energize the neutral or interrupt it improperly. Colour identification is a safety convention; it does not change ampacity or temperature rating.

61. A — A conduit body such as an LB provides access for pulling conductors and changes the direction of a raceway run, for example around an obstruction. It is a junction/pull point, not an overcurrent device, grounding electrode, or ampacity enhancer.

62. C — Electric heating panels must be kept clear of insulation and combustibles per the manufacturer because trapped heat against these materials can ignite them. The clearance prevents the panel from overheating its surroundings. Insulation contact does not improve efficiency, and the rule applies to electric units.

63. D — Dwelling bathroom receptacles require GFCI protection because water and grounded fixtures make shock highly likely. The GFCI interrupts small leakage currents before they injure. Arc-fault protection, panel surge protection, or an isolated-ground receptacle do not provide this personnel shock protection.

64. B — A junction box housing spliced conductors must have sufficient volume so conductors are not crowded, which would damage insulation and trap heat at the splices. Adequate box fill keeps connections cool and protected. Volume does not set voltage rating or colour coding, and smaller boxes worsen heat.

65. A — Excessive cathodic protection current causes coating disbondment and hydrogen evolution that can embrittle and damage the structure. The rectifier output must be adjusted to protect without overprotecting. More current does not indefinitely improve protection or extend rectifier life; overprotection is itself harmful.

66. D — Conduit in a slab must be supported and protected before the pour because movement during placement can crush, displace, or block the raceway, making it unusable. Proper anchoring keeps it positioned and intact. Concrete does not automatically protect against corrosion, and support is required.

67. B — Stairwell emergency lighting must illuminate the path of travel and any change in floor level so occupants can see steps and direction during an evacuation when normal power fails. Its purpose is egress safety, not daytime lighting, energy reduction, or routine use.

68. C — Flexible cord is more prone to damage and is not rated for permanent concealed installation through building structure, so it cannot substitute for fixed wiring. It is intended for portable or temporary connection. Cord ampacity and cost are not the governing reasons; durability and code listing are.

69. A — A receptacle on a 20 A kitchen branch circuit must be rated compatibly with the circuit so it can safely carry the load without overheating. The device rating must match the circuit's capacity. Receptacle rating does not affect voltage drop, conductor colour, or available current.

70. D — Overload relays for a non-thermally-protected motor are placed in the starter (contactor) enclosure, connected in series with the motor windings so they sense actual motor current. From there they open the control circuit on a sustained overload. The panel or e-stop enclosure are not where overloads are located.

71. B — A holding (seal-in) contact maintains the coil circuit after the momentary start button is released, keeping the motor running until stop is pressed. It parallels the start button. It does not reverse rotation, provide overload protection, or change control voltage.

72. A — A VFD changes motor speed primarily by varying the frequency supplied to the motor, with voltage adjusted proportionally to maintain flux. Since synchronous speed depends on frequency, controlling it sets the speed. The drive does not add series resistance, change poles, or alter the mechanical load.

73. C — Reversing rotation of a three-phase induction motor is done by interchanging any two of the three line conductors, which reverses the rotating magnetic field. This is the standard, simple correction. Changing the motor, raising voltage, or lowering frequency does not reverse direction.

74. C — A service factor of 1.15 means the motor can carry 115% of its rated load continuously without immediate damage, providing a safety margin for occasional overload. It is not a voltage requirement, a fixed efficiency, or a current reduction. Sustained operation in the service-factor range does shorten life.

75. B — Reduced-voltage starting limits the high inrush current and mechanical shock that full-voltage starting imposes on large motors and the supply. Lower starting voltage means lower starting torque and current. It does not eliminate overload protection or double the running speed.

76. D — A PLC input module receives signals from field devices such as pushbuttons, limit switches, and sensors, converting them to logic the processor can read. It does not power motor windings, provide overcurrent protection, or store the program (that is the processor's memory).

77. A — A motor control centre centralizes multiple starters in one assembly, simplifying control wiring, coordinated protection, and maintenance access. Grouping starters improves organization and serviceability. An MCC does not remove the need for overloads or disconnects, nor does it boost motor horsepower.

78. C — A line reactor or harmonic filter on the drive input reduces the harmonic currents a VFD injects back onto the supply, protecting other equipment. Larger overloads, bigger control transformers, or extra e-stops do not address harmonics. Filtering at the source mitigates the distortion.

79. B — A control (step-down) transformer in the starter provides the correct 120 V coil voltage from the 600 V supply, isolating and reducing the control circuit voltage for safety. A current or potential transformer is for measurement, and an overload relay protects the motor, not supplies coil voltage.

80. D — A very low megohmmeter reading indicates deteriorated or contaminated winding insulation, signalling an impending ground fault or short. Good insulation reads high resistance. Low insulation resistance is a failure indicator, not a sign of efficiency or excessive supply voltage.

81. A — An inductive proximity sensor detects metallic objects without contact, ideal for sensing parts on a conveyor. It responds to the metal target entering its field. A thermostat, pressure switch, or smoke detector senses entirely different variables and would not detect the part.

82. C — Unequal line currents on a running three-phase motor commonly indicate a voltage imbalance between phases or a developing winding fault, both of which cause uneven heating and reduced life. Rated efficiency, slightly high frequency, or a high service factor would not produce significant current imbalance.

83. B — In a two-wire control scheme with a maintained-contact device, the motor restarts automatically when power returns because the maintained contact stays closed, a recognized safety concern. Three-wire control with a momentary start avoids this. The motor does not stay off, reverse, or skip inrush.

84. D — An acceleration ramp controls the rate at which the drive increases motor speed, reducing mechanical and electrical stress on the motor, coupling, and driven load. It does not raise peak torque, eliminate the disconnect, or change the nameplate current. Smooth ramping protects the system.

85. A — Correct shaft alignment between motor and load prevents the vibration that causes accelerated bearing wear and premature failure. Misalignment imposes cyclic loads on bearings and couplings. It does not improve efficiency, affect lead colour coding, or reduce winding current.

86. C — The stop button is wired normally closed so that a broken wire or failed contact opens the circuit and stops the motor, giving fail-safe operation. A normally open stop would leave the motor running on a wire break. It is a safety design, not a cost or torque consideration.

87. D — A soft starter controls the voltage applied during starting to ramp the motor up smoothly but does not provide continuous variable-speed control during running, which is the VFD's function. The soft starter is a starting device only; once at speed the motor runs across the line.

88. B — Verifying field wiring against the control schematic before energizing catches errors that could cause unsafe operation, equipment damage, or injury. Miswired controls can start machinery unexpectedly. Verification does not raise transformer voltage, reduce input devices, or change PLC scan time.

89. A — A repeatedly tripping overload relay signals a real problem—mechanical overload, low voltage, or a winding fault—that must be investigated rather than reset away. Resetting without diagnosis or oversizing/bypassing the relay removes protection and risks burning out the motor. Find the root cause first.

90. C — An interposing relay is used so the PLC's low-current output can switch a contactor coil that draws more current than the output can handle, while isolating and protecting the PLC. It does not slow scan time, change phases, or serve as the motor's overload protection.

91. D — An end-of-line resistor lets the fire alarm panel supervise the initiating circuit by maintaining a small monitoring current; a break in the wiring changes that current and triggers a trouble signal. This ensures wiring faults are detected. It does not boost voltage, limit detector current, or convert signal type.

92. B — Communication cabling is separated from power conductors to minimize electromagnetic interference coupling onto the data signals, which would cause errors and degraded throughput. Separation reduces EMI; it does not increase bandwidth on its own, and the rule applies to copper data cable, not only fibre.

93. A — Twisting conductor pairs reduces crosstalk and improves common-mode noise rejection, because the twists cause induced noise to cancel. This is fundamental to twisted-pair performance. The twisting does not add tensile strength, raise voltage rating, or increase current capacity.

94. D — Integrating HVAC, lighting, and security on one automation network provides coordinated control that improves efficiency and centralizes monitoring. Shared data lets systems respond together. Integration does not eliminate overcurrent protection, raise operating voltage, or remove the need for sensors.

95. B — A supervised signalling circuit indicates a trouble or fault condition when a wire breaks, alerting maintenance so the fault can be repaired. Supervision is the whole point of the design. It does not keep operating silently, boost voltage, or reroute through power conductors.

96. A — A fibre end face must be clean and properly polished or cleaved because contamination or a poor finish causes signal loss and reflection at the joint, degrading the link. A pristine end face ensures efficient light coupling. It has nothing to do with current capacity, colour code, or voltage rating.

97. C — Cat cabling has a 90 m horizontal length limit because signal degradation and timing errors occur beyond the rated length, breaking the link's performance guarantees. The limit preserves signal integrity. It does not relate to supply voltage, power wiring, or current capacity.

98. D — Class 2 circuits are voltage- and power-limited specifically to reduce fire and shock hazard, which is what allows their relaxed wiring methods. The power limit is the safety basis for the lighter installation rules. It does not increase data rate, permit larger conductors, or raise wiring temperature.

99. B — A coaxial cable must maintain its characteristic impedance (e.g., 75  $\Omega$ ) throughout, because mismatches cause signal reflections that degrade the CATV signal quality. Consistent impedance ensures clean transmission. Impedance does not improve quality by being higher, set current rating, or apply only to fibre.

100. C — A standard open communication protocol allows interoperability between equipment from different manufacturers, the key benefit of integrated control systems. Devices can exchange data regardless of vendor. It does not raise operating voltage, remove commissioning, or eliminate surge protection.