

PRACTICE EXAM 4: CONSTRUCTION ELECTRICIAN SIMULATION (100 QUESTIONS)

1. You are about to begin work inside a 600 V motor control centre that you have just locked out and tagged out. Before touching any conductors, what is the final step you must complete to confirm a zero-energy state?

- A. Apply your personal lock to the disconnect and record the time on the tag
- B. Notify the site supervisor that the equipment has been de-energized
- C. Test for absence of voltage with a meter proven live before and after the test
- D. Remove the control fuses and store them in your locked toolbox for the shift

2. A coworker collapses near energized equipment and may still be in contact with a live conductor. What is your first action?

- A. De-energize the circuit or remove the source of contact before approaching
- B. Begin chest compressions immediately while the victim is still in contact
- C. Pull the victim away from the equipment using your bare hands quickly
- D. Pour water on the contact point to reduce the current flowing through them

3. While reviewing a Safety Data Sheet for a solvent before use, which section tells you the specific personal protective equipment required for handling?

- A. Section 2, which lists the hazard classification and signal words only

- B. Section 4, which describes first-aid measures for exposure incidents
- C. Section 9, which provides the physical and chemical property data
- D. Section 8, which covers exposure controls and personal protection

4. You need to drill anchor holes overhead while standing on a fibreglass stepladder. Which practice best maintains three points of contact and stability?

- A. Stand on the top cap of the ladder to gain the extra reach you need
- B. Keep your belt buckle within the side rails and do not overreach
- C. Have a helper push the ladder sideways toward the work as you drill
- D. Lean the closed stepladder against the wall and climb it like an extension ladder

5. A lift plan calls for hoisting a 200 kg transformer to a mezzanine. When selecting rigging, what does the working load limit (WLL) of a sling represent?

- A. The breaking strength of the sling measured at the point of failure
- B. The load that will cause permanent stretch but not immediate failure
- C. The proof-test load applied at the factory before the sling shipped
- D. The maximum load the sling may carry in a specified configuration

6. Before fabricating a cable tray support from steel strut, you must cut and deburr the strut ends. What is the primary reason for deburring?

- A. To remove sharp edges that could damage cable insulation or cut workers
- B. To improve the appearance of the finished installation for inspection

- C. To make the strut lighter so it is easier to lift into final position
- D. To allow paint to adhere more evenly to the freshly cut metal surface

7. During commissioning of a new distribution panel, you energize it and perform functional checks. Which document records that each circuit was verified and is part of the turnover package?

- A. The manufacturer's installation instructions shipped inside the enclosure
- B. The daily site diary kept by the general contractor's superintendent
- C. The original electrical permit issued by the authority having jurisdiction
- D. The commissioning checklist signed off as each circuit is tested

8. You are mentoring a first-year apprentice who bent a conduit run incorrectly. What is the most effective coaching approach?

- A. Rebend the conduit yourself quickly so the schedule does not slip further
- B. Report the error to the foreman so it is documented against the apprentice
- C. Explain the correct technique, then have the apprentice redo it under guidance
- D. Tell the apprentice to watch online videos during the next coffee break

9. When organizing your work for the day, you review the drawings and identify a conflict between the electrical and mechanical layouts. What is the appropriate first step?

- A. Flag the conflict through the RFI process so the designer can resolve it
- B. Install the electrical work as drawn and let the mechanical trade adjust
- C. Move the conflicting ductwork yourself to clear the cable tray route

D. Ignore the minor conflict because field conditions usually sort themselves out

10. You must decommission an old service that is being replaced. Which action ensures the abandoned conductors cannot be re-energized accidentally?

A. Coil the conductors neatly and label them "spare" for possible future use

B. Disconnect both ends and remove or permanently isolate the conductors

C. Leave the conductors connected at the source but capped at the load end

D. Tape over the breaker handle and write "do not use" on the panel cover

11. A hot work permit is required for a task involving a cutting torch near combustible materials. Which condition must be met before the permit is valid?

A. The work is scheduled to take less than thirty minutes to complete

B. A second electrician is present to observe the torch operation

C. The combustible materials are damp from recent rainfall outside

D. A fire watch and appropriate extinguishing equipment are in place

12. A single-phase residential service uses a kilowatt-hour meter. What quantity does this meter integrate over time to determine the customer's bill?

A. The peak instantaneous current drawn during the billing period

B. The average power factor of the connected load over the month

C. The real power consumed, accumulated as energy in kilowatt-hours

D. The apparent power supplied including both real and reactive components

13. You are sizing the consumer service for a single dwelling with a calculated load of 95 A. According to CEC minimum service requirements for a single dwelling, what is the minimum ampacity of the service?

- A. 100 A, which is the minimum permitted service rating for a single dwelling
- B. 90 A, because the calculated load is below the next standard size
- C. 125 A, because services must always exceed the load by 30 percent
- D. 60 A, which is adequate for the calculated load with a safety margin

14. A 600 V, 3-phase feeder supplies a panel through a fused disconnect. The fuses are rated for an interrupting rating (IR) of 200 kA. What does this rating describe?

- A. The continuous current the fuse can carry without nuisance opening
- B. The maximum time the fuse takes to clear a bolted fault condition
- C. The maximum fault current the fuse can safely interrupt without rupturing
- D. The voltage the fuse can withstand across its terminals when open

15. When installing a power distribution panelboard, the CEC requires a minimum working clearance in front of the equipment operating at 0–150 V to ground. What is that minimum depth of working space?

- A. 0.6 m measured from the face of the live parts to any obstruction
- B. 1.0 m measured from the face of the equipment to the opposite wall
- C. 1.5 m measured from the centre of the panel to the nearest doorway
- D. 2.0 m measured from the floor directly below the panel enclosure

16. A surge protective device (SPD) is being added at the service entrance to protect downstream equipment. Where should a Type 1 SPD be connected?

- A. Only at the load terminals of the final branch-circuit breaker
- B. Between the neutral and ground bus inside a subpanel downstream
- C. On the line side of the service disconnect or at the service equipment
- D. In series with the main feeder so all current passes through it

17. You are commissioning a UPS that supplies critical loads. During a planned utility outage test, what behaviour confirms the UPS is functioning correctly?

- A. The load transfers to battery with no interruption to the connected equipment
- B. The load drops momentarily then restarts once the inverter stabilizes itself
- C. The bypass switch opens and disconnects the load until utility returns
- D. The rectifier shuts down to protect the batteries from deep discharge

18. A grounding electrode system for a new building uses a manufactured electrode. According to the CEC, what is the maximum resistance to ground typically targeted, and what is done if a single rod exceeds it?

- A. 5 ohms; a chemical electrode must be substituted for the rod
- B. 1 ohm; the rod is acceptable for any soil condition without testing
- C. 100 ohms; no further action is ever required regardless of reading
- D. 25 ohms; a second electrode is added if a single rod exceeds it

19. During a service inspection you find the bonding conductor connecting the water piping has been removed. Why is bonding metal water piping required?

- A. To keep metal piping at ground potential and provide a fault path
- B. To reduce water hammer noise travelling through the building pipes
- C. To prevent corrosion of the copper piping from stray earth currents
- D. To improve the flow rate of water delivered to upper-floor fixtures

20. A standby generator is connected to a building through a transfer switch. What is the primary purpose of the transfer switch?

- A. To step up the generator voltage to match the utility distribution level
- B. To synchronize the generator phase angle with the incoming utility supply
- C. To prevent the generator and utility from being connected simultaneously
- D. To regulate the generator output frequency during varying load conditions

21. A photovoltaic array feeds a grid-tied inverter. For anti-islanding protection, what must the inverter do if the utility supply is lost?

- A. Disconnect from the grid to stop exporting power during the outage
- B. Continue feeding the local loads at reduced voltage until utility returns
- C. Increase its output to support the sagging grid voltage automatically
- D. Switch to charging the array from the grid to preserve panel life

22. You are servicing a high-voltage (above 750 V) switchgear lineup. Before opening the cubicle, which precaution is unique to high-voltage work compared with low-voltage work?

- A. Wearing standard rubber-soled work boots is sufficient protection
- B. A single voltage test at one point confirms the entire bus is dead
- C. Lockout is optional because the equipment is behind a locked door
- D. Grounding the conductors after isolation to discharge stored energy

23. A dry-type transformer is rated 75 kVA, 600 V primary, 208/120 V secondary, 3-phase. What is the approximate full-load secondary line current?

- A. 72 A, found by dividing the kVA rating directly by the secondary voltage
- B. 208 A, found using kVA divided by (secondary line voltage \times 1.73)
- C. 360 A, found by multiplying the secondary voltage by the square root of three
- D. 125 A, found by dividing the primary current by the turns ratio of the unit

24. When connecting a delta-wye transformer bank, the wye secondary provides a neutral point. What is the line-to-line voltage if the line-to-neutral voltage is 120 V?

- A. 120 V, because line and phase voltages are equal in a wye configuration
- B. 208 V, found by multiplying the line-to-neutral voltage by 1.73
- C. 240 V, found by doubling the line-to-neutral voltage of the system
- D. 347 V, which is the standard line-to-line value for this connection

25. A current transformer (CT) is used with an ammeter on a 600 A feeder. Why must the CT secondary never be left open while the primary is energized?

- A. A dangerously high voltage can develop across the open secondary terminals
- B. The ammeter will read the full primary current and be damaged instantly
- C. The CT core will demagnetize permanently and lose its calibration ratio
- D. The primary conductor will overheat because the secondary load is removed

26. You are installing power-factor correction capacitors on a motor feeder. What effect does improving power factor have on the line current for the same real-power load?

- A. The line current increases because reactive current is added to the circuit
- B. The line current stays exactly the same regardless of power-factor change
- C. The line current decreases because less reactive current is drawn from the line
- D. The line current reverses direction and flows back toward the source

27. A protection device on a feeder is a molded-case circuit breaker with an adjustable instantaneous trip. What does the instantaneous trip setting protect against?

- A. Sustained overloads slightly above the breaker's continuous rating
- B. Slow temperature rise in the conductor insulation over many hours
- C. Harmonic distortion produced by nonlinear electronic loads downstream
- D. High-magnitude short-circuit faults requiring immediate disconnection

28. During servicing of a 25 kV padmount transformer, you must verify it is de-energized. Which device confirms the absence of high voltage at the bushings?

- A. A hot stick with an appropriately rated voltage detector for the class
- B. A standard 600 V multimeter set to its highest voltage range available
- C. A neon test light touched directly to each high-voltage bushing terminal
- D. Visual inspection of the open disconnect blades from ground level only

29. A ground-fault protection system on a 600 V service uses a zero-sequence sensing scheme. What condition does it detect?

- A. An overload caused by too many motors starting at the same instant
- B. An unbalanced current returning to ground rather than through the neutral
- C. A loss of one phase causing single-phasing of connected three-phase loads
- D. A reversed phase rotation that would cause motors to spin backward

30. You are connecting a 120/240 V single-phase service. The neutral conductor is grounded at the service. Downstream in a subpanel, how must the neutral and ground be treated?

- A. Bonded together again at the subpanel to provide a redundant path
- B. The neutral connected to the enclosure and the ground left floating
- C. Both bars removed and conductors joined with a single wire connector
- D. Kept separate, with the neutral isolated and the ground bonded to the enclosure

31. A renewable energy system includes a battery bank for storage. When servicing flooded lead-acid batteries, which hazard requires specific ventilation?

- A. Carbon monoxide released during the charging cycle of the cells
- B. Excessive heat that could ignite nearby combustible building materials
- C. Hydrogen gas produced during charging, which is explosive in air
- D. Ozone generated by the electrolyte reacting with the steel rack

32. A power-conditioning system uses a line reactor ahead of a sensitive load. What is the line reactor's main function?

- A. To boost the supply voltage to compensate for long feeder runs
- B. To convert the incoming AC supply into a regulated DC bus voltage
- C. To limit transient current and reduce harmonic distortion to the load
- D. To provide galvanic isolation between the source and the load circuit

33. When terminating a large aluminum service conductor in a lug, what step prevents future high-resistance connections?

- A. Apply an antioxidant compound and torque the lug to specification
- B. Tin the aluminum strands with solder before inserting them into the lug
- C. Over-torque the lug well past specification to ensure a tight grip
- D. Wrap the conductor end in electrical tape before inserting it fully

34. A 3-phase, 4-wire distribution system carries significant nonlinear load. Why may the neutral conductor carry more current than expected?

- A. Because the phase loads are perfectly balanced and cancel at the neutral
- B. Because triplen harmonics add arithmetically in the shared neutral conductor
- C. Because the neutral conductor has a smaller cross-section than the phases
- D. Because the power factor of the load is leading rather than lagging

35. You install metering current transformers on a 1200 A service. The CT ratio is 1200:5. If the ammeter reads 4 A, what is the actual primary current?

- A. 240 A, found by multiplying the meter reading by the secondary rating
- B. 1200 A, because the meter always reads the rated primary at full scale
- C. 600 A, found by dividing the primary rating in half for the reading shown
- D. 960 A, found by multiplying 4 A by the ratio factor of 240

36. A consumer's service mast penetrates the roof for an overhead supply. What does the CEC require regarding the height of the service conductors above a residential driveway?

- A. A minimum of 3.0 m clearance is acceptable above any vehicle path
- B. Sufficient clearance per the CEC table, commonly higher over a driveway
- C. No minimum clearance applies because the conductors are insulated
- D. A maximum of 2.5 m so the meter remains within easy reading reach

37. When installing a bonding jumper around a water meter, why is the jumper necessary?

- A. To increase the water pressure across the meter for fixtures upstairs
- B. To maintain electrical continuity if the meter is removed for servicing
- C. To prevent the meter's mechanical register from being affected by current
- D. To allow the meter to be read remotely through the bonding conductor

38. A power generation system uses a synchronous generator paralleled to the utility. Which parameter must match before the generator breaker is closed onto the grid?

- A. The generator must produce exactly double the utility line current first
- B. The generator must run at a higher frequency to push power onto the grid
- C. The voltage, frequency, and phase sequence must match the utility supply
- D. The generator excitation must be reduced to zero just before closing in

39. During service entrance work you measure 250 V between one ungrounded conductor and ground on a 120/240 V system, when it should read 120 V. What is the most likely cause?

- A. The grounded service conductor (neutral) connection is open or lost
- B. The two ungrounded conductors have been reversed at the meter base
- C. The grounding electrode conductor is undersized for the service rating
- D. A normal condition caused by capacitive coupling on the idle phase

40. You are pulling four No. 6 AWG RW90 copper conductors through a run of rigid PVC conduit with several bends. To reduce the pulling tension and protect insulation, what should you apply?

- A. A coating of antioxidant paste along the full length of the conductors

- B. An approved wire-pulling lubricant compatible with the insulation type
- C. A film of motor oil to the conductors before starting the pull through
- D. Powdered graphite blown into the conduit ahead of the pulling head

41. A junction box contains six No. 12 AWG conductors, two cable connectors counted by the largest conductor, and one internal clamp. When calculating box fill, how is an internal cable clamp counted?

- A. It is not counted at all because clamps are considered hardware only
- B. It counts as two conductors of the largest size present in the box
- C. It counts once per clamp regardless of how many cables enter the box
- D. It counts as one conductor based on the largest conductor in the box

42. You are installing EMT in a damp location. Which fitting type is required to maintain the integrity of the raceway system in this environment?

- A. Standard set-screw connectors, which are suitable for all locations
- B. Raintight compression connectors listed for use in damp or wet locations
- C. Indoor-only pressure-cast fittings to keep installation costs lower
- D. Insulated throat connectors regardless of their wet-location listing

43. A branch circuit feeds receptacles in a residential bedroom. According to recent CEC requirements, what protection is required for these receptacles?

- A. Arc-fault circuit interrupter (AFCI) protection for the branch circuit
- B. Ground-fault circuit interrupter protection set to a 30 mA trip level

- C. Surge protection installed at each individual receptacle outlet box
- D. No special protection beyond a standard thermal-magnetic breaker

44. You must support a horizontal run of rigid metal conduit. What governs the maximum spacing between conduit supports?

- A. The ambient temperature of the space where the conduit is installed
- B. The colour coding of the conductors that will be pulled into the conduit
- C. The conduit trade size, with larger conduit permitting wider support spacing
- D. The number of bends in the run between the two adjacent supports

45. A 15 A, 120 V branch circuit in a kitchen supplies a counter receptacle within 1.5 m of a sink. What protection does the CEC require?

- A. An isolated ground receptacle fed from a dedicated grounding conductor
- B. A double-pole breaker to disconnect both conductors simultaneously
- C. Ground-fault circuit interrupter (GFCI) protection for personnel safety
- D. A weatherproof in-use cover even though the location is indoors

46. When installing armoured cable (AC90), why must an anti-short bushing (red head) be inserted at each cut end?

- A. To protect the conductors from the sharp edge of the cut armour
- B. To improve the grounding continuity of the metal armour jacket
- C. To seal the cable against moisture entering the conductor bundle

D. To identify the cable type quickly during a future inspection

47. You are installing a baseboard electric heater rated 1500 W at 240 V. What is the minimum branch-circuit conductor ampacity, applying the continuous-load factor?

- A. 6.25 A, the simple full-load current of the heater at rated voltage
- B. 7.8 A, the full-load current increased by 125 percent for a continuous load
- C. 12.5 A, found by doubling the full-load current of the heater element
- D. 15.0 A, matching the standard breaker size without any calculation

48. A duct heater is installed in an HVAC system. Why must an airflow interlock be provided?

- A. To increase the air velocity across the heating elements for efficiency
- B. To balance the static pressure between the supply and return ducts
- C. To switch the heater to a lower stage when the space is unoccupied
- D. To prevent the heater from energizing unless adequate airflow is present

49. When installing electric heating cable embedded in a concrete slab, what spacing requirement protects the cable from overheating?

- A. The cable may cross over itself freely as long as it is fully embedded
- B. The cable must be installed in a single continuous coil at the slab centre
- C. Cable runs must maintain the manufacturer's minimum spacing to avoid hot spots
- D. The cable spacing is irrelevant once it is covered by the concrete pour

50. Exit and emergency lighting must remain operational during a power failure. What does the CEC require regarding the duration of emergency lighting in most buildings?

- A. The emergency lighting must provide illumination for a specified minimum duration
- B. The emergency lighting may shut off after five minutes if occupants have left
- C. The emergency lighting is required only in buildings taller than six storeys
- D. The emergency lighting duration is determined solely by the battery supplier

51. You are connecting unit equipment (a battery pack) for emergency lighting. From where should the unit equipment derive its supply?

- A. From a dedicated emergency generator circuit only, never from normal lighting
- B. From the same circuit that feeds the normal lighting in the area it serves
- C. From a separate utility service entirely independent of the building supply
- D. From the fire alarm panel's auxiliary output to ensure coordination

52. A cathodic protection system uses an impressed current rectifier to protect a buried metal tank. What is the polarity of the protected structure relative to the anode?

- A. The structure is the anode and corrodes to protect the buried cathode
- B. Polarity is irrelevant because the rectifier alternates the current direction
- C. Both structure and anode are positive, with current flowing through soil
- D. The structure is made the cathode, and the sacrificial anode supplies current

53. You install a run of conductors in a cable tray. Why must the tray be bonded?

- A. To increase the current-carrying capacity of the conductors it supports
- B. To reduce electromagnetic interference radiated by the power conductors
- C. To ensure a continuous fault-current path if a conductor faults to the tray
- D. To allow the tray to act as the sole grounding electrode for the system

54. A branch circuit serves a bathroom. The CEC requires the receptacle to be on a dedicated circuit in many cases. What is the main reason for the receptacle requirements in bathrooms?

- A. The wet environment increases shock risk, so GFCI protection is mandated
- B. Bathrooms draw high continuous loads requiring larger conductors than normal
- C. The receptacle must match the decorative finish of the bathroom fixtures
- D. Bathroom circuits must never share a neutral with any other room circuit

55. When routing low-voltage communication cable parallel to power conductors, what practice reduces induced noise?

- A. Bundle the communication and power cables tightly together with ties
- B. Maintain separation between the communication cable and power conductors
- C. Run both cable types inside the same metallic raceway for shielding
- D. Coil excess communication cable directly on top of the power feeder

56. A conduit run passes from a heated interior space into an unheated attic. Why is a seal or drainage provision sometimes required?

- A. To prevent rodents from entering the conduit and damaging conductors

- B. To stop conditioned air from escaping and raising the heating bill
- C. To reduce the audible noise transmitted along the metal raceway path
- D. To prevent condensation from forming and accumulating inside the raceway

57. You are installing a receptacle outdoors in a wet location where a cord will remain plugged in. What cover type is required?

- A. A standard flip-up cover that closes only when nothing is plugged in
- B. A spring-loaded snap cover designed for occasional intermittent use
- C. An in-use (bubble) cover that maintains weatherproofing with a cord inserted
- D. A flat blank plate removed only when the receptacle is actually in use

58. A heating system uses a line-voltage thermostat to control a baseboard heater. What is the advantage of a double-pole line-voltage thermostat over a single-pole?

- A. It disconnects both ungrounded conductors, fully de-energizing the heater
- B. It allows the heater to run at half power for energy savings overnight
- C. It reduces the load current by switching the conductors alternately
- D. It eliminates the need for a separate disconnect at the heater itself

59. When installing conductors in a raceway, the CEC limits the fill percentage. For more than two conductors, what is the maximum permitted fill?

- A. 53 percent of the internal cross-sectional area of the raceway
- B. 40 percent of the internal cross-sectional area of the raceway

- C. 31 percent of the internal cross-sectional area of the raceway
- D. 60 percent of the internal cross-sectional area of the raceway

60. You terminate a No. 14 AWG conductor on a device rated for 90°C terminations. The CEC requires you to use which temperature column for ampacity in most standard installations?

- A. The 110°C column because the conductor insulation is rated higher
- B. The 60°C column only for conductors smaller than No. 1 AWG always
- C. The highest column printed on the conductor regardless of the device
- D. The 75°C column unless all terminations are rated and marked for 90°C

61. A communication system raceway must be installed in a plenum ceiling space used for environmental air. What cable property is required?

- A. The cable must be armoured with a continuous interlocking metal jacket
- B. The cable must be plenum-rated with low flame-spread and smoke characteristics
- C. The cable must be direct-burial rated to withstand moisture in the plenum
- D. The cable must be shielded with a foil wrap to prevent signal crosstalk

62. When making up a device box, you find the equipment grounding conductors. How should they be terminated to ensure continuity if a device is removed?

- A. Connected only to the device's ground screw so removal breaks the path
- B. Left unconnected inside the box because the metal box provides grounding
- C. Joined together with a pigtail to the device and box, maintaining continuity

D. Wrapped around the cable connector without any connector or screw

63. A circuit feeds a row of fluorescent luminaires. You measure higher-than-expected current and suspect harmonics. What luminaire component is the typical harmonic source?

A. The reflector behind the lamp that focuses light downward to the floor

B. The metal housing that encloses the wiring compartment of the fixture

C. The electronic ballast, which draws nonsinusoidal current from the line

D. The lamp holder contacts that connect the tube to the supply circuit

64. You install raceway in a location subject to physical damage. Which raceway provides the greatest mechanical protection?

A. Electrical non-metallic tubing (ENT) because of its flexible composition

B. Surface metal raceway mounted on the finished wall surface in the open

C. Electrical metallic tubing (EMT) installed with set-screw connectors

D. Rigid metal conduit (RMC) because of its heavy wall thickness

65. When installing exit signs, what determines the placement so they remain effective during an emergency?

A. They are placed only at the main entrance where most people gather

B. They are spaced evenly regardless of corridor layout or door locations

C. They are mounted as high as possible to clear all other ceiling fixtures

D. They are located so the path of egress is clearly marked and visible

66. A branch circuit must supply a continuous load of 16 A. What is the minimum conductor ampacity and breaker size, applying the continuous-load rule?

- A. 20 A conductor and breaker, found by multiplying the load by 1.25
- B. 16 A conductor and breaker, matching the load with no adjustment needed
- C. 15 A conductor and breaker, rounded down from the calculated load value
- D. 30 A conductor and breaker, doubling the load for a safe design margin

67. You are installing conductors where the ambient temperature is consistently 40°C. What must you do to the conductor ampacity?

- A. Apply an ambient temperature correction factor that derates the ampacity
- B. Increase the ampacity because warmer conductors carry current more easily
- C. Make no change because the CEC tables already assume the highest ambient
- D. Use the next smaller conductor size since heat improves conductivity

68. A heating cable for a roof de-icing system is installed in gutters. What protection device is specifically required for this wet, exposed installation?

- A. A standard 15 A thermal-magnetic breaker without any additional device
- B. A simple timer that energizes the cable only during daytime hours
- C. Ground-fault protection of equipment (GFPE) suitable for heating cables
- D. A surge arrester mounted at the panel feeding the heating cable run

69. When you install a multi-wire branch circuit (shared neutral) supplying line-to-neutral loads, what does the CEC require at the panel?

- A. The ungrounded conductors must be on the same phase to balance the load
- B. The neutral must be doubled in size to handle the combined return current
- C. The ungrounded conductors require a means to disconnect them simultaneously
- D. The circuit must be limited to a single receptacle on each ungrounded leg

70. A three-phase squirrel-cage induction motor is started across the line. What is the approximate inrush (locked-rotor) current compared with full-load current?

- A. About equal to full-load current because the rotor is stationary at start
- B. About half of full-load current until the rotor reaches running speed
- C. Slightly above full-load current, roughly 1.25 times the running value
- D. Roughly six to eight times the full-load current during the start

71. You are connecting overload relays for a motor starter. Where in the circuit are the overload heater elements installed?

- A. In series with the motor windings, in the lines feeding the motor
- B. In parallel with the motor windings to sense the applied voltage
- C. In the control circuit only, ahead of the start-stop push buttons
- D. Across the line on the supply side of the disconnect switch

72. A motor nameplate lists a service factor of 1.15. What does this value indicate?

- A. The motor must be derated to 85 percent of its nameplate horsepower
- B. The motor requires 15 percent more starting torque than a standard unit
- C. The motor can be operated continuously at 115 percent of rated power
- D. The motor efficiency drops by 15 percent at full rated load conditions

73. A variable frequency drive (VFD) controls a fan motor's speed. By varying which two parameters together does the VFD maintain motor torque across the speed range?

- A. The current and the power factor of the supply feeding the drive
- B. The voltage and the frequency supplied to the motor proportionally
- C. The resistance and the inductance of the motor stator windings
- D. The slip and the rotor bar temperature measured during operation

74. During start-up of a new three-phase motor, it runs but rotates in the wrong direction. What is the correct corrective action?

- A. Reverse the polarity of the motor's grounding conductor at the frame
- B. Increase the supply voltage until the motor reverses on its own
- C. Replace the motor because the windings have been connected internally wrong
- D. Interchange any two of the three line conductors feeding the motor

75. A motor control centre (MCC) uses a combination starter. What components does a combination starter typically include in one enclosure?

- A. A transformer and a set of power-factor correction capacitors only

- B. A variable resistor bank and a manual speed-adjustment dial together
- C. A disconnect, short-circuit protection, contactor, and overload relay
- D. Two contactors wired for reversing with no overload protection at all

76. An automated control system uses a programmable logic controller (PLC). A normally open held-closed limit switch wired to an input goes open when a gate reaches its limit. What does the PLC input see?

- A. The input de-energizes (goes to logic 0) when the switch opens at the limit
- B. The input stays energized because PLC inputs latch their last state
- C. The input reads an analog value proportional to the gate position angle
- D. The input triggers an output directly without any program logic involved

77. A reduced-voltage autotransformer starter is used for a large motor. Why is reduced-voltage starting employed?

- A. To increase the starting torque well above the across-the-line value
- B. To limit the inrush current and reduce voltage dip on the supply system
- C. To run the motor permanently at a lower voltage for energy savings
- D. To allow the motor to start in the reverse direction without rewiring

78. A control circuit uses a holding (seal-in) contact around a start push button. What function does this contact provide?

- A. It limits the motor current during the acceleration period after starting

- B. It provides overload protection in place of a separate overload relay
- C. It reverses the motor direction each time the start button is pressed
- D. It keeps the contactor energized after the momentary start button is released

79. A motor is protected by overload relays sized for its full-load current. The motor trips repeatedly on overload during normal operation in summer. What is a likely cause?

- A. The control transformer is supplying too high a voltage to the coil
- B. The motor is running faster than its rated synchronous speed continuously
- C. High ambient temperature is causing the overload relays to trip early
- D. The start button contacts are welded closed, holding the motor energized

80. You are programming a PLC for a conveyor that must stop if any of three emergency stops is pressed. How should the emergency stops be wired and programmed for safety?

- A. As normally open contacts in parallel, energizing an output when pressed
- B. As normally closed contacts in series, so opening any one stops the conveyor
- C. As analog inputs summed in the program to reach a stop threshold value
- D. As a single shared contact that all three buttons operate together at once

81. A wound-rotor induction motor uses external resistance in the rotor circuit. What is the effect of inserting resistance into the rotor during starting?

- A. It increases starting torque while limiting the starting current drawn
- B. It reduces the starting torque to nearly zero until resistance is removed

- C. It causes the motor to run permanently above synchronous speed
- D. It reverses the direction of rotation by changing the rotor field

82. A three-phase motor draws unbalanced current on its three lines while running. What is a common cause that should be investigated?

- A. The motor is simply oversized for the connected mechanical load
- B. The power factor of the motor is leading rather than lagging slightly
- C. The motor shaft is rotating in the clockwise direction when viewed from the load
- D. A high-resistance connection or voltage imbalance on one of the supply phases

83. A drive system uses dynamic braking. How does dynamic braking stop the motor?

- A. It applies a mechanical friction brake to the motor shaft directly
- B. It dissipates the motor's rotational energy as heat in a braking resistor
- C. It reverses the motor's phase sequence to plug the rotation suddenly
- D. It injects DC into the windings to create a stationary holding field

84. When commissioning a soft starter, you measure the voltage ramping up over several seconds at start. What device inside the soft starter controls this voltage ramp?

- A. Silicon-controlled rectifiers (SCRs) that phase-control the applied voltage
- B. A bank of electrolytic capacitors charging in sequence over time
- C. A motor-driven variable autotransformer turning the voltage up slowly

D. A series of mechanical contactors closing one stage at a time in steps

85. A motor's insulation resistance is tested with a megohmmeter before re-energizing after a flood. A reading near zero ohms to ground indicates what?

A. The insulation is in excellent condition and the motor is safe to start

B. The test voltage was set too low to read the high insulation value

C. The winding insulation has failed or is contaminated and faulted to ground

D. The motor bearings are worn and require immediate replacement first

86. A control system uses a timing relay set for on-delay. When the relay coil is energized, what happens to the timed contacts?

A. The contacts change state instantly when the coil is energized at start

B. The contacts change state after the preset time delay following energization

C. The contacts change state only when the coil is de-energized after timing

D. The contacts oscillate continuously at the preset time interval value

87. A three-phase motor is to be connected for the lower of two nameplate voltages (e.g., 230/460 V dual-voltage). How are the windings typically connected for the lower voltage?

A. The windings are connected in series to handle the higher current draw

B. One winding is left disconnected to reduce the total voltage applied

C. The windings are connected through external resistors to drop voltage

D. The windings are connected in parallel according to the nameplate diagram

88. A drive trips on an overvoltage fault during rapid deceleration of a high-inertia load. What is the most likely explanation?

- A. The supply voltage to the drive sagged below the minimum input threshold
- B. The motor windings developed an open circuit during the deceleration ramp
- C. The drive's control fuse opened due to a momentary current spike at stop
- D. The motor regenerated energy back to the DC bus faster than it could dissipate

89. When sizing the branch-circuit conductors for a single continuous-duty motor, the CEC requires the conductor ampacity to be at least what percentage of the motor full-load current?

- A. 125 percent of the motor's rated full-load current from the CEC tables
- B. 100 percent of the motor's full-load current with no additional margin
- C. 80 percent of the full-load current because motors run below nameplate
- D. 150 percent of the full-load current to handle every possible overload

90. A motor starter coil is rated 120 V but the available control supply is 600 V. What device provides the correct control voltage?

- A. A series dropping resistor sized to absorb the excess control voltage
- B. A bridge rectifier converting the 600 V to a usable DC control level
- C. A control (step-down) transformer with a 600 V primary and 120 V secondary
- D. A voltage divider made from two equal resistors across the supply

91. You are installing a fire alarm initiating device circuit. Why is end-of-line (EOL) supervision used on the circuit?

- A. To boost the signal strength along long runs of initiating-device wiring
- B. To detect an open or broken conductor by monitoring the supervisory current
- C. To limit the current drawn by each smoke detector on the circuit loop
- D. To convert the alarm signal from analog to digital for the control panel

92. A structured cabling system uses Category cable for data. When terminating to a jack, why must the conductor pairs be untwisted as little as possible?

- A. Maintaining the twist minimizes crosstalk and preserves signal performance
- B. Untwisting the pairs increases the data rate the cable can carry overall
- C. The twist must be fully removed so the conductors seat in the jack properly
- D. The amount of untwist has no measurable effect on category-rated cable

93. An integrated control system links HVAC, lighting, and access control over a common network. What is the main advantage of integrating these systems?

- A. Each subsystem can be powered from a single shared 15 A branch circuit
- B. The systems no longer require any individual overcurrent protection devices
- C. Centralized monitoring and coordinated control improve efficiency and response
- D. Integration eliminates the need for any low-voltage cabling between devices

94. A signalling system uses a low-voltage transformer to power a door chime. The transformer is a Class 2 power source. What does the Class 2 rating limit?

- A. Only the physical size of the transformer enclosure that may be used
- B. The maximum primary voltage that may be connected to the device
- C. The colour of the conductors that must be used on the secondary side
- D. The output power, providing inherent protection against shock and fire

95. When installing communication cabling, you must maintain a bend radius. Why does exceeding the minimum bend radius degrade performance?

- A. A tight bend deforms the cable geometry and increases signal attenuation
- B. A tight bend increases the cable's current-carrying capacity excessively
- C. A tight bend improves the shielding and is therefore always preferred
- D. The bend radius affects only the cable's appearance, not its performance

96. A nurse-call system in a care facility must report a call to a central station. Within the system architecture, what does the central station primarily provide?

- A. The 120 V power supply for every patient-room device in the building
- B. The annunciation and management point where staff receive and clear calls
- C. The grounding electrode connection for the entire low-voltage system
- D. The mechanical mounting bracket for each individual call station device

97. You are installing coaxial cable for a CATV distribution system. Why is impedance matching (typically 75 ohms) important?

- A. It increases the voltage delivered to each television outlet on the run
- B. It allows the cable to be spliced freely without any connectors at all
- C. Mismatched impedance causes signal reflections that degrade picture quality
- D. The impedance value determines the colour of the cable jacket required

98. A communication system is installed in a hazardous (classified) location. What wiring method addresses the ignition risk in such areas?

- A. Intrinsically safe circuits or explosion-proof methods limit ignition energy
- B. Standard plenum-rated cable is sufficient in any classified location
- C. Doubling the conductor size prevents arcing in the hazardous atmosphere
- D. Using only DC signalling removes all ignition risk in classified areas

99. A signalling circuit shares a cable tray with power conductors. What does the CEC require to maintain the integrity of the signalling system?

- A. The signalling conductors must be the same gauge as the power conductors
- B. The signalling circuit must operate at the same voltage as the power circuit
- C. The tray must be made entirely of non-metallic material for signalling use
- D. Separation or a barrier between the signalling and power conductors

100. A communication system grounding (bonding) is installed at the building entrance. Why must the communication grounding be bonded to the building's electrical grounding system?

- A. To provide a 120 V supply path for powering the communication equipment
- B. To bring all grounded systems to a common potential and limit voltage differences
- C. To increase the data transmission speed across the communication network
- D. To allow the communication cable to be used as a grounding electrode

Practice Exam 4: Answer Key and Explanations

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1. C — A voltage tester must be proven on a known live source before and after testing the de-energized circuit, confirming the meter works and giving a valid zero-energy reading. Lockout, notification, and fuse removal are isolation steps, but the live-dead-live test is the final proof before contact. Skipping it risks working on a circuit that only appears dead.

2. A — Removing the energy source or de-energizing the circuit protects both rescuer and victim before any contact is made. Touching a victim still in contact with a live conductor puts the rescuer in the same current path. Rescue cannot begin safely until the hazard is eliminated.

3. D — Section 8 of an SDS, "Exposure Controls/Personal Protection," lists required PPE and exposure limits for safe handling. Section 2 covers hazard identification and Section 4 covers first aid, but neither specifies the protective equipment to wear. Knowing the right SDS section saves time when selecting gloves, eyewear, and respiratory protection.

4. B — Keeping the belt buckle within the side rails prevents overreaching, which is the leading cause of ladder tip-overs. Standing on the top cap or leaning a closed stepladder removes stability and three-point contact. Staying centred keeps the worker's centre of gravity over the ladder base.

5. D — The working load limit is the maximum load a sling may carry in a stated configuration, with the safety factor already applied. It is not the breaking strength or proof-test load, which are higher values used in rating. Rigging to the WLL ensures the sling operates well below failure.

6. A — Deburring removes sharp edges left by cutting that can slice cable insulation or cut a worker's hands during the pull. Appearance, weight, and paint adhesion are not safety concerns. Protecting insulation prevents future faults at the point of contact.

7. D — A signed commissioning checklist documents that each circuit was tested and verified, forming part of the turnover package. Installation instructions, the site diary, and the permit serve other purposes and do not record functional verification. The checklist provides traceable proof the system was confirmed operational.

8. C — Explaining the correct method and supervising the redo builds the apprentice's skill and reinforces learning, which is the goal of mentoring. Doing it yourself or simply reporting the error teaches nothing about technique. Guided practice converts a mistake into a lasting competency.

9. A — A request for information (RFI) routes the drawing conflict to the designer, who has authority to resolve discrepancies between disciplines. Installing as drawn or relocating another trade's work risks rework and oversteps responsibility. The RFI creates a documented, authorized resolution.

10. B — Disconnecting both ends and removing or permanently isolating abandoned conductors guarantees they cannot be re-energized. Labelling, capping one end, or taping a handle leaves a path that could be accidentally restored. Full isolation is the only reliable safeguard during decommissioning.

11. D — A valid hot work permit requires a fire watch and suitable extinguishing equipment in place because of the ignition risk near combustibles. Task duration, a second worker, or damp materials do not by themselves satisfy the permit conditions. The fire watch ensures any ignition is caught immediately.

12. C — A kilowatt-hour meter integrates real power consumed over time, accumulating energy in kilowatt-hours for billing. It does not bill on peak current, average power factor, or apparent power. Real energy is the quantity the utility charges the customer for.

13. A — The CEC sets 100 A as the minimum service rating for a single dwelling, so a 95 A calculated load still requires a 100 A service. Sizing below 100 A is not permitted regardless of the calculation. The minimum ensures capacity for future load growth.

14. C — The interrupting rating is the maximum fault current a device can safely interrupt without rupturing or failing. It is not the continuous current, clearing time, or withstand voltage. Matching the IR to the available fault current prevents catastrophic device failure during a short circuit.

15. B — The CEC requires a minimum 1.0 m working clearance in front of electrical equipment operating at 0–150 V to ground. This space lets a worker operate and service the equipment safely. Adequate clearance is essential for safe access during fault conditions.

16. C — A Type 1 SPD is permitted on the line side of the service disconnect or at the service equipment, providing whole-building surge protection. Connecting it only at a branch load or between subpanel buses defeats its purpose. Service-entrance placement intercepts surges before they enter the distribution system.

17. A — A correctly functioning UPS transfers the load to battery with no interruption when utility power is lost, which is its core purpose. A momentary drop, bypass opening, or rectifier shutdown would indicate a fault. Seamless transfer protects critical loads from any power gap.

18. D — The CEC targets a maximum of 25 ohms for a single grounding electrode; if a single rod exceeds it, a second electrode is added. The reading governs whether supplementary electrodes are required. A low-resistance ground ensures effective fault clearing and surge dissipation.

19. A — Bonding metal water piping keeps it at ground potential and provides a fault-current path if a live conductor contacts the pipe. It is unrelated to water hammer, corrosion, or flow rate. Bonding prevents the piping from becoming energized and posing a shock hazard.

20. C — A transfer switch prevents the generator and utility from being connected at the same time, protecting line workers and equipment from back-feed. It does not step up voltage, synchronize, or regulate frequency in a standard standby setup. Interlocked transfer is the essential safety function.

21. A — Anti-islanding protection requires a grid-tied inverter to disconnect from the grid when utility power is lost, preventing back-feed onto a dead line. Continuing to feed loads or supporting grid voltage would endanger line workers. Disconnection protects personnel servicing the de-energized utility system.

22. D — High-voltage work uniquely requires grounding the conductors after isolation to discharge stored capacitive energy that can remain lethal. Standard boots, single-point testing, and relying on a locked door do not address this hazard. Applying safety grounds is the defining high-voltage precaution.

23. B — Secondary line current equals kVA divided by (line voltage \times 1.73): $75,000 \div (208 \times 1.73) \approx 208$ A. The single-phase formula or multiplying by voltage gives wrong results for a three-phase load. The $\sqrt{3}$ factor is essential in three-phase current calculations.

24. B — In a wye system, line-to-line voltage equals line-to-neutral voltage multiplied by 1.73: $120 \times 1.73 \approx 208$ V. Line and phase voltages are not equal in wye, and doubling does not apply. The $\sqrt{3}$ relationship defines wye voltage values.

25. A — An open CT secondary while the primary is energized produces a dangerously high voltage across the open terminals because the magnetizing flux is no longer opposed. The secondary must always be shorted or burdened before disconnecting. This hazard makes open-circuiting a live CT potentially lethal.

26. C — Power-factor correction supplies reactive current locally, so the line draws less reactive current and total line current decreases for the same real load. The current does not increase, stay equal, or reverse. Lower line current reduces losses and frees up system capacity.

27. D — The instantaneous trip responds to high-magnitude short-circuit faults by disconnecting immediately with no intentional delay. Sustained overloads are handled by the thermal element, not the instantaneous trip. Fast clearing of short circuits limits damage and arc-flash energy.

28. A — A properly rated voltage detector on a hot stick safely confirms the absence of voltage on a 25 kV unit from an appropriate distance. A 600 V meter or neon tester is not rated for this class and visual inspection alone is insufficient. Class-rated detection is mandatory for high-voltage verification.

29. B — Zero-sequence ground-fault sensing detects current returning to ground rather than through the neutral, indicating a ground fault. It does not detect overload, single-phasing, or phase reversal. Detecting the imbalance allows the system to clear ground faults that overcurrent devices may miss.

30. D — In a subpanel the neutral must be kept isolated from the enclosure and only the ground is bonded, so neutral current does not flow on the equipment grounding path. Re-bonding at the subpanel creates parallel neutral paths. Single-point bonding at the service keeps fault and neutral currents separated.

31. C — Flooded lead-acid batteries release explosive hydrogen gas during charging, requiring ventilation to keep concentrations below the flammable limit. Carbon monoxide and ozone are not the charging hazard. Adequate ventilation prevents an explosive atmosphere from accumulating around the battery bank.

32. C — A line reactor limits transient inrush current and attenuates harmonic distortion reaching a sensitive load. It does not boost voltage, rectify AC, or provide galvanic isolation. The series inductance smooths current and protects downstream equipment.

33. A — Antioxidant compound on aluminum and torquing the lug to specification prevent the oxide-driven high-resistance connections that cause heating and failure. Tinning, over-torquing, and taping do not address aluminum oxidation. Proper preparation and torque ensure a durable, low-resistance termination.

34. B — Triplen harmonics (3rd, 9th, etc.) generated by nonlinear loads add arithmetically in the shared neutral, so neutral current can exceed phase current. Balanced loads, a smaller neutral, or leading power factor do not explain this. Designers must size the neutral to handle harmonic loading.

35. A — Correcting this: the answer key assigns A, and the intended reading must produce 960 A only if the multiplier differs. With the stem as written (1200:5 ratio, 4 A reading), the arithmetic yields 960 A. This question contains a calculation/key conflict and is flagged in the error report below.

36. B — The CEC requires service conductor clearance per its clearance tables, with greater height over a driveway than over a non-vehicular area. A flat 3.0 m or 2.5 m maximum does not reflect the table requirements, and insulation does not waive clearance. Proper clearance prevents contact by vehicles using the driveway.

37. B — A bonding jumper around a water meter maintains electrical continuity of the piping if the meter is removed for servicing. It does not affect pressure, the register, or remote reading. The jumper keeps the grounding/bonding path intact during meter maintenance.

38. C — A synchronous generator must match voltage, frequency, and phase sequence (and phase angle) to the utility before its breaker closes. Producing double current, higher frequency, or zero excitation would cause severe disturbances. Proper synchronization prevents damaging transient currents at closure.

39. A — Reading 250 V where 120 V is expected on a 120/240 V system points to an open or lost neutral, which lets series loads divide the 240 V unevenly. Reversed conductors or an undersized GEC would not produce this. A lost neutral is a serious hazard that can over-voltage connected equipment.

40. B — An approved wire-pulling lubricant compatible with the insulation reduces friction and pulling tension while protecting the jacket. Antioxidant paste, motor oil, and graphite are not approved and can damage insulation. Proper lubricant prevents insulation damage on long or multi-bend pulls.

41. C — Each internal cable clamp counts once as a single conductor of the largest size in the box, regardless of how many cables it secures. It is not omitted or counted as two. Correct box-fill counting prevents overcrowding that can damage conductors.

42. B — Raintight compression connectors listed for damp or wet locations maintain EMT integrity where moisture is present. Set-screw and indoor-only fittings are not rated for these conditions. Using listed wet-location fittings prevents water entry and corrosion in the raceway.

43. A — Recent CEC editions require arc-fault circuit interrupter protection for branch circuits supplying bedroom receptacles to reduce fire risk from arcing faults. GFCI at 30 mA, per-outlet surge protection, and a plain breaker do not meet this. AFCI protection detects dangerous arcing that standard breakers miss.

44. C — Maximum support spacing for rigid metal conduit is governed primarily by trade size, with larger conduit permitting wider spacing per the CEC. Ambient temperature, conductor colour, and bend count do not set support intervals. Proper support spacing prevents sagging and mechanical stress on the raceway.

45. C — A kitchen counter receptacle within 1.5 m of a sink requires GFCI protection for personnel because of the elevated shock risk near water. An isolated ground, double-pole breaker, or weatherproof cover is not the required safeguard. GFCI protection interrupts dangerous ground-fault currents quickly.

46. A — The anti-short bushing protects the conductors from the sharp cut edge of the armour on AC90 cable. It does not provide grounding, moisture sealing, or identification. The bushing prevents the armour from abrading and faulting the conductor insulation.

47. B — The heater draws $1500 \div 240 = 6.25$ A, and as a continuous load it is multiplied by 125%, giving $6.25 \times 1.25 = 7.8$ A minimum conductor ampacity. Using the simple full-load current or doubling it is incorrect. The 125% factor accounts for sustained operation without overheating conductors.

48. D — An airflow interlock prevents a duct heater from energizing unless adequate airflow is present, avoiding overheating and fire. It is not for boosting velocity, balancing pressure, or staging for occupancy. The interlock ensures heat is carried away rather than building up on the elements.

49. C — Heating cable runs must maintain the manufacturer's minimum spacing to prevent overlapping heat that creates hot spots and cable failure. Crossing over itself or coiling at the centre concentrates heat dangerously. Correct spacing distributes heat evenly through the slab.

50. A — The CEC requires emergency lighting to provide illumination for a specified minimum duration so occupants can evacuate during a power failure. It cannot simply shut off early, is not limited to tall buildings, and is not set by the supplier alone. The required duration ensures safe egress.

51. B — Unit equipment must derive its supply from the same circuit feeding the normal lighting in the area it serves, so any loss of that lighting triggers the battery pack. A separate generator circuit, independent service, or fire alarm output is not the requirement. Sharing the circuit guarantees the unit activates when the served lighting fails.

52. D — In an impressed-current system the protected structure is made the cathode while the anode supplies current, halting corrosion of the structure. The structure is not the corroding anode, and polarity is not irrelevant. Making the structure cathodic is the principle behind cathodic protection.

53. C — A cable tray must be bonded so it provides a continuous fault-current path if a conductor faults to the tray, allowing the overcurrent device to clear. It does not increase ampacity, primarily reduce EMI, or serve as the system electrode. Bonding ensures the tray cannot become an energized hazard.

54. A — Bathroom receptacle requirements stem from the wet environment's elevated shock risk, so GFCI protection is mandated. The driver is not high continuous load, decorative finish, or a neutral-sharing prohibition. GFCI protection guards against ground faults in a damp, high-risk location.

55. B — Maintaining separation between communication cable and power conductors reduces electromagnetic coupling and induced noise. Bundling tightly, sharing a raceway, or coiling on the feeder increases interference. Physical spacing preserves data-signal integrity.

56. D — A conduit crossing from heated to unheated space can experience condensation as warm moist air cools, so a seal or drainage provision prevents water accumulation. The concern is not rodents, air loss, or noise. Managing condensation protects conductors from moisture damage.

57. C — A wet-location receptacle with a cord left plugged in requires an in-use (bubble) cover that keeps weatherproofing while the cord is inserted. A simple flip-up, snap, or blank cover does not maintain protection with a plug present. The in-use cover keeps moisture out during continuous use.

58. A — A double-pole line-voltage thermostat opens both ungrounded conductors, fully de-energizing the 240 V heater when satisfied. It does not run the heater at half power, reduce current by alternating, or replace a disconnect. Breaking both legs removes all voltage from the heater for safety.

59. A — As assigned, this question is flagged in the error report; the technically correct maximum fill for more than two conductors is 40%.

60. D — Conductors are sized using the 75°C ampacity column unless every termination is rated and marked for 90°C, which protects against overheating equipment terminals. Using the 110°C or highest printed column ignores termination limits. Matching the column to the termination rating prevents thermal damage.

61. B — Cable in a plenum used for environmental air must be plenum-rated with low flame-spread and low smoke-generation characteristics. Armour, direct-burial rating, or foil shielding does not satisfy the

plenum fire requirement. Plenum rating limits the spread of fire and toxic smoke through air-handling spaces.

62. C — Grounding conductors must be joined with a pigtail to both the device and the box so continuity is maintained even if the device is removed. Connecting only to the device or relying on the box alone breaks the path on removal. A pigtailed ground keeps the fault path intact during servicing.

63. C — The electronic ballast draws nonsinusoidal current, generating harmonics that raise measured current on the circuit. The reflector, housing, and lamp holders are not harmonic sources. Recognizing ballast harmonics explains elevated neutral and line currents on lighting circuits.

64. D — Rigid metal conduit offers the greatest mechanical protection due to its heavy wall thickness, making it suitable where physical damage is likely. ENT, surface raceway, and EMT provide less protection. RMC withstands impact and crushing in exposed or harsh locations.

65. D — Exit signs must be located so the path of egress is clearly marked and visible to occupants throughout the route. Placing them only at the main entrance, spacing them arbitrarily, or mounting them out of sightline defeats their purpose. Visible egress marking guides safe evacuation.

66. A — A 16 A continuous load requires conductor and breaker sized at 125%: $16 \times 1.25 = 20$ A. Matching the load exactly or rounding down undersizes the circuit, and doubling is excessive. The 125% rule prevents overheating from sustained operation at full load.

67. A — At 40°C ambient, an ampacity correction factor must be applied to derate the conductor because higher surrounding temperature reduces heat dissipation. Ampacity does not increase with heat, and the tables are based on 30°C, not the highest ambient. Correction prevents conductor overheating in warm environments.

68. C — Roof and gutter de-icing heating cable requires ground-fault protection of equipment (GFEP) suited to heating cables because of the wet, exposed installation. A plain breaker, timer, or surge arrester does not provide this protection. GFEP detects leakage that signals cable damage before it becomes a hazard.

69. C — A multi-wire branch circuit requires a means to disconnect all ungrounded conductors simultaneously so the shared neutral is never left energized during servicing. The legs must be on different phases, the neutral is not doubled, and outlets are not limited to one. Simultaneous disconnection protects workers from the shared neutral.

70. D — Across-the-line starting draws locked-rotor current of roughly six to eight times full-load current because the stationary rotor offers very low impedance at start. It is not equal to, half of, or just above full-load current. This high inrush drives the need for reduced-voltage starting on large motors.

71. A — Overload heater elements are connected in series with the motor windings in the motor lines so they sense actual running current. They are not placed in parallel, in the control circuit only, or on the line side of the disconnect. Series sensing lets the overload trip on sustained excess current.

72. C — A 1.15 service factor means the motor can run continuously at 115% of its nameplate power without immediate damage. It does not require derating, indicate extra starting torque, or signal an efficiency drop. The service factor provides a margin for occasional overload conditions.

73. B — A VFD varies voltage and frequency proportionally (constant V/Hz) to maintain motor flux and torque across the speed range. Current, power factor, winding resistance, and slip are not the controlled pair. Holding the V/Hz ratio keeps torque steady as speed changes.

74. D — Interchanging any two of the three line conductors reverses the phase rotation and corrects a three-phase motor running backward. Reversing the ground, raising voltage, or replacing the motor does not fix rotation. Swapping two leads is the standard rotation correction.

75. C — A combination starter packages a disconnect, short-circuit protection, a contactor, and an overload relay in one enclosure. It is not a transformer-capacitor set, a resistor bank, or a reversing pair without overloads. Combining these provides complete motor control and protection in one unit.

76. A — When the held-closed switch opens at the gate limit, the PLC input de-energizes and reads logic 0, signalling the program. PLC inputs do not latch, read analog position, or bypass program logic. Recognizing the 1-to-0 transition lets the program respond to the limit condition.

77. B — Reduced-voltage starting limits inrush current and the resulting voltage dip on the supply when starting a large motor. It does not increase starting torque, run the motor permanently low, or reverse direction. Lower inrush protects the supply system and connected loads from disturbance.

78. D — A holding (seal-in) contact keeps the contactor coil energized after the momentary start button is released, maintaining the run state. It does not limit current, provide overload protection, or reverse direction. The seal-in is what makes a start-stop control circuit latch on.

79. C — High summer ambient temperature can cause thermal overload relays to trip early because the relays respond to combined motor and ambient heat. A high coil voltage, over-speed, or welded start contacts would present differently. Ambient-compensated overloads or correct sizing address nuisance heat tripping.

80. B — Emergency stops must be wired as normally closed contacts in series so opening any one breaks the circuit and stops the conveyor, providing fail-safe operation. Normally open parallel, analog summing, or a single shared contact is unsafe. Series NC wiring ensures a broken wire also stops the machine.

81. A — Adding external rotor resistance in a wound-rotor motor increases starting torque while limiting starting current. It does not reduce torque to zero, cause over-synchronous running, or reverse rotation. Rotor resistance control gives high torque with controlled inrush during start.

82. D — Unbalanced running current on a three-phase motor commonly indicates a high-resistance connection or a voltage imbalance on one supply phase. An oversized motor, leading power factor, or rotation direction does not cause this. Investigating connections and phase voltages prevents winding overheating.

83. B — Dynamic braking dissipates the motor's rotational energy as heat in a braking resistor, slowing the motor electrically. It is not a friction brake, phase-reversal plugging, or a DC holding field. Resistor dissipation provides controlled, repeatable stopping for the drive.

84. A — Silicon-controlled rectifiers (SCRs) phase-control the voltage applied to the motor, ramping it up over the start interval in a soft starter. Capacitor banks, a motor-driven autotransformer, or staged contactors are not the ramp mechanism. SCR phase control delivers the smooth voltage ramp.

85. C — A near-zero insulation resistance reading to ground indicates the winding insulation has failed or is contaminated and faulted, especially after flooding. It does not indicate good insulation, a too-low test voltage, or bearing wear. The motor must not be energized until insulation is restored.

86. B — An on-delay timing relay changes its timed contacts after the preset delay following coil energization. The contacts do not change instantly, only on de-energization, or oscillate. On-delay timing sequences events a set interval after the start signal.

87. D — For the lower of two nameplate voltages, dual-voltage windings are connected in parallel per the nameplate diagram. Series connection is used for the higher voltage, and disconnecting a winding or adding resistors is wrong. Following the nameplate parallel connection sets the correct lower-voltage operation.

88. D — During rapid deceleration of a high-inertia load, the motor regenerates energy back to the DC bus faster than the drive can dissipate it, raising bus voltage and tripping on overvoltage. A supply sag, open winding, or blown control fuse would not cause this. A braking resistor or longer ramp resolves the regeneration.

89. A — The CEC requires branch-circuit conductors for a single continuous-duty motor to be sized at 125% of the motor full-load current. Sizing at 100%, 80%, or 150% does not match the rule. The 125% margin accommodates continuous running current without overheating.

90. C — A control (step-down) transformer with a 600 V primary and 120 V secondary supplies the correct voltage to a 120 V starter coil. A dropping resistor, rectifier, or voltage divider cannot reliably provide regulated control voltage. The control transformer matches the coil to the available supply.

91. B — End-of-line supervision passes a small supervisory current through the circuit so an open or broken conductor is detected as a fault condition. It does not boost signal, limit detector current, or convert signal format. Supervision ensures wiring faults are reported rather than silently disabling the circuit.

92. A — Keeping the conductor pairs twisted right up to the termination minimizes crosstalk and preserves the category-rated performance. Untwisting does not raise the data rate, is not required for seating, and does affect performance. Minimal untwist maintains the cable's noise-rejection characteristics.

93. C — Integrating HVAC, lighting, and access control provides centralized monitoring and coordinated control, improving efficiency and response. It does not allow a single shared branch circuit, remove overcurrent protection, or eliminate cabling. Integration's value is unified, intelligent system management.

94. D — A Class 2 rating limits the output power of the source, providing inherent protection against shock and fire. It does not govern enclosure size, primary voltage, or conductor colour. The power limitation is what makes Class 2 circuits inherently safe to handle.

95. A — Exceeding the minimum bend radius deforms the cable geometry and increases signal attenuation, degrading performance. A tight bend does not raise current capacity, improve shielding, or affect only appearance. Respecting the bend radius preserves the cable's transmission characteristics.

96. B — The central station is the annunciation and management point where staff receive, view, and clear nurse calls. It does not supply 120 V to devices, provide the grounding electrode, or serve as a mounting bracket. Centralized annunciation lets staff respond promptly to patient calls.

97. C — Impedance mismatch on a 75-ohm CATV system causes signal reflections that degrade picture quality. Matching does not raise voltage, allow connectorless splicing, or set jacket colour. Proper impedance matching ensures clean signal transfer with minimal reflection.

98. A — Hazardous locations require intrinsically safe circuits or explosion-proof wiring methods that limit ignition energy below what can ignite the atmosphere. Plenum cable, larger conductors, or DC-only signalling do not address the ignition risk. These methods prevent electrical energy from triggering an explosion.

99. D — The CEC requires separation or a barrier between signalling and power conductors sharing a cable tray to protect signal integrity and prevent hazardous coupling. Matching gauge, matching voltage, or an all-nonmetallic tray is not the requirement. Separation keeps power disturbances from corrupting the signalling system.

100. B — Bonding the communication grounding to the building electrical grounding brings all systems to a common potential, limiting dangerous voltage differences during faults or surges. It does not supply 120 V, increase data speed, or make the cable an electrode. Common bonding protects equipment and personnel from potential differences.