PRACTICE EXAM 11: CONSTRUCTION ELECTRICIAN SIMULATION (100 QUESTIONS)

1. A worker must perform a lockout on a 600 V three-phase feeder before servicing a motor. After de-energizing and applying their personal lock and tag, what is the final critical step before beginning work?

A. Notify the building owner that the circuit is now safe to use

B. Re-energize briefly to confirm the meter is functioning

C. Verify the absence of voltage at the point of work with a tested meter

D. Remove the fuses and store them in the panel for safekeeping

2. Two electricians are installing a cable tray run at a 4 m height. According to standard fall-protection practice, at what height is fall protection generally required on a construction site?

A. 1.5 m

B. 3 m

C. 4.5 m

D. 6 m

3. A Safety Data Sheet (SDS) is required on site for a solvent-based cleaner. Which section of the SDS provides first-aid measures?

A. Section 1

B. Section 8

C. Section 14

D. Section 4

4. An apprentice needs to cut threads on a 25 mm rigid steel conduit. Which tool is used to remove the sharp internal burr after cutting?

A. A hacksaw

B. A reamer

C. A fish tape

D. A knockout punch

5. When organizing a wiring job, an electrician reviews the project documents to determine circuit routing and device locations. Which document primarily shows the physical layout of devices on the floor plan?

A. The specification sheet

B. The single-line diagram

C. The schedule of values

D. The drawings/blueprints

6. A worker fabricates a strut support to mount a junction box to a concrete ceiling. Which fastener is most appropriate for anchoring strut into solid concrete?

A. A wedge/expansion anchor

B. A toggle bolt

C. A self-drilling sheet-metal screw

D. A plastic wall plug

7. During commissioning of a newly installed lighting circuit, an insulation resistance test is performed. Which instrument is used for this test?

A. A clamp-on ammeter

B. A multimeter on the ohms range

C. A megohmmeter (insulation resistance tester)

D. A receptacle tester

8. A journeyperson is mentoring an apprentice who repeatedly makes the same wiring error. What is the most effective mentoring approach?

A. Report the apprentice to the supervisor immediately

B. Demonstrate the correct method and have the apprentice practice it

C. Complete the task yourself to save time

D. Assign the apprentice to a different trade

9. Before decommissioning an old electrical service, what must be confirmed first?

A. The utility has disconnected the supply and the conductors are de-energized

B. The new service has already been energized

C. The customer has paid the final invoice

D. All luminaires have been removed from the building

10. A worker must lift a 30 kg transformer onto a shelf at chest height. What is the correct manual handling practice?

A. Lift quickly using the back muscles to minimize strain time

B. Twist at the waist while holding the load to position it

C. Keep the load away from the body for better visibility

D. Bend at the knees, keep the load close, and lift with the legs

11. Personal protective equipment for arc-flash protection is selected based on which of the following?

A. The incident energy / arc-flash hazard analysis for the equipment

B. The colour of the electrical panel

C. The preference of the apprentice

D. The ambient temperature of the room

12. A single-phase 120/240 V residential service uses a watthour meter. The meter measures the consumption of which quantity?

A. Apparent power in volt-amperes

B. Instantaneous current in amperes

C. Energy in kilowatt-hours

D. Power factor as a percentage

13. A consumer's service entrance is rated 200 A at 120/240 V. The main service conductors must be sized to carry the calculated load. Which factor most directly determines the minimum conductor ampacity?

A. The calculated load and the conductor's allowable ampacity rating

B. The colour of the conductor insulation

C. The length of the meter base

D. The number of luminaires in the dwelling

14. A moulded-case circuit breaker provides protection against both overload and short-circuit conditions. The instantaneous trip element responds to which condition?

A. A slow, sustained overload over several minutes

B. Normal inrush current at motor start

C. Ambient temperature rise in the panel

D. A high-magnitude short-circuit fault current

15. A fuse is marked with an interrupting rating of 200 kA. This rating indicates the maximum:

A. Continuous current the fuse can carry indefinitely

B. Fault current the fuse can safely interrupt

C. Voltage that may be applied across the fuse

D. Temperature the fuse element can withstand

16. Power distribution equipment includes a panelboard fed from a 600 V, 3-phase, 4-wire system. The neutral conductor in this system carries:

A. The full phase current at all times

B. Twice the line current under balanced load

C. The unbalanced current of the phase conductors

D. No current under any condition

17. An uninterruptible power supply (UPS) is installed to protect a computer server. A double-conversion (online) UPS provides power to the load by:

A. Switching to battery only after utility failure is detected

B. Filtering surges but passing utility power directly through

C. Continuously converting AC to DC and back to AC

D. Using a flywheel for short-term mechanical storage

18. A surge protective device (SPD) is installed at a service entrance. Its primary function is to:

A. Divert transient overvoltages to ground

B. Correct the system power factor

C. Reduce the load's continuous current draw

D. Provide backup power during an outage

19. A grounding electrode conductor connects the service neutral to the grounding electrode. The primary purpose of system grounding is to:

A. Reduce the electric bill by lowering resistance

B. Increase the available short-circuit current

C. Provide a path to improve luminaire brightness

D. Stabilize voltage and provide a path for fault current

20. A ground-fault circuit interrupter (GFCI) protecting a receptacle trips when it detects:

A. An overload on the protected circuit

B. A difference between the current in the line and neutral conductors

C. A voltage sag on the supply side

D. A short circuit between two phase conductors

21. A standby generator is connected to a building through a transfer switch. The transfer switch must prevent which dangerous condition?

A. Excessive fuel consumption by the engine

B. Overcharging of the starting battery

C. Reverse rotation of the alternator

D. Backfeeding the utility line while it is being serviced

22. A photovoltaic (PV) array produces DC, which must be converted for connection to the AC grid. This conversion is performed by a(n):

A. Inverter

B. Rectifier

C. Step-up transformer

D. Battery charger

23. A battery energy storage system uses lithium-ion batteries. A key safety concern specific to lithium-ion chemistry during a fault is:

A. Acid spillage requiring neutralization

B. Hydrogen gas venting requiring ventilation

C. Thermal runaway leading to fire

D. Memory effect reducing capacity

24. Work on a high-voltage (over 750 V) system requires special precautions. Before working on de-energized HV conductors, the conductors must be:

A. Painted with a warning colour

B. Grounded and bonded with approved grounding sets

C. Coiled neatly to prevent tripping hazards

D. Tested for continuity using a low-voltage meter

25. A delta-wye (Δ-Y) transformer connection is commonly used for a building service because it:

A. Eliminates the need for overcurrent protection

B. Provides a neutral point for a 4-wire secondary

C. Reduces the primary voltage by exactly half

D. Removes all harmonic currents from the system

26. A single-phase transformer has a primary of 600 V and a secondary of 120 V. What is the turns ratio (primary to secondary)?

A. 1:5

B. 1:120

C. 600:1

D. 5:1

27. A 3-phase, 4-wire, 208Y/120 V system is derived from a wye-connected transformer secondary. The voltage measured between any two line conductors is approximately:

A. 208 V

B. 120 V

C. 360 V

D. 416 V

28. A current transformer (CT) used for metering has a secondary that must never be left open while the primary is energized because:

A. The CT will draw excessive current from the line

B. The meter reading will read low

C. A dangerously high voltage can develop across the open secondary

D. The CT core will demagnetize permanently

29. A 75 kVA transformer supplies a 480 V, 3-phase load. What is the approximate full-load secondary line current? (Use $\sqrt{3} \approx 1.73$)

A. 208 A

B. 360 A

C. 156 A

D. 90 A

30. Power conditioning equipment is installed to address voltage sags affecting sensitive electronics. A voltage sag is best described as:

A. A momentary complete loss of voltage

B. A high-frequency transient spike

C. A sustained overvoltage condition

D. A short-duration reduction in RMS voltage

31. A grounding electrode system for a building includes a metal underground water pipe. When the water pipe is used as an electrode, it must be supplemented because:

A. Water pipes conduct electricity too well

B. The pipe may be replaced with non-metallic material in the future

C. The pipe increases the system voltage

D. Plastic pipe conducts better than metal

32. During servicing of a power distribution panel, an electrician finds discoloured, overheated termination lugs. The most likely cause is:

A. Excessive insulation resistance

B. A power factor that is too high

C. Loose connections causing high resistance

D. The neutral conductor being undersized for the load

33. A neutral grounding resistor (NGR) is installed on a generator. Its purpose is to:

A. Increase the available ground-fault current

B. Step up the generator output voltage

C. Eliminate the need for a grounding electrode

D. Limit the ground-fault current to a safe value

34. Metering equipment for a large commercial service uses both current transformers and potential (voltage) transformers because:

A. The line voltage and current are too high to connect directly to the meter

B. The meter requires DC input only

C. Transformers are cheaper than direct-connected meters

D. The utility prohibits direct measurement entirely

35. A surge suppression system for a data centre uses a multi-stage approach. The first stage of protection is typically located at the:

A. Individual computer power supply

B. Service entrance

C. Branch-circuit receptacle

D. Lighting panel

36. A standby diesel generator must be tested under load periodically. Running a generator with little or no load for extended periods can cause:

A. Excessive fuel efficiency

B. Wet stacking and carbon buildup

C. Overvoltage on the output

D. Reverse power flow to the tank

37. When servicing a transformer, the cooling method "ONAN" indicates:

A. Forced oil with forced air

B. Dry-type with fan cooling

C. Water-cooled with natural air

D. Oil natural, air natural (self-cooled)

38. A bonding conductor connects non-current-carrying metal parts together. The purpose of bonding is to:

A. Carry the normal load current of the circuit

B. Increase the impedance of the fault path

C. Keep metal parts at the same potential to prevent shock

D. Replace the need for circuit overcurrent protection

39. A residential consumer service mast extends through the roof to support the service drop. The mast and weatherhead must be installed so that:

A. Conductors form a drip loop to prevent water entry

B. The mast is filled with insulating oil

C. Water drains directly into the meter base

D. The weatherhead points downward toward the wall

40. An electrician installs EMT (electrical metallic tubing) in a commercial corridor. EMT is connected to boxes using:

A. Compression couplings welded in place

B. Threaded rigid fittings only

C. Set-screw or compression connectors

D. Plastic cement adhesive

41. A raceway run has four 90° bends between pull points. According to standard practice, the maximum total bend allowed between pull points is:

A. 90°

B. 180°

C. 270°

D. 360°

42. A box fill calculation must account for conductors, devices, and clamps. A single device (such as a receptacle) counts as how many conductor volume allowances?

A. One based on the largest conductor connected to it

B. Two based on the largest conductor connected to it

C. Zero — devices are not counted

D. Four regardless of conductor size

43. A branch circuit supplies a continuous load. The circuit conductors and overcurrent device must be rated for not less than what percentage of the continuous load?

A. 125%

B. 100%

C. 80%

D. 150%

44. A 15 A, 120 V branch circuit using No. 14 AWG copper conductors is being installed. The maximum overcurrent protection for this conductor is:

A. 20 A

B. 30 A

C. 15 A

D. 10 A

45. When installing armoured cable (AC90), an anti-short bushing (red head) is installed at terminations to:

A. Improve the bonding connection

B. Increase the cable's ampacity

C. Protect conductors from the sharp cut edge of the armour

D. Allow the cable to be installed underground

46. A receptacle in a residential kitchen counter area within 1.5 m of a sink must be protected by:

A. A standard 15 A breaker only

B. An arc-fault circuit interrupter only

C. A surge protective device

D. A ground-fault circuit interrupter (Class A)

47. Conductors installed in a raceway exposed to physical damage in a parking garage should be enclosed in:

A. Electrical non-metallic tubing (ENT)

B. Rigid metal conduit (RMC)

C. Flexible non-metallic tubing

D. Surface raceway with snap covers

48. An electric baseboard heater is a continuous-duty heating load. Its branch-circuit conductors must be sized at a minimum of:

A. 80% of the heater rating

B. 100% of the heater rating

C. 125% of the heater rating

D. 150% of the heater rating

49. A heat recovery ventilator (HRV) is part of an HVAC system. Its primary electrical-related function is to:

A. Heat domestic hot water directly

B. Provide standby emergency power

C. Act as the main disconnect for the furnace

D. Exchange heat between incoming and outgoing air streams

50. Exit signs and emergency lighting must remain operational during a power failure. Battery-supported unit equipment ("emergency packs") must provide illumination for a minimum of:

A. 30 minutes

B. 10 minutes

C. 5 minutes

D. 90 minutes

51. When derating conductor ampacity for more than three current-carrying conductors in a raceway, the ampacity must be:

A. Increased proportionally

B. Reduced according to the derating factor

C. Left unchanged below 10 conductors

D. Doubled to compensate for heat

52. A pull box is required for a conduit run because of multiple bends. For a straight pull, the minimum length of the box must be at least:

A. 8 times the diameter of the largest raceway

B. 2 times the diameter of the largest raceway

C. Equal to the conductor length

D. 16 times the conductor diameter

53. Cathodic protection systems protect metal structures from corrosion using:

A. A high-frequency AC signal

B. A pneumatic pressure system

C. An impressed DC current or sacrificial anode

D. A neutral grounding resistor

54. A three-way switch arrangement controls a luminaire from two locations. The conductors running between the two three-way switches are called:

A. Line conductors

B. Neutral conductors

C. Grounding conductors

D. Traveller conductors

55. When terminating a conductor under a screw terminal, the loop should be formed and placed so that tightening the screw:

A. Pushes the loop open and away from the screw

B. Closes the loop in the direction of screw rotation

C. Has no effect on the loop direction

D. Requires the loop to face counterclockwise

56. A non-metallic sheathed cable (NMD90) is run through a bored hole in a wood stud. To protect it from drywall screws, the hole must be:

A. Kept back at least 32 mm from the edge, or protected by a steel plate

B. Drilled at the very edge of the stud

C. Lined with insulating tape only

D. Enlarged to twice the cable diameter

57. A luminaire is recessed into an insulated ceiling. The luminaire must be marked "IC" to indicate that it is:

A. Internally cooled by a fan

B. Intended for industrial circuits

C. Rated for direct insulation contact

D. Installed in a cold climate only

58. An electric furnace draws 48 A continuous. The branch-circuit conductor ampacity must be at least:

A. 48 A

B. 38.4 A

C. 60 A

D. 96 A

59. Emergency lighting in a building must illuminate which areas as a priority?

A. Storage rooms and closets

B. Exit paths and means of egress

C. Mechanical rooms only

D. Exterior parking lots only

60. When installing conductors in a vertical raceway, the conductors must be supported at intervals to prevent:

A. Voltage drop along the run

B. Excessive current draw

C. Magnetic interference

D. The weight of the conductors damaging terminations

61. A junction box installed in a finished ceiling must remain:

A. Accessible without removing part of the building structure

B. Permanently sealed behind drywall

C. Filled with insulation

D. Painted to match the ceiling

62. A branch circuit conductor experiences voltage drop. To reduce voltage drop on a long run, the most common solution is to:

A. Reduce the circuit length by adding more loads

B. Lower the circuit voltage

C. Add additional overcurrent devices

D. Increase the conductor size

63. PVC rigid conduit expands and contracts with temperature. For long runs, the installation must include:

A. Additional grounding bushings

B. Expansion fittings

C. Set-screw couplings

D. Anti-short bushings

64. A cathodic protection rectifier converts:

A. DC to AC for the protected structure

B. Low voltage to high voltage

C. AC to DC to supply protective current

D. Single-phase to three-phase

65. When installing a wiring system in a wet location, fittings and boxes must be:

A. Rated and listed for wet locations

B. Sealed with electrical tape

C. Installed only above grade

D. Made of non-conductive wood

66. An HVAC rooftop unit requires a disconnecting means. The disconnect must be located:

A. Inside the building's main electrical room only

B. At least 10 m from the unit

C. Behind a locked panel accessible to the utility

D. Within sight of and readily accessible to the unit

67. An electric heating cable for floor warming is installed in a slab. The cable spacing and layout must follow:

A. The electrician's preferred pattern

B. Any random arrangement that fits

C. The lowest available spacing for maximum heat

D. The manufacturer's installation instructions

68. Multiple current-carrying conductors generate heat in a raceway. The neutral of a 3-phase, 4-wire wye circuit serving non-linear (electronic) loads is counted as a current-carrying conductor because it carries:

A. Only balanced fundamental current

B. Harmonic currents that do not cancel

C. No current at all

D. Only the grounding fault current

69. When installing exit signs, the supply circuit should be:

A. Switched off at night to save energy

B. Connected to a dimmer for adjustment

C. Connected ahead of (unswitched) so it is always energized

D. Fed from a portable extension cord

70. A magnetic motor starter uses a holding (seal-in) contact. The purpose of the holding contact is to:

A. Provide overload protection to the motor windings

B. Maintain the coil circuit after the start button is released

C. Reverse the direction of motor rotation

D. Step down the control voltage

71. A three-phase induction motor runs in the wrong direction after installation. To reverse the rotation, an electrician should:

A. Interchange any two of the three line leads

B. Reverse all three line leads

C. Reverse the neutral connection

D. Increase the supply frequency

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

A. Short-circuit faults between phases

B. Lightning-induced surges

C. Sustained excessive current (overload)

D. Voltage transients on the line

73. A motor nameplate lists a service factor of 1.15. This means the motor can:

A. Be operated continuously at 15% above its rated horsepower under defined conditions

B. Draw 15% less current than rated

C. Run at 1.15 times its rated speed

D. Operate only at 85% of rated voltage

74. A variable frequency drive (VFD) controls the speed of an AC induction motor by varying the:

A. Resistance in series with the rotor

B. DC field excitation

C. Number of stator poles mechanically

D. Frequency and voltage supplied to the motor

75. A reduced-voltage starter is used for a large motor to:

A. Limit the high inrush current during starting

B. Increase the running torque permanently

C. Reverse the motor more quickly

D. Eliminate the need for overload protection

76. A control circuit uses a normally open (NO) push button for "start" and a normally closed (NC) push button for "stop." Pressing the stop button:

A. Energizes the starter coil

B. Has no effect while running

C. Opens the control circuit and de-energizes the coil

D. Reverses the motor direction

77. A motor's full-load current (FLC) is used to size the conductors. The branch-circuit conductors for a single continuous-duty motor must have an ampacity of at least:

A. 100% of the motor FLC

B. 125% of the motor FLC

C. 80% of the motor FLC

D. 250% of the motor FLC

78. A squirrel-cage induction motor develops torque due to:

A. Permanent magnets embedded in the rotor

B. Brushes and a commutator

C. A wound rotor with external resistance

D. Induced currents in the rotor bars from the rotating stator field

79. A programmable logic controller (PLC) receives a signal from a limit switch. This signal enters the PLC through a(n):

A. Analog output module

B. Communication port

C. Power supply terminal

D. Input module

80. A motor control centre (MCC) consolidates multiple motor starters in one assembly. A key advantage of an MCC is:

A. Centralized control and reduced wiring/space requirements

B. Elimination of the need for overload protection

C. Lower available short-circuit current

D. Removing the need for a disconnecting means

81. A VFD can cause bearing damage in a motor due to:

A. Excessive mechanical vibration only

B. Reduced lubrication temperature

C. Circulating shaft currents from common-mode voltage

D. Lower-than-rated operating speed

82. When troubleshooting a motor that hums but will not start, the most likely cause in a three-phase motor is:

A. Excessive line voltage

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

C. An open neutral conductor

D. Too high a power factor

83. A "jogging" or "inching" control allows a motor to:

A. Run in short bursts for positioning by momentary operation

B. Run continuously at full speed

C. Operate without any overload protection

D. Reverse automatically every cycle

84. The full-load current of a motor must be determined for conductor and overload sizing. For overload protection sizing, the value typically used is:

A. The locked-rotor current

B. The starting inrush current

C. The nameplate full-load current

D. The no-load current

85. An automated control system uses a proportional-integral-derivative (PID) loop. The PID controller's function is to:

A. Provide overcurrent protection to the motor

B. Convert AC to DC for the field

C. Disconnect the motor during a fault

D. Continuously adjust output to minimize error from a setpoint

86. A motor disconnecting means must be located:

A. At the main service panel only

B. Within sight of the motor and its controller

C. A minimum of 10 m from the motor

D. Inside the motor terminal box

87. A soft starter differs from a VFD in that a soft starter:

A. Controls inrush during starting but does not vary running speed

B. Varies the running speed continuously

C. Converts DC to AC for the motor

D. Provides no current limiting at all

88. A normally closed overload relay contact is wired into the control circuit so that an overload condition will:

A. Energize the starter coil to keep the motor running

B. Increase the supply voltage

C. Sound an alarm but keep the motor running

D. Open the control circuit and stop the motor

89. A two-speed motor changes speed by changing the:

A. Supply voltage only

B. Number of stator poles connected

C. Rotor resistance only

D. Direction of rotation

90. A PLC program uses ladder logic. A "rung" in ladder logic represents:

A. A physical conduit run between devices

B. The power supply voltage rating

C. A logical control statement (inputs controlling an output)

D. The grounding connection of the panel

91. A fire alarm system uses an end-of-line resistor on an initiating device circuit. The purpose of this resistor is to:

A. Allow the panel to supervise the circuit for open faults

B. Increase the current to the smoke detectors

C. Provide backup power to the horns

D. Reduce voltage to the pull stations

92. Category 6 (Cat 6) cabling is used for a data network. The maximum recommended horizontal run length for a permanent link is approximately:

A. 305 m

B. 50 m

C. 200 m

D. 90 m

93. A twisted-pair communication cable uses twisting of the conductor pairs to:

A. Increase the cable's current capacity

B. Make the cable easier to pull

C. Reduce electromagnetic interference (crosstalk)

D. Add mechanical strength only

94. A coaxial cable (CATV) carries video signals. Its characteristic impedance for residential distribution is typically:

A. 50 ohms

B. 75 ohms

C. 100 ohms

D. 600 ohms

95. An integrated building control system combines lighting, HVAC, and security on a common network. A common open communication protocol used for this purpose is:

A. BACnet

B. RS-232 only

C. Coaxial RG-6

D. 120 V AC signalling

96. A fibre-optic cable transmits data using:

A. Electrical pulses on copper conductors

B. Radio waves through the air

C. Magnetic flux variations

D. Pulses of light through a glass or plastic core

97. A nurse-call signalling system in a healthcare facility is classified as a life-safety system, meaning it must:

A. Operate only during business hours

B. Have a reliable power source including backup

C. Share the same circuit as general lighting

D. Be installed without supervision

98. When terminating Cat 6 cable to an RJ-45 jack, the amount of untwisting of the pairs at the termination should be:

A. Kept to a minimum to preserve signal performance

B. As long as possible for easier handling

C. At least 50 mm for every pair

D. Irrelevant to performance

99. A passive infrared (PIR) sensor in a security/control system detects:

A. Changes in air pressure

B. Sound vibrations in the room

C. Changes in infrared (heat) energy from movement

D. Magnetic field disturbances

100. A communication system uses a structured cabling backbone connecting telecommunications rooms. The backbone cabling primarily provides:

A. Final connections to individual workstation outlets

B. Interconnection between equipment rooms and telecommunications rooms

C. Power distribution to lighting panels

D. Grounding for the building steel

Practice Exam 11: Answer Key and Explanations

1. C — You must always verify the absence of voltage at the actual point of work using a tested meter (test-before-touch). Lockout and tagout alone do not confirm de-energization; a wrong lock, mislabeled panel, or backfeed could leave the circuit live. Proving zero voltage is the only step that confirms it is safe to work.

2. B — Fall protection is generally required at 3 m on Canadian construction sites. Falls are a leading cause of serious workplace injury and death, so a guardrail, travel-restraint, or fall-arrest system must be in place at this height. The 4 m working height in the scenario clearly exceeds the trigger.

3. D — Section 4 of an SDS contains first-aid measures under the standardized 16-section GHS format. Knowing the fixed section order lets a worker locate critical information quickly during an exposure emergency. First aid being in Section 4 is consistent across all GHS-compliant sheets.

4. B — A reamer removes the sharp internal burr left after cutting conduit. Burrs left in place will nick or strip conductor insulation as wires are pulled through, creating a fault risk. Reaming protects the conductors and is a required step after every cut.

5. D — The drawings/blueprints (floor plans) show the physical layout and locations of devices within the building. Single-line diagrams show electrical connections schematically, not physical placement. Electricians use the drawings to determine where devices and circuits are physically routed.

6. A — A wedge/expansion anchor is designed to grip solid concrete by expanding against the drilled hole. Toggle bolts and plastic plugs are for hollow or soft materials and lack the holding strength for strut. The expansion anchor provides the secure mechanical load capacity needed overhead.

7. C — A megohmmeter (insulation resistance tester) applies a high DC test voltage to measure insulation integrity. A standard multimeter cannot detect insulation weakness because it uses too low a test voltage. Insulation testing during commissioning confirms conductors are safe to energize.

8. B — Effective mentoring uses demonstration followed by supervised practice so the apprentice corrects the behaviour through repetition. Simply doing the task or reporting the apprentice fails to build the skill. Hands-on guided practice produces lasting competence and safer work.

9. A — Before decommissioning, you must confirm the utility has disconnected supply and that the conductors are verified de-energized. Service conductors can remain live up to the utility connection even when the building main is off. Confirming dead status prevents fatal contact during removal.

10. D — Correct manual handling means bending at the knees, keeping the load close to the body, and lifting with the legs. This keeps the spine neutral and uses the strong leg muscles instead of the vulnerable lower back. Twisting or holding loads away from the body are the leading causes of lifting injuries.

11. A — Arc-flash PPE is selected from the incident energy / arc-flash hazard analysis for the specific equipment. The available incident energy determines the required arc rating (cal/cm^2) of the protective clothing. Matching PPE to the calculated hazard prevents serious burn injury during an arc event.

12. C — A watthour meter measures energy consumed in kilowatt-hours, which is what the utility bills. It integrates power over time rather than reading instantaneous current or power factor. Energy in kWh is the billable quantity for the consumer.

13. A — Service conductor ampacity is determined by the calculated load and the conductor's allowable ampacity rating. The conductor must safely carry the demand without overheating. Insulation colour and physical dimensions of components do not set the ampacity requirement.

14. D — The instantaneous trip element of a moulded-case breaker responds to high-magnitude short-circuit fault currents by opening with no intentional delay. The thermal element handles slow overloads, while the magnetic instantaneous element clears dangerous faults immediately. Fast fault clearing limits damage and arc energy.

15. B — An interrupting rating specifies the maximum fault current the fuse can safely interrupt without rupturing. This rating must equal or exceed the available fault current at the installation point. Adequate interrupting rating prevents catastrophic failure of the overcurrent device during a fault.

16. C — In a 3-phase, 4-wire system the neutral carries only the unbalanced (out-of-balance) current of the three phase conductors. Under perfectly balanced loading the phase currents cancel and the neutral carries near zero. This is why neutral current depends on load imbalance.

17. C — A double-conversion (online) UPS continuously converts incoming AC to DC and back to AC, so the load is always supplied from the inverter. Because there is no transfer time, the load is fully isolated from utility disturbances. This provides the cleanest, most seamless protection for sensitive equipment.

18. A — A surge protective device diverts transient overvoltages to ground, clamping the voltage seen by downstream equipment. It does not supply backup power or correct power factor. Diverting surges protects connected equipment from insulation damage caused by spikes.

19. D — System grounding stabilizes voltage to ground and provides a low-impedance path for fault current to operate overcurrent devices. This allows faults to clear quickly and limits voltage stress during transients. It does not affect energy cost or luminaire brightness.

20. B — A GFCI trips when it senses a difference between line and neutral current, indicating current leaking to ground through an unintended path (such as a person). It is not an overload or short-circuit device. Detecting that imbalance protects people from electrocution.

21. D — A transfer switch must prevent backfeeding the utility line while it is being serviced, which would endanger line workers and equipment. It electrically isolates the generator from the grid before connecting the load. This interlock is the critical life-safety function of the transfer switch.

22. A — An inverter converts the DC output of a PV array into grid-compatible AC. A rectifier does the opposite (AC to DC), so it is incorrect here. The inverter is the essential interface allowing solar power to feed an AC system.

23. C — The key lithium-ion hazard during a fault is thermal runaway, a self-sustaining heating reaction that can ignite a fire. Unlike lead-acid, the risk is not acid spillage or hydrogen venting. Recognizing thermal runaway is critical for safe installation and emergency response.

24. B — De-energized high-voltage conductors must be grounded and bonded with approved grounding sets before work begins. This drains stored charge and protects workers if the line is accidentally re-energized or induced. Temporary protective grounds are a mandatory HV safety practice.

25. B — A delta-wye transformer provides a neutral point at the wye secondary, enabling a 4-wire system with both line and phase voltages. This is why it is common for building services needing 120 V and 208 V. It does not eliminate overcurrent protection or remove harmonics.

26. D — The turns ratio equals the voltage ratio: 600 V ÷ 120 V = 5, giving a primary-to-secondary ratio of 5:1. The higher-voltage winding has proportionally more turns. This ratio governs both voltage and inverse current transformation.

27. A — In a 208Y/120 V wye system, the line-to-line voltage is 208 V while line-to-neutral is 120 V ($208 = 120 \times \sqrt{3}$). Measuring between any two line conductors gives 208 V. Understanding this relationship is essential for correct voltage testing.

28. C — An open CT secondary while the primary is energized develops a dangerously high voltage across the open terminals because there is no secondary current to oppose the primary flux. This can

injure personnel and destroy insulation. CT secondaries must always be shorted before opening the circuit.

29. D — Using I = VA ÷ (E × √3): 75,000 ÷ (480 × 1.73) = 75,000 ÷ 830 ≈ 90 A. The three-phase full-load current depends on both the kVA rating and the line voltage, so a higher secondary voltage yields a lower line current for the same kVA. Correctly applying the √3 factor is essential when sizing conductors and overcurrent protection for three-phase transformers.

30. D — A voltage sag is a short-duration reduction in RMS voltage, typically from motor starting or faults elsewhere on the system. It is not a complete outage or an overvoltage. Power conditioning equipment rides through sags to protect sensitive electronics.

31. B — A metal water pipe used as an electrode must be supplemented because the pipe could later be replaced with non-metallic material, losing the grounding path. A supplemental electrode guarantees the grounding system remains effective. This redundancy protects long-term safety.

32. C — Discoloured, overheated lugs are most commonly caused by loose connections producing high contact resistance and localized heating. Loose terminations are a leading cause of equipment fires. Proper torque to specification prevents this failure.

33. D — A neutral grounding resistor limits ground-fault current to a safe value, reducing arc-flash energy and equipment damage while still allowing fault detection. It does not increase fault current or step up voltage. Current limiting protects both equipment and personnel.

34. A — Large commercial metering uses CTs and PTs because the line current and voltage are too high to connect directly to the meter. The instrument transformers scale these quantities down to safe, standard values. This allows accurate, safe measurement of high-power services.

35. B — In a multi-stage surge protection scheme, the first and largest stage is located at the service entrance to intercept the highest-energy transients. Downstream stages then clamp lower residual surges. Coordinated staging protects equipment throughout the facility.

36. B — Lightly loaded diesel generators run cool and incompletely combust fuel, causing wet stacking and carbon buildup in the exhaust. Periodic load-bank testing prevents this damage. Adequate loading keeps the engine healthy and reliable.

37. D — ONAN stands for Oil Natural, Air Natural, meaning the transformer is oil-filled and self-cooled by natural convection of both oil and air. No pumps or fans are used. Recognizing cooling-class codes is important when servicing transformers.

38. C — Bonding connects non-current-carrying metal parts so they remain at the same electrical potential, preventing dangerous voltage differences during a fault. It provides a low-impedance fault path that helps clear faults. This protects people from shock between metal surfaces.

39. A — A service mast and weatherhead must be installed so the conductors form a drip loop, allowing water to drip off before reaching the entrance. This prevents water from following the conductors into the meter base or panel. The drip loop is a basic weatherproofing requirement.

40. C — EMT is connected to boxes using set-screw or compression connectors because it is unthreaded thin-wall tubing. It is not threaded like rigid conduit, nor cemented like PVC. These connectors provide mechanical and grounding continuity.

41. D — The maximum total bend between pull points is 360°, equivalent to four 90° bends. Exceeding this makes conductor pulling difficult and risks insulation damage. Limiting cumulative bends keeps pulls within safe tension.

42. B — A single device counts as two conductor volume allowances based on the largest conductor connected to it. This accounts for the physical space the device occupies in the box. Accurate box-fill calculation prevents overcrowding and overheating.

43. A — Conductors and the overcurrent device for a continuous load must be rated at not less than 125% of the continuous load. This margin prevents overheating from current flowing three hours or more. The 125% factor is a core sizing rule for continuous loads.

44. C — No. 14 AWG copper is protected at a maximum of 15 A. This conductor-specific ampacity limit prevents overheating regardless of the load served. Matching the breaker to the conductor rating is a fundamental overcurrent rule.

45. C — An anti-short bushing (red head) protects the conductors from the sharp cut edge of the armour at AC90 terminations. Without it, the metal edge can abrade insulation and cause a fault. The bushing is a required termination component.

46. D — A kitchen counter receptacle within 1.5 m of a sink must be protected by a Class A GFCI. This protects against electrocution where water and electricity are in close proximity. GFCI protection is mandatory in these wet kitchen locations.

47. B — Conductors exposed to physical damage, such as in a parking garage, should be enclosed in rigid metal conduit (RMC) for maximum mechanical protection. ENT and flexible non-metallic products do not provide that ruggedness. RMC resists impact and crushing.

48. C — An electric baseboard heater is a continuous load, so its branch-circuit conductors must be sized at a minimum of 125% of the heater rating. This prevents conductor overheating during prolonged operation. The 125% factor mirrors the general continuous-load rule.

49. D — A heat recovery ventilator exchanges heat between incoming fresh air and outgoing stale air, improving efficiency. It is not a disconnect or emergency power source. Recovering heat reduces the load on the building's heating system.

50. A — Battery-supported unit equipment must provide emergency illumination for a minimum of 30 minutes. This allows occupants enough time to evacuate safely during a power failure. The 30-minute duration is a life-safety requirement for egress lighting.

51. B — When more than three current-carrying conductors share a raceway, ampacity must be reduced by the applicable derating factor. The bundled conductors retain more heat, lowering their safe current capacity. Derating prevents insulation damage from accumulated heat.

52. A — For a straight pull, the pull box length must be at least 8 times the diameter of the largest raceway. This gives conductors enough room to enter and exit without excessive bending stress. Proper box sizing protects insulation during pulling.

53. C — Cathodic protection prevents corrosion using an impressed DC current or a sacrificial anode that corrodes preferentially. This makes the protected structure the cathode of the corrosion cell. The method preserves buried metal pipelines and tanks.

54. D — The conductors running between two three-way switches are called travellers. They provide the alternate paths that allow control of a luminaire from either location. Identifying travellers correctly is essential to wiring a three-way circuit.

55. B — A terminal loop should close in the direction of screw rotation (clockwise) so tightening pulls the loop snug rather than pushing it open. This produces a secure, low-resistance connection. Proper loop direction prevents loose terminations.

56. A — NMD90 through a bored stud must be kept at least 32 mm back from the stud edge, or protected by a steel plate where that clearance can't be met. This guards the cable from screws and nails. The clearance rule prevents accidental penetration of the cable.

57. C — A luminaire marked "IC" is rated for direct insulation contact and may be buried in thermal insulation without overheating. Non-IC fixtures require clearance from insulation to avoid fire. The marking tells the installer the fixture is safe in insulated ceilings.

58. C — A 48 A continuous load requires conductors rated at 125%: 48 × 1.25 = 60 A. The conductor ampacity must therefore be at least 60 A. Applying the continuous-load factor prevents overheating of the furnace circuit.

59. B — Emergency lighting must prioritize illuminating exit paths and the means of egress so occupants can evacuate safely. Storage and mechanical rooms are not the priority. Lighting the egress route is the core purpose of emergency illumination.

60. D — Conductors in a vertical raceway must be supported at intervals so their weight does not pull on and damage the terminations. Long vertical runs place significant tension on connections. Supports relieve that strain and maintain safe terminations.

61. A — A junction box must remain accessible without removing part of the building structure so connections can be inspected and serviced. Sealing it permanently behind drywall is prohibited. Accessibility ensures future maintenance and safety.

62. D — Increasing the conductor size reduces resistance and therefore voltage drop on a long run. Larger conductors carry the same current with less voltage loss. Upsizing is the standard remedy for excessive voltage drop.

63. B — Long PVC conduit runs require expansion fittings to absorb thermal expansion and contraction. Without them, temperature swings can buckle or pull apart the conduit. Expansion fittings maintain the integrity of the raceway.

64. C — A cathodic protection rectifier converts AC to DC to supply the protective (impressed) current to the structure. DC is required to drive the protective electrochemical reaction. This impressed-current system protects large buried metal assets.

65. A — Boxes and fittings in wet locations must be rated and listed for wet locations to keep moisture out. Tape or improper materials will not maintain a watertight, durable installation. Listed wet-location equipment prevents corrosion and faults.

66. D — An HVAC unit disconnect must be located within sight of and readily accessible to the unit. This lets a worker safely de-energize the equipment before servicing it. Line-of-sight disconnects are a key maintenance-safety requirement.

67. D — Electric heating cable must be installed according to the manufacturer's installation instructions, which specify spacing and layout. Deviating risks hot spots, cable damage, or fire. Following the listed instructions is required for safe, compliant installation.

68. B — In a 3-phase, 4-wire wye circuit serving non-linear loads, the neutral carries triplen harmonic currents that add rather than cancel, so it counts as a current-carrying conductor. This added current generates heat. Counting it ensures proper conductor derating.

69. C — Exit signs must be connected ahead of (unswitched from) the local switching so they remain energized at all times. They cannot be allowed to be turned off. Continuous power ensures the exit path is always marked.

70. B — The holding (seal-in) contact maintains the coil circuit after the momentary start button is released, keeping the motor running. Without it, the motor would stop the instant the operator let go of start. This is the basis of standard three-wire control.

71. A — Interchanging any two of the three line leads reverses the phase rotation and thus the direction of a three-phase induction motor. Reversing all three changes nothing. Swapping two leads is the standard method to correct rotation.

72. C — Overload relays protect the motor against sustained excessive current (overload), which would otherwise overheat the windings. They are not designed to clear short circuits, which are handled by the breaker or fuses. Overload protection prevents thermal damage from prolonged overcurrent.

73. A — A service factor of 1.15 means the motor can be operated continuously at 15% above its rated horsepower under defined conditions without damage. It is a built-in overload margin, not a speed or voltage adjustment. The service factor allows occasional safe overloading.

74. D — A VFD controls motor speed by varying the frequency and voltage supplied to the motor. Since synchronous speed is proportional to frequency, changing frequency changes speed. Maintaining the volts-per-hertz ratio preserves torque across the speed range.

75. A — A reduced-voltage starter limits the high inrush current that occurs when a large motor starts across the line. This reduces voltage dips and mechanical stress. It does not eliminate overload protection or permanently boost torque.

76. C — Pressing the NC stop button opens the control circuit, de-energizing the starter coil and stopping the motor. The stop function must interrupt the seal-in path. This is how the standard start/stop control station works.

77. B — Branch-circuit conductors for a single continuous-duty motor must be rated at least 125% of the motor's full-load current. This margin handles the heat of continuous running. The 125% factor is the standard motor-conductor sizing rule.

78. D — A squirrel-cage induction motor develops torque from currents induced in the rotor bars by the rotating stator field. It has no brushes, commutator, or permanent magnets. This simple, rugged design makes it the most common industrial motor.

79. D — A signal from a limit switch enters the PLC through an input module, which conditions the field signal for the processor. Outputs drive loads, not receive signals. Correctly identifying inputs versus outputs is fundamental to PLC wiring.

80. A — A motor control centre consolidates starters into one assembly, providing centralized control and greatly reduced wiring and floor space. It does not eliminate overloads or disconnects. Centralization simplifies installation and maintenance.

81. C — VFDs can cause bearing damage through circulating shaft currents driven by common-mode voltage, which discharge through the bearings and pit the races. Shaft grounding rings or insulated bearings mitigate this. Recognizing this failure mode is key to VFD-motor reliability.

82. B — A three-phase motor that hums but won't start is most likely single-phasing — it has lost one of its three phases. With only two phases present there is no rotating field to start the motor. Prolonged single-phasing quickly overheats the windings.

83. A — Jogging (inching) runs the motor in short bursts through momentary operation, used for positioning equipment. The seal-in is bypassed so the motor runs only while the button is held. This gives precise, controlled movement.

84. C — Overload protection is sized from the motor's nameplate full-load current, the actual running current under rated load. Starting and locked-rotor currents are far higher and not used for overload sizing. Using nameplate FLC ensures correct thermal protection.

85. D — A PID controller continuously adjusts its output to minimize the error between the measured value and the setpoint. The proportional, integral, and derivative terms together produce stable, accurate control. PID loops are the foundation of process automation.

86. B — A motor disconnecting means must be located within sight of the motor and its controller so it can be safely locked out before servicing. Line-of-sight placement prevents accidental re-energization. This is a core motor-safety requirement.

87. A — A soft starter controls inrush current during starting but does not vary the running speed once the motor is up to full speed. A VFD, by contrast, controls speed continuously. The soft starter is simpler and used purely for smooth starting.

88. D — A normally closed overload relay contact opens the control circuit on an overload, de-energizing the coil and stopping the motor. This protects the windings from thermal damage. The NC contact wiring is what links overload sensing to motor shutdown.

89. B — A two-speed motor changes speed by changing the number of stator poles connected, since speed is inversely related to pole count. This is a consequent-pole or separate-winding design. Changing poles yields discrete operating speeds.

90. C — A rung in ladder logic represents a logical control statement where input conditions on the left control an output on the right. It mimics the layout of a relay control circuit. Each rung executes as the processor scans the program.

91. A — An end-of-line resistor allows the fire alarm panel to supervise the circuit, detecting open (wiring) faults by monitoring a small current through the resistor. If the circuit breaks, the supervisory current is lost and a trouble signal is generated. Supervision ensures the system is always ready to operate.

92. D — The maximum recommended horizontal permanent-link run for Cat 6 is approximately 90 m, with an additional allowance for patch cords up to a 100 m channel. Exceeding this degrades signal performance. The 90 m limit is a structured-cabling standard.

93. C — Twisting the conductor pairs reduces electromagnetic interference and crosstalk by causing induced noise to cancel between adjacent twists. Tighter, balanced twists improve signal integrity at higher data rates. This is the fundamental reason twisted pair is used for data.

94. B — Residential CATV/coaxial distribution uses 75-ohm characteristic impedance. Matching this impedance minimizes signal reflections and loss. The 50-ohm value is used for other applications such as RF transmission, not residential video.

95. A — BACnet is a common open communication protocol used to integrate building systems such as lighting, HVAC, and security on one network. Being open and standardized lets equipment from different manufacturers interoperate. This interoperability is the goal of integrated building control.

96. D — Fibre-optic cable transmits data as pulses of light through a glass or plastic core. Because it uses light rather than electrical current, it is immune to electromagnetic interference and supports very high bandwidth over long distances. This makes it ideal for backbone communication links.

97. B — A nurse-call system is a life-safety system and must have a reliable power source, including backup, so it remains functional during outages. Lives depend on its continuous availability. Reliable, supervised power is mandatory for such systems.

98. A — Untwisting of pairs at a Cat 6 termination must be kept to a minimum to preserve the cable's noise-cancelling performance. Excessive untwist degrades crosstalk performance and can cause the link to fail certification. Tight terminations maintain signal integrity.

99. C — A passive infrared sensor detects changes in infrared (heat) energy caused by a person moving across its field of view. It is passive because it senses emitted heat rather than transmitting a signal. PIR sensors are common in occupancy and security applications.

100. B — Backbone cabling provides interconnection between equipment rooms and telecommunications rooms (and between buildings). Horizontal cabling, not backbone, runs to individual workstation outlets. The backbone forms the high-capacity spine of structured cabling.