PRACTICE EXAM 6: STATIONARY ENGINEER (ELECTRIC) SIMULATION — 100 QUESTIONS

ELECTRICAL FUNDAMENTALS (Questions 1–12)

1. A 12V battery connected to a 4-ohm resistor will produce a current of?

A. 48A

B. 3A

C. 0.33A

D. 8A

2. Three resistors of 6Ω, 12Ω, and 4Ω are connected in series. What is the total resistance?

A. 2.4Ω

B. 6Ω

C. 12Ω

D. 22Ω

3. In an AC circuit, capacitive reactance decreases when?

A. Capacitance decreases

B. Frequency decreases

C. Resistance increases

D. Frequency increases

4. Which of the following best describes apparent power in an AC circuit?

A. The power actually consumed by resistive loads

B. The power stored and released by reactive components

C. The total power supplied by the source, combining real and reactive components

D. The power lost in distribution conductors

5. The power factor of a purely capacitive circuit is?

A. 1.0

B. 0.85 lagging

C. 0.5 leading

D. 0 (zero)

6. A 240V, 3,600W electric heater draws how much current?

A. 864,000A

B. 15A

C. 7.5A

D. 30A

7. Lenz's Law states that an induced EMF will?

A. Add to the original magnetic field that caused it

B. Always be equal to the applied voltage

C. Decrease when the circuit resistance increases

D. Oppose the change in magnetic flux that produced it

8. In a three-phase wye system, if the phase voltage is 120V, the line voltage is approximately?

A. 120V

B. 208V

C. 240V

D. 277V

9. The capacitive reactance (XC) of a 100μF capacitor at 60 Hz is approximately?

A. 6,000Ω

B. 26.5Ω

C. 0.038Ω

D. 100Ω

10. Which law states that the algebraic sum of currents entering and leaving a node equals zero?

A. Kirchhoff's Current Law

B. Ohm's Law

C. Faraday's Law

D. Lenz's Law

11. A transformer's efficiency is highest at?

A. The load at which core losses equal copper losses

B. No-load conditions

C. Full-load conditions

D. 50% of rated load

12. Mutual inductance between two coils is increased by?

A. Moving the coils farther apart

B. Reducing the number of turns in each coil

C. Increasing the coupling between the coils

D. Using air core rather than iron core construction

WIRING, CONDUCTORS, AND PROTECTIVE DEVICES (Questions 13–22)

13. The minimum burial depth for PVC conduit containing 120V branch circuit conductors under a residential driveway is?

A. 6 inches

B. 12 inches

C. 18 inches

D. 24 inches

14. A 30-ampere, 240V branch circuit for a dryer requires a minimum conductor size of?

A. 10 AWG

B. 12 AWG

C. 8 AWG

D. 6 AWG

15. Which type of overcurrent device is used when the available fault current exceeds the interrupting rating of standard molded case breakers?

A. Fused disconnect switch with Class H fuses

B. Current-limiting fuses or current-limiting breakers

C. Standard dual-element time-delay fuses

D. Thermal magnetic breakers with higher trip settings

16. The NEC permits conductors of different circuits in the same raceway provided?

A. All circuits originate from the same panel only

B. All conductors are insulated for the maximum voltage present in the raceway

C. No more than three circuits share the same conduit

D. All circuits are protected by the same overcurrent device

17. A wire nut (twist connector) is suitable for use with conductors up to a maximum size of?

A. 6 AWG

B. 10 AWG

C. 14 AWG

D. 4 AWG

18. The equipment grounding conductor (EGC) in a branch circuit must be?

A. Sized per NEC Table 250.122 based on the rating of the circuit's overcurrent protective device

B. The same size as the phase conductors always

C. A minimum of 12 AWG regardless of circuit size

D. Sized at 125% of the phase conductor ampacity

19. Type NM cable (Romex) is not permitted in which of the following locations?

A. Wood frame residential construction

B. Concealed in finished walls

C. Attic spaces with less than 2 inches clearance

D. Commercial buildings, exposed in areas subject to physical damage, or embedded in concrete

20. A thermal-magnetic circuit breaker uses two separate trip mechanisms. The magnetic element provides?

A. Time-delayed tripping for sustained overloads

B. Reset capability after tripping

C. Temperature compensation for ambient conditions

D. Instantaneous tripping for high-magnitude short circuit currents

21. Which of the following describes the purpose of a service entrance conductor?

A. To carry feeder current between panels within a building

B. To carry branch circuit current to individual loads

C. To connect the utility meter to the first disconnect means

D. To connect the grounding electrode to the neutral bar

22. The NEC requires working space in front of electrical panels to be a minimum of?

A. 36 inches deep (for voltages to ground up to 150V)

B. 24 inches deep

C. 18 inches deep

D. 48 inches deep

POWER DISTRIBUTION AND HIGH-TENSION SYSTEMS (Questions 23–32)

23. A facility draws 500 kW at a power factor of 0.80. The apparent power is?

A. 400 kVA

B. 400 kW

C. 625 kVA

D. 600 kVA

24. Which type of transformer connection is used to step up voltage for long-distance power transmission?

A. Delta-delta

B. Wye-wye

C. Delta-wye

D. Wye-delta

25. The purpose of a metering current transformer (CT) accuracy class is to?

A. Ensure measurement accuracy within a defined percentage at specified burden and current

B. Define the CT's short circuit withstand rating

C. Specify the CT's physical mounting dimensions

D. Establish the CT's maximum operating temperature

26. A 480V motor control center (MCC) is fed by a 75 kVA transformer. The maximum continuous load the MCC can carry is?

A. 75A

B. 90A

C. 90.2A

D. 104A

27. Bus impedance in a switchgear lineup affects?

A. The voltage drop across the bus under fault and load current conditions

B. The thermal rating of the switchgear enclosure only

C. The breaker trip time settings

D. The transformer turns ratio feeding the bus

28. The purpose of a reactor (current-limiting reactor) on a medium-voltage bus tie is to?

A. Improve power factor on the bus

B. Limit fault current when the bus sections are paralleled

C. Provide voltage regulation on the bus

D. Protect against ferroresonance conditions

29. Transformer core saturation caused by DC offset during inrush is managed in modern differential relays by?

A. Harmonic restraint — blocking operation during 2nd harmonic inrush current

B. Increasing the relay pickup setting during energization

C. Using time delay to ride through the inrush period

D. Adding resistance in the CT secondary circuit

30. The rated continuous current of a 15kV, 1,200A air disconnect switch may be derated in high-ambient-temperature environments because?

A. Current-carrying capacity decreases as ambient temperature reduces the thermal gradient available for heat dissipation

B. High temperature increases contact resistance, reducing rated ampacity

C. The switch's insulation degrades faster at elevated ambient temperature

D. Operating mechanisms seize at elevated temperatures

31. Which relay function protects against loss of excitation on a synchronous generator?

A. ANSI Function 40 — loss of excitation (impedance) relay

B. ANSI Function 87 — differential relay

C. ANSI Function 51 — overcurrent relay

D. ANSI Function 27 — undervoltage relay

32. The primary advantage of a grounded wye system over an ungrounded delta system for fault detection is?

A. Lower operating voltage for the same power delivery

B. Higher fault current capacity

C. Reduced harmonic distortion

D. Ground faults are immediately detectable and overcurrent devices operate to clear them

GENERATORS, MOTORS, AND MOTOR CONTROL (Questions 33–44)

33. A diesel generator set's rated standby power differs from its rated prime power in that standby power is?

A. The maximum output for unlimited hours of continuous operation

B. The maximum output available for a limited number of hours in a non-parallel standby application

C. Derated for high-altitude operation only

D. The output available for continuous parallel operation with the utility

34. When a motor is started across the line (full voltage), the starting current is typically?

A. Equal to full-load amperes

B. 50% of full-load amperes

C. 600–800% of full-load amperes

D. 200% of full-load amperes

35. The purpose of regenerative DC drives in elevator applications is to?

A. Provide backup power during utility outages

B. Eliminate the need for a mechanical brake

C. Control elevator speed during acceleration only

D. Return energy to the supply during regenerative braking when the car descends with a load

36. In a motor control circuit, a "jog" function allows?

A. The motor to run at reduced speed for precise positioning

B. The motor to start automatically after a set time delay

C. The motor to reverse direction automatically

D. Momentary motor operation only while the jog button is held — the motor stops when released

37. What happens to motor torque if supply voltage drops by 10%?

A. Torque increases by 10%

B. Torque decreases by approximately 19% (torque varies as voltage squared)

C. Torque is unaffected by voltage variation

D. Torque decreases by exactly 10%

38. An alternator's voltage regulator hunts (oscillates) at no load. The most likely cause is?

A. Excessive load on the generator output

B. Unstable AVR gain settings or a faulty sensing circuit

C. Open circuit in the field winding

D. Governor malfunction causing speed fluctuation

39. The purpose of a motor's locked rotor code letter (on the nameplate) is to?

A. Indicate the range of locked rotor kVA per horsepower

B. Specify the motor's maximum operating temperature

C. Identify the motor's enclosure type

D. Define the motor's service factor rating

40. A three-phase motor operating on single-phase (due to phase loss) will experience which condition immediately?

A. Reduced current draw and lower temperature

B. Normal torque at reduced speed

C. Reduced speed only with normal current

D. Excessive current draw and rapid overheating

41. The purpose of a time-delay relay (TDR) in a motor control circuit is to?

A. Limit motor inrush current during starting

B. Allow a timed sequence of operations — such as star-delta transition or sequential starting

C. Protect the motor from voltage surges

D. Monitor motor running current continuously

42. Which DC motor characteristic makes it suitable for crane hoist applications?

A. Its ability to provide high torque at low speed and act as a dynamic brake during lowering

B. Its constant speed under varying load

C. Its simple speed control requiring no external devices

D. Its brushless construction requiring minimal maintenance

43. Motor insulation class F is rated for a maximum winding temperature of?

A. 105°C

B. 155°C

C. 130°C

D. 180°C

44. A motor nameplate showing "NEMA Design B" indicates the motor has?

A. High starting torque and high slip

B. Normal starting torque, normal starting current, and low slip — general purpose design

C. Low starting torque and very low slip

D. High starting torque and very high starting current

ELECTRICAL TESTING, TROUBLESHOOTING, AND MAINTENANCE (Questions 45–54)

45. A step voltage test (step-voltage test or SV test) is used to?

A. Detect localized insulation weaknesses that a standard spot megger test may miss

B. Determine the transformer turns ratio

C. Calibrate overcurrent relay trip settings

D. Measure contact resistance of switchgear bus connections

46. The correct action when a megohmmeter reads infinity (∞) during a motor insulation test is?

A. This indicates excellent insulation — no current leakage path exists

B. The winding has completely failed — no insulation remains

C. The test leads are reversed — reverse and retest

D. The motor requires immediate rewinding

47. A circuit has three parallel branch faults — one shorted, one open, and one normal. The total circuit current will?

A. Be less than the normal branch current

B. Be equal to the normal branch current only

C. Be unaffected by the open branch

D. Be dominated by the shorted branch — extremely high total current

48. Power factor meters on a generator panel read below 0.80 lagging at light load. This typically indicates?

A. The generator is overloaded

B. The AVR setpoint is too low

C. The governor is malfunctioning

D. The reactive load (inductive) exceeds the real load — normal at light load

49. A motor draws locked rotor current indefinitely without starting. After investigation, the driven equipment is found to be mechanically jammed. The immediate protective action should be?

A. Increase the overload relay setting to allow more time

B. Disconnect power immediately to prevent motor damage

C. Switch to reduced voltage starting to allow more time for startup

D. Replace the motor with a higher horsepower unit

50. When performing relay testing on a time-overcurrent relay, the technician injects current at 200% pickup and measures trip time. This test verifies?

A. The relay's instantaneous element operation

B. The relay's pickup current setting accuracy

C. The relay's time-current characteristic at the test multiple

D. The relay's reset time after tripping

51. An electrical panel's neutral bus is found to be running hot during infrared scan. The most likely cause is?

A. Overcurrent on the phase conductors only

B. A high-resistance connection at the neutral bus or excessive neutral current from harmonic loads

C. Incorrect ambient temperature in the panel room

D. Oversized neutral conductor causing inductive heating

52. A locked rotor test on a motor reveals very high current at a low applied voltage. This indicates?

A. Normal motor behavior under locked rotor conditions

B. High winding resistance due to overheating

C. Open circuit in one phase winding

D. Low rotor resistance, confirming a low-impedance rotor circuit

53. The purpose of time-overcurrent relay coordination in a distribution system is to?

A. Ensure all breakers trip simultaneously during any fault

B. Maximize fault current to speed up protective device operation

C. Ensure that only the protective device closest to the fault operates, preserving service to unfaulted areas

D. Set all relay pickup values to the same threshold

54. When should a dielectric absorption test NOT be used as the primary insulation assessment method?

A. On new equipment before initial energization

B. On equipment that has been in service for many years

C. On very short cable runs where the capacitance is too small for the ratio to be meaningful

D. On motors rated above 4,160V

MECHANICAL EQUIPMENT (Questions 55–63)

55. A pump running at 1,800 RPM is slowed to 900 RPM using a VFD. Per the affinity laws, the new flow rate is?

A. 25% of original flow

B. 75% of original flow

C. 200% of original flow

D. 50% of original flow

56. The purpose of a mechanical seal flush plan (API Plan 11) on a centrifugal pump is to?

A. Lubricate the pump bearing with filtered process fluid

B. Circulate gas to cool the mechanical seal face

C. Provide cooling water from an external source to the seal

D. Recirculate clean process fluid from the pump discharge to cool and lubricate the seal faces

57. Which diesel engine component directly controls the timing of fuel injection?

A. Governor

B. Fuel transfer pump

C. Injection pump camshaft and timing mechanism

D. Thermostat

58. An air compressor unloader valve is stuck open. The result is?

A. The compressor builds pressure too rapidly

B. The compressor overheats due to continuous operation

C. The receiver tank pressure rises above the relief valve setting

D. The compressor runs but cannot build pressure in the receiver tank

59. The purpose of an overspeed trip on a steam turbine or diesel engine is to?

A. Reduce engine speed during peak load conditions

B. Automatically synchronize the machine to the grid

C. Control speed during normal load changes

D. Immediately shut down the machine if speed exceeds a safe maximum limit

60. Thermal imaging of a motor drive end bearing shows elevated temperature compared to the opposite drive end. This most likely indicates?

A. Normal bearing temperature differential between loaded and unloaded ends

B. Overloading of the driven equipment

C. Bearing over-greasing, preload issue, misalignment, or developing bearing fault

D. Low ambient temperature on the drive end side

61. A hydraulic system's pump cavitates. The first corrective action is to?

A. Check the inlet strainer and suction line for restrictions

B. Increase system pressure to force fluid into the pump

C. Replace the pump immediately

D. Add hydraulic fluid to the reservoir

62. A diesel generator's oil consumption has increased significantly over three months. The most likely cause is?

A. Worn piston rings allowing oil to be burned in the combustion chamber

B. Excessive generator loading beyond rated kVA

C. Governor malfunction causing engine overspeed

D. Clogged oil filter reducing lubrication flow

63. The function of a vibration switch on rotating equipment is to?

A. Measure and record vibration data for trending

B. Shut down the equipment if vibration amplitude exceeds a preset threshold

C. Indicate the direction of shaft rotation

D. Balance the rotating assembly automatically

FLUID SYSTEMS (Questions 64–72)

64. Which valve type requires only a quarter turn to fully open or close and provides minimal flow restriction when fully open?

A. Globe valve

B. Gate valve

C. Needle valve

D. Ball valve

65. In a steam heating system, the steam main is pitched in the direction of flow to?

A. Allow condensate to drain in the direction of steam flow to traps and drip legs

B. Increase steam velocity through the distribution system

C. Reduce the system operating pressure

D. Prevent water hammer at branch takeoffs

66. A centrifugal pump is operating at 100 PSI discharge pressure with normal flow. The suction pressure gauge reads -5 PSI (vacuum). This indicates?

A. Normal operating condition for most installations

B. Adequate NPSH for the pump at this operating point

C. The pump is operating at peak efficiency

D. A high suction lift condition that may be approaching the NPSH limit

67. The purpose of a makeup water system on a cooling tower is to?

A. Replace water lost through evaporation, drift, and blowdown to maintain basin level

B. Provide emergency fire suppression water for the facility

C. Supply chemical treatment solution directly to the tower basin

D. Pre-cool incoming warm condenser water before it enters the tower fill

68. In a hydronic heating system, a three-way mixing valve is used to?

A. Provide automatic pressure regulation in the distribution loop

B. Mix supply and return water to achieve a desired mixed supply temperature

C. Prevent backflow in the boiler return piping

D. Balance flow between multiple heating zones automatically

69. Which type of pipe expansion joint absorbs thermal expansion through flexible bellows without requiring adjacent pipe anchoring?

A. Slip-type expansion joint

B. Ball-type expansion joint

C. Bellows (expansion) joint

D. Swing loop expansion joint

70. The purpose of a deaerator in a steam boiler feedwater system is to?

A. Remove dissolved oxygen and non-condensable gases from feedwater before it enters the boiler

B. Regulate the pressure of steam supplied to the turbine

C. Cool the condensate return before it enters the feedwater tank

D. Filter suspended solids from the makeup water supply

71. A three-way solenoid valve in a pneumatic control system is used to?

A. Regulate air pressure to multiple actuators simultaneously

B. Direct air pressure to one of two actuator ports or exhaust it

C. Filter particulates from the compressed air supply

D. Convert pneumatic signal to a 4–20mA electrical signal

72. Which refrigerant is classified as an HFC and is the most common replacement for R-22 in commercial HVAC systems?

A. R-11

B. R-410A

C. R-123

D. R-134a

CONSTRUCTION, TOOLS, AND RIGGING (Questions 73–80)

73. When using a chain fall (chain hoist) to lift a load, the hand chain should be pulled?

A. In quick jerking motions to overcome static friction

B. Using the full body weight for maximum mechanical advantage

C. Smoothly and steadily to maintain controlled load movement

D. At maximum speed to reduce fatigue

74. The purpose of a swivel hook in a rigging assembly is to?

A. Increase the working load limit of the assembly

B. Replace shackles when direct connection is required

C. Allow the load to rotate freely without twisting the sling or hoist chain

D. Provide a secondary safety latch for overhead lifts

75. A conduit bender with a 1-inch bending shoe is used to make a 90° stub-up. The developed length of conduit consumed by the bend is approximately?

A. 6 inches

B. 8 inches

C. 15 inches

D. 12 inches

76. On a mechanical assembly drawing, a tolerance of ±0.005" on a shaft diameter means?

A. The shaft must be exactly the specified diameter

B. The shaft diameter may not exceed the nominal value

C. The shaft diameter must fall within 0.005" above or below the specified nominal dimension

D. The shaft may vary by 0.005" in roundness only

77. Which pipe fitting is used to connect two pipes of different sizes in a straight run?

A. Coupling

B. Reducer (concentric or eccentric)

C. Union

D. Bushing

78. The safe working load limit of an eyebolt is reduced when the load is applied at an angle to the eyebolt axis because?

A. The eyebolt shank experiences bending stress in addition to tensile stress

B. The eyebolt threads are subjected to shear loading

C. The load transfer through the eye becomes inefficient

D. Angled loading causes the eyebolt to loosen under dynamic loads

79. Which of the following describes the purpose of a come-along used in cable pulling operations?

A. To measure tension in a wire rope during pulling

B. To pull conductors through conduit using a ratcheting pulling force

C. To support the cable reel during conductor installation

D. To cut conductors to length during termination

80. A stud finder is used in construction maintenance to?

A. Locate wall studs, joists, and concealed structural members behind finished surfaces

B. Identify the type of fastener used in a structural connection

C. Measure the depth of embedment of anchor bolts

D. Test the pull-out strength of installed fasteners

HAZARDOUS MATERIALS AND ENVIRONMENTAL COMPLIANCE (Questions 81–89)

81. The OSHA PEL (Permissible Exposure Limit) for asbestos in general industry is?

A. 0.2 fibers per cubic centimeter (f/cc) as an 8-hour TWA

B. 0.1 fibers per cubic centimeter (f/cc) as an 8-hour TWA

C. 1.0 fibers per cubic centimeter (f/cc) as an 8-hour TWA

D. 2.0 fibers per cubic centimeter (f/cc) as an 8-hour TWA

82. A chemical labeled with GHS pictogram showing a skull and crossbones indicates?

A. The chemical is a flammable liquid

B. The chemical is an environmental hazard

C. The chemical is corrosive to skin

D. The chemical is acutely toxic by ingestion, inhalation, or skin contact

83. Which section of the SDS contains information about safe handling, storage conditions, and incompatibilities?

A. Section 6

B. Section 9

C. Section 7

D. Section 11

84. The EPA requires facilities with transformers containing 500 PPM or more of PCBs to notify the EPA and register within?

A. 30 days of discovery

B. The first annual inspection report after discovery

C. 90 days of discovery

D. 180 days of discovery

85. Facilities in NYC that store more than 110 gallons of petroleum products aboveground must comply with?

A. NYC Fire Code petroleum storage requirements and obtain FDNY permits

B. RCRA large quantity generator requirements

C. CERCLA reportable quantity provisions only

D. EPA SPCC plan requirements only

86. The OSHA noise standard requires that workers exposed to 90 dBA TWA be provided with hearing protection and enrolled in a hearing conservation program if engineering controls cannot reduce the exposure. This standard is codified at?

A. 29 CFR 1910.269

B. 29 CFR 1910.95

C. 29 CFR 1910.134

D. 29 CFR 1910.1200

87. A facility's hazardous waste is found to contain both RCRA-listed waste and radioactive material. This waste is known as?

A. Acutely hazardous waste

B. Universal waste

C. Characteristic waste only

D. Mixed waste

88. The Clean Air Act's National Emission Standards for Hazardous Air Pollutants (NESHAP) for asbestos requires that?

A. Asbestos emissions from demolition and renovation are controlled and reported to the EPA

B. Asbestos abatement workers be licensed by the EPA

C. All asbestos-containing materials be removed before any building maintenance

D. Facility owners conduct annual asbestos air monitoring

89. The Toxic Substances Control Act (TSCA) Section 6(e) specifically regulates?

A. PCBs — prohibiting their manufacture, processing, distribution, and requiring proper disposal

B. Asbestos removal procedures in schools

C. Lead paint abatement in residential buildings

D. Refrigerant management and phase-out schedules

SAFETY, LOTO, ARC FLASH, AND EMERGENCY PROCEDURES (Questions 90–100)

90. Under OSHA 1910.147, the energy control procedure must be reviewed and updated when?

A. A new worker is assigned to the facility

B. Annual review only is required regardless of changes

C. A periodic inspection reveals it is inadequate, or when equipment or process changes affect it

D. Every six months regardless of changes

91. The purpose of an arc flash boundary label on equipment is to?

A. Mark the location of the nearest fire extinguisher

B. Indicate the equipment's voltage rating for maintenance planning

C. Show the required PPE for routine operation of the equipment

D. Warn workers of the minimum safe working distance and required PPE before opening the equipment

92. A confined space attendant observes smoke entering the permit space from an adjacent area. The correct action is to?

A. Enter the space to warn the entrants directly

B. Ventilate the space by opening additional access points

C. Contact the fire department before ordering evacuation

D. Order immediate evacuation of all entrants and cancel the permit

93. Which of the following is NOT a recognized method for controlling arc flash hazard per NFPA 70E?

A. De-energizing the equipment before work

B. Increasing the working distance from the arc source

C. Working faster to minimize exposure time

D. Using current-limiting fuses to reduce clearing time

94. OSHA requires that workers who use respiratory protection be medically evaluated by?

A. The facility's safety officer annually

B. A licensed healthcare professional before initial use

C. An OSHA-approved industrial hygienist

D. The facility's occupational health nurse

95. Which type of PPE is required when working within the restricted approach boundary of exposed energized conductors at 480V?

A. Class E hard hat and safety glasses only

B. Voltage-rated gloves with leather protectors and appropriate arc-rated clothing

C. Standard leather work gloves and FR coveralls

D. Chemical-resistant gloves and face shield

96. A worker discovers a gas leak while performing maintenance in a mechanical room. The correct first action is to?

A. Evacuate the area, avoid creating any ignition source, and activate the emergency response plan

B. Attempt to isolate the leak by closing the nearest shutoff valve

C. Open windows and doors to dilute the gas concentration

D. Continue work and report the leak to supervision at the end of the shift

97. The NFPA 101 Life Safety Code governs?

A. Electrical system design in commercial buildings

B. Sprinkler system maintenance intervals

C. Fire suppression agent selection

D. Means of egress, exit signage, and occupant safety in buildings

98. Eye and face protection must comply with which ANSI standard for use in electrical work?

A. ANSI Z89.1

B. ANSI Z535

C. ANSI Z87.1

D. ANSI Z41

99. The purpose of a job hazard analysis (JHA) before beginning a maintenance task is to?

A. Document labor hours for project billing purposes

B. Assign responsibility for equipment failure during maintenance

C. Satisfy union contract requirements for hazardous work

D. Identify hazards, assess risks, and determine protective measures before work begins

100. When a Stationary Engineer observes an unsafe condition that poses immediate danger to life but their supervisor is unavailable, they should?

A. Stop the unsafe activity or work immediately and report the condition through the chain of command

B. Continue working and document the hazard for future review

C. Wait for the supervisor to return before taking any action

D. Contact OSHA directly before taking any corrective action

PRACTICE EXAM 6 — ANSWER KEY AND FULL EXPLANATIONS

ELECTRICAL FUNDAMENTALS (Questions 1–12)

1. Correct Answer: B — 3A

Using Ohm's Law: I = V ÷ R = 12 ÷ 4 = 3 amperes. A 12-volt source driving current through 4 ohms of resistance produces exactly 3 amperes of current flow through the circuit.

2. Correct Answer: D — 22Ω

Total series resistance = 6 + 12 + 4 = 22 ohms. All resistances in a series circuit add directly because the single current path passes through every component sequentially.

3. Correct Answer: D — Frequency increases

Capacitive reactance XC = 1 ÷ (2π × f × C). As frequency increases, the denominator grows larger and XC decreases. Higher-frequency AC can charge and discharge the capacitor faster, presenting less opposition to current flow.

4. Correct Answer: C — The total power supplied by the source, combining real and reactive components

Apparent power (VA) is the vector combination of real power (watts) and reactive power (VARs) — it represents the total power the source must supply regardless of what portion does useful work. It equals voltage times current without regard to phase angle.

5. Correct Answer: D — 0 (zero)

A purely capacitive circuit stores and releases energy with no real power consumption — voltage and current are 90° out of phase (current leads voltage). Power factor = cos(90°) = 0. No real power is consumed; all power is reactive.

6. Correct Answer: B — 15A

Current = Power ÷ Voltage = 3,600 ÷ 240 = 15 amperes. A resistive heating element converts all electrical energy to heat, so power factor is 1.0 and the current calculation is straightforward.

7. Correct Answer: D — Oppose the change in magnetic flux that produced it

Lenz's Law states that the direction of induced EMF is always such that the current it would produce opposes the change in magnetic flux that caused the induction. This is a consequence of the conservation of energy — the induced EMF acts as a counter-force.

8. Correct Answer: B — 208V

In a three-phase wye system, line voltage = phase voltage × √3 = 120 × 1.732 = 207.8V ≈ 208V. This is the standard 208/120V wye system used throughout commercial buildings — 120V phase-to-neutral, 208V phase-to-phase.

9. Correct Answer: B — 26.5Ω

XC = 1 ÷ (2π × f × C) = 1 ÷ (2 × 3.14159 × 60 × 0.0001) = 1 ÷ 0.03770 = 26.5 ohms. Note that 100μF = 0.0001 farads — the unit conversion is critical in this calculation.

10. Correct Answer: A — Kirchhoff's Current Law

Kirchhoff's Current Law (KCL) states that the algebraic sum of all currents entering and leaving any node (junction) in a circuit equals zero — in other words, current in equals current out. This is a fundamental expression of charge conservation.

11. Correct Answer: A — The load at which core losses equal copper losses

A transformer reaches maximum efficiency at the load where variable copper losses (I^2R) equal the constant core losses (hysteresis and eddy current). This load is typically 50–75% of full rated load, which is why transformers are often sized to operate in this range.

12. Correct Answer: C — Increasing the coupling between the coils

Mutual inductance increases with tighter magnetic coupling between coils — bringing them closer together, using a common iron core, or aligning their axes to maximize the flux linkage between them. An iron core concentrates the magnetic flux far more effectively than an air core.

WIRING, CONDUCTORS, AND PROTECTIVE DEVICES (Questions 13–22)

13. Correct Answer: D — 24 inches

NEC Table 300.5 requires PVC conduit under driveways for residential properties to be buried a minimum of 24 inches. The depth requirements vary by wiring method, voltage, and surface type — driveways require greater depth than general outdoor areas due to vehicle load.

14. Correct Answer: A — 10 AWG

NEC Table 310.15(B)(16) shows 10 AWG copper is rated for 30 amperes at 60°C or 35 amperes at 75°C. A 30-ampere, 240V dryer circuit requires a minimum of 10 AWG copper conductors with a 30-ampere overcurrent protective device.

15. Correct Answer: B — Current-limiting fuses or current-limiting breakers

When available fault current exceeds the interrupting rating of standard MCCB breakers, current-limiting fuses (Class R, Class J, Class L) or current-limiting circuit breakers must be installed. These devices interrupt fault current so rapidly that the let-through current never reaches its prospective peak, protecting downstream equipment.

16. Correct Answer: B — All conductors are insulated for the maximum voltage present in the raceway

NEC Section 300.3(C) permits conductors of different circuits in the same raceway provided all conductors are insulated for the maximum voltage present. Additional restrictions apply for AC and DC circuits sharing a raceway, and for circuits from different systems.

17. Correct Answer: B — 10 AWG

Wire nuts are rated by manufacturer specification, but most standard wire nuts are suitable for conductors up to 10 AWG. For larger conductors (8 AWG and above), mechanical lugs, compression connectors, or listed split-bolt connectors are required for reliable connections.

18. Correct Answer: A — Sized per NEC Table 250.122 based on the rating of the circuit's overcurrent protective device

NEC Table 250.122 specifies minimum EGC sizes based on the ampere rating of the overcurrent protective device protecting the circuit — not based on phase conductor size. A 20A circuit requires a minimum 12 AWG EGC; a 100A circuit requires a minimum 8 AWG EGC.

19. Correct Answer: D — Commercial buildings, exposed in areas subject to physical damage, or embedded in concrete

Type NM (non-metallic sheathed) cable is restricted to residential and small commercial wood-frame construction in concealed locations. It is not permitted in commercial buildings (except certain dwelling units), exposed locations subject to damage, or embedded in concrete, masonry, or plaster.

20. Correct Answer: D — Instantaneous tripping for high-magnitude short circuit currents

The magnetic element of a thermal-magnetic circuit breaker responds to the intense magnetic force created by a high-magnitude fault current, tripping the breaker instantaneously (within one cycle) to protect against short circuits. The thermal bimetallic element handles slower-developing overloads with time-delayed tripping.

21. Correct Answer: C — To connect the utility meter to the first disconnect means

Service entrance conductors run from the utility service point (weatherhead or underground service) through the meter socket to the main service disconnect — the first overcurrent protective device on the premises. They are not considered branch circuit or feeder conductors.

22. Correct Answer: A — 36 inches deep (for voltages to ground up to 150V)

NEC Section 110.26 requires a minimum working space of 36 inches in depth in front of electrical equipment for voltages to ground up to 150V (Condition 1). Working space increases to 42 inches for 151–600V and can require up to 48 inches for higher voltage or more complex conditions.

POWER DISTRIBUTION AND HIGH-TENSION SYSTEMS (Questions 23–32)

23. Correct Answer: C — 625 kVA

Apparent power = Real power ÷ Power factor = 500 ÷ 0.80 = 625 kVA. The source must supply 625 kVA of apparent power even though only 500 kW does useful work — the remaining reactive component circulates between source and load without performing real work.

24. Correct Answer: D — Wye-delta

A wye-delta transformer connection is used to step up voltage for transmission — the wye primary allows a neutral grounding point on the generator side, and the delta secondary provides a higher line voltage for efficient long-distance transmission. The delta-wye connection is used at the receiving end to step back down.

25. Correct Answer: A — Ensure measurement accuracy within a defined percentage at specified burden and current

CT metering accuracy class (e.g., 0.3B0.9) specifies that the ratio and phase angle errors will not exceed the accuracy class percentage (0.3%) at rated current and at the specified standard burden (0.9 VA). Higher accuracy classes are required for revenue metering and protection-grade CTs.

26. Correct Answer: C — 90.2A

Full-load secondary current = kVA × 1,000 ÷ Voltage = 75,000 ÷ 480 = 156.25A for single-phase. For three-phase: I = kVA × 1,000 ÷ (V × √3) = 75,000 ÷ (480 × 1.732) = 75,000 ÷ 831.4 = 90.2 amperes maximum continuous current from a 75 kVA, 480V three-phase transformer.

27. Correct Answer: A — The voltage drop across the bus under fault and load current conditions

Bus impedance (resistance and inductance of the copper or aluminum bus bars) causes a voltage drop proportional to the current flowing through the bus. Under fault conditions, bus impedance also limits maximum fault current contributed by the bus, affecting protective relay settings and equipment interrupting ratings.

28. Correct Answer: B — Limit fault current when the bus sections are paralleled

When two bus sections are operated in parallel through a tie breaker, the combined fault current available at any point on the paralleled bus doubles. A current-limiting reactor in the bus tie circuit adds impedance that limits fault current to a level within the equipment's interrupting rating while allowing normal load sharing.

29. Correct Answer: A — Harmonic restraint — blocking operation during 2nd harmonic inrush current

Transformer inrush current is rich in second harmonic (120 Hz) content because of core saturation. Modern differential relays use harmonic restraint — detecting 2nd harmonic in the differential current — to distinguish inrush from an internal fault and block false tripping during transformer energization.

30. Correct Answer: A — Current-carrying capacity decreases as ambient temperature reduces the thermal gradient available for heat dissipation

A conductor or switch contact can only dissipate heat into its environment. At high ambient temperature, the temperature difference between the conductor and ambient is reduced, limiting heat dissipation and requiring a lower current to keep the conductor within its rated maximum temperature.

31. Correct Answer: A — ANSI Function 40 — loss of excitation (impedance) relay

ANSI Function 40 monitors the generator's impedance at its terminals. When field excitation is lost, the generator absorbs reactive power from the system and its terminal impedance characteristic changes in a predictable way — the Function 40 relay detects this change and trips the unit before pole slipping causes mechanical damage.

32. Correct Answer: D — Ground faults are immediately detectable and overcurrent devices operate to clear them

In a grounded wye system, any ground fault creates a complete circuit through the grounded neutral, allowing sufficient fault current to flow and operate fuses or breakers. In an ungrounded delta system, the first ground fault produces no fault current and goes undetected — creating a dangerous latent hazard for the second ground fault.

GENERATORS, MOTORS, AND MOTOR CONTROL (Questions 33–44)

33. Correct Answer: B — The maximum output available for a limited number of hours in a non-parallel standby application

Standby power rating is the maximum output a generator set can deliver in a non-paralleled standby application for a limited number of hours per year (typically 200 hours) at variable load. Prime power is the rating for unlimited continuous operation at variable load, and it is typically 10–15% lower than standby rating.

34. Correct Answer: C — 600–800% of full-load amperes

Across-the-line starting draws locked rotor current (LRC) — typically 600–800% of full-load amperes (FLA) — because the motor has no back-EMF at standstill and presents only its locked rotor impedance to the supply. This high inrush current lasts until the motor accelerates to near synchronous speed.

35. Correct Answer: D — Return energy to the supply during regenerative braking when the car descends with a load

In elevator applications, regenerative DC drives reverse current flow during braking — the motor acts as a generator and the drive feeds the generated energy back to the AC supply grid. This energy recovery significantly reduces building energy consumption, particularly in high-rise buildings with high elevator duty cycles.

36. Correct Answer: D — Momentary motor operation only while the jog button is held — the motor stops when released

Jog control bypasses the holding (seal-in) contact of the motor starter, allowing the motor to run only while the jog pushbutton is physically depressed. Releasing the button de-energizes the contactor and stops the motor — used for precise positioning, inching equipment into place, or testing.

37. Correct Answer: B — Torque decreases by approximately 19% (torque varies as voltage squared)

Motor torque is proportional to the square of the applied voltage. A 10% voltage reduction results in a torque reduction of $(1 - 0.9^2) = (1 - 0.81) = 19\%$. This is why voltage unbalance and voltage reduction are significant concerns for motor applications with high torque requirements.

38. Correct Answer: B — Unstable AVR gain settings or a faulty sensing circuit

Generator voltage hunting (oscillation) at no load, with the governor functioning correctly, points to the automatic voltage regulator (AVR) as the source. Incorrect gain settings, a faulty voltage sensing circuit, or a damaged AVR feedback component causes the excitation to continuously overshoot and undershoot the setpoint.

39. Correct Answer: A — Indicate the range of locked rotor kVA per horsepower

NEMA locked rotor code letters (A through V) on a motor nameplate indicate the range of kilovolt-amperes per horsepower drawn at locked rotor conditions. This information is essential for properly sizing branch circuit conductors, overcurrent protection, and starting equipment. Code letter F, for example, indicates 5.0–5.59 kVA/HP.

40. Correct Answer: D — Excessive current draw and rapid overheating

When a three-phase motor loses one phase, it must develop the required torque using only the remaining two phases. The motor draws very high current — often 2–3 times normal — in the remaining windings, generating excessive heat that rapidly destroys winding insulation if the motor is not disconnected quickly.

41. Correct Answer: B — Allow a timed sequence of operations — such as star-delta transition or sequential starting

Time-delay relays in motor control circuits control the timing of sequential events — transitioning from star to delta connection after a set acceleration time, sequencing multiple motors to start in a predetermined order, or timing the transition from reduced voltage to full voltage starting.

42. Correct Answer: A — Its ability to provide high torque at low speed and act as a dynamic brake during lowering

DC motors are ideal for crane hoists because they develop full torque at standstill for controlled lifting from rest, provide smooth infinitely variable speed control in both directions, and can operate in regenerative or dynamic braking mode during controlled load lowering — maintaining safe descent speed.

43. Correct Answer: B — 155°C

NEMA and IEC insulation class ratings: Class A = 105°C, Class B = 130°C, Class F = 155°C, Class H = 180°C. Class F is the most common insulation class for modern general-purpose NEMA motors, providing a 25°C margin above Class B for extended insulation life.

44. Correct Answer: B — Normal starting torque, normal starting current, and low slip — general purpose design

NEMA Design B is the standard general-purpose induction motor design — it provides normal starting torque (approximately 150% of full-load torque), normal locked rotor current, and low slip at full load. Design A has higher starting current; Design C has high starting torque; Design D has very high slip.

ELECTRICAL TESTING, TROUBLESHOOTING, AND MAINTENANCE (Questions 45–54)

45. Correct Answer: A — Detect localized insulation weaknesses that a standard spot megger test may miss

The step-voltage test applies the test voltage in equal increments, holding at each step for a set time and recording insulation resistance. Weak spots in the insulation show a disproportionate drop in resistance at a specific voltage step — revealing localized damage that a single-voltage megger reading might not detect.

46. Correct Answer: A — This indicates excellent insulation — no current leakage path exists

An infinity (∞) reading on a megohmmeter indicates that the insulation resistance is beyond the meter's maximum measurable range — meaning essentially zero leakage current flows through the insulation. This is an excellent result indicating very high-quality, clean, dry insulation.

47. Correct Answer: D — Be dominated by the shorted branch — extremely high total current

A shorted branch presents near-zero resistance, drawing extremely high current limited only by the supply impedance. This dominates total circuit current far beyond what the normal and open branches contribute. The normal branch current is negligible compared to the short circuit current.

48. Correct Answer: D — The reactive load (inductive) exceeds the real load — normal at light load

At light load, motors and transformers still draw their full magnetizing reactive current even though real power consumption is minimal. The ratio of reactive to real power is high, resulting in a low lagging power factor. This is the normal characteristic of inductive equipment at light load.

49. Correct Answer: B — Disconnect power immediately to prevent motor damage

A motor drawing locked rotor current indefinitely is carrying 6–8 times full-load current and will overheat rapidly — destroying winding insulation within seconds to minutes. Power must be disconnected immediately. The mechanical jam must then be cleared before any restart attempt.

50. Correct Answer: C — The relay's time-current characteristic at the test multiple

Injecting current at 200% of pickup (twice the pickup setting) and measuring the actual trip time verifies that the relay's time-current characteristic curve is correct at that test point. The measured time should match the published TCC curve value at 2× pickup for the selected time dial setting.

51. Correct Answer: B — A high-resistance connection at the neutral bus or excessive neutral current from harmonic loads

A hot neutral bus is most commonly caused by either a loose or corroded connection creating resistance heating, or by excessive neutral current from triplen harmonics (3rd, 9th, 15th) generated by non-linear single-phase loads. Triplen harmonics add arithmetically on the neutral rather than canceling as balanced fundamental currents do.

52. Correct Answer: D — Low rotor resistance, confirming a low-impedance rotor circuit

A locked rotor test applies reduced voltage to the stator with the rotor blocked and measures current drawn. Very high current at low applied voltage confirms low rotor circuit impedance — indicating healthy, low-resistance rotor bars. This distinguishes between high- and low-impedance rotor designs and detects broken rotor bars.

53. Correct Answer: C — Ensure that only the protective device closest to the fault operates, preserving service to unfaulted areas

Protective device coordination (selectivity) is achieved by setting time-current characteristics so that for any fault, the device immediately upstream of the fault operates first while all upstream devices remain closed. This minimizes the extent of the outage and preserves power to all areas not directly affected by the fault.

54. Correct Answer: C — On very short cable runs where the capacitance is too small for the ratio to be meaningful

The dielectric absorption ratio (DAR) — 60-second reading divided by 30-second reading — relies on the insulation's charging current declining over time. Very short cables have so little capacitance that the charging current decays almost instantly, producing a ratio near 1.0 regardless of insulation condition, making the test uninformative.

MECHANICAL EQUIPMENT (Questions 55–63)

55. Correct Answer: D — 50% of original flow

Per the pump affinity laws, flow is directly proportional to speed: Q2 = Q1 × (N2 ÷ N1) = Q1 × (900 ÷ 1800) = Q1 × 0.5. Halving the speed halves the flow. Head is reduced to 25% of original, and power drops to 12.5% — a significant energy saving at reduced flow.

56. Correct Answer: D — Recirculate clean process fluid from the pump discharge to cool and lubricate the seal faces

API Plan 11 takes a flow of clean, filtered process fluid from the high-pressure discharge of the pump and returns it to the mechanical seal chamber. This maintains positive pressure at the seal, cools the seal faces, and ensures the seal always operates in clean fluid — preventing dry running and premature seal failure.

57. Correct Answer: C — Injection pump camshaft and timing mechanism

The injection pump camshaft governs both the timing and quantity of fuel delivered to each cylinder. The camshaft lobes actuate the injection pump plungers at precisely timed intervals synchronized to the engine crankshaft position, determining injection advance angle and injection duration.

58. Correct Answer: D — The compressor runs but cannot build pressure in the receiver tank

With the unloader valve stuck open, the cylinder pressure is continuously vented back to the intake — the compressor runs but performs no useful compression work. The receiver tank pressure does not build, the system has no compressed air supply, but the motor runs continuously at low load current.

59. Correct Answer: D — Immediately shut down the machine if speed exceeds a safe maximum limit

Overspeed trips are critical safety devices that initiate an emergency shutdown when shaft speed exceeds a preset limit — typically 110–115% of rated speed. Without overspeed protection, a governor failure or sudden load rejection could cause the machine to reach destructive speed within seconds, risking catastrophic disintegration.

60. Correct Answer: C — Bearing over-greasing, preload issue, misalignment, or developing bearing fault

Elevated temperature at the drive end bearing compared to the opposite end indicates a problem specific to that bearing — excess grease churning, incorrect preload causing internal friction, shaft misalignment creating additional radial or axial load on that bearing, or a developing race or rolling element defect.

61. Correct Answer: A — Check the inlet strainer and suction line for restrictions

Pump cavitation (violent collapse of vapor bubbles formed when fluid pressure drops below vapor pressure) is most commonly caused by insufficient fluid reaching the pump inlet — a clogged inlet strainer or restricted suction line is the first thing to check. Increasing system pressure or adding fluid addresses symptoms rather than the root cause.

62. Correct Answer: A — Worn piston rings allowing oil to be burned in the combustion chamber

Gradual oil consumption increase over time is the classic symptom of worn piston rings. As rings wear, their ability to seal the combustion chamber from the crankcase deteriorates, allowing lubricating oil to be drawn past the rings into the combustion chamber where it burns and exits through the exhaust.

63. Correct Answer: B — Shut down the equipment if vibration amplitude exceeds a preset threshold

A vibration switch (vibration switch/transmitter with setpoint) continuously monitors vibration amplitude and initiates a protective shutdown signal when amplitude exceeds the programmed alarm or trip setpoint — preventing equipment damage from developing faults that would otherwise go undetected between inspection intervals.

FLUID SYSTEMS (Questions 64–72)

64. Correct Answer: D — Ball valve

Ball valves use a spherical plug with a through-bore that aligns with the pipe when open — requiring only a 90° turn from fully open to fully closed. When fully open, the bore matches the pipe diameter, providing essentially no flow restriction and very low pressure drop.

65. Correct Answer: A — Allow condensate to drain in the direction of steam flow to traps and drip legs

Steam mains are pitched at a minimum of ¼ inch per 10 feet in the direction of steam flow so that condensate — which forms continuously as steam gives up heat to the piping — flows by gravity to drip legs and steam traps for removal. Without proper pitch, condensate accumulates and causes water hammer.

66. Correct Answer: D — A high suction lift condition that may be approaching the NPSH limit

A suction pressure reading of -5 PSI (vacuum) indicates the pump is lifting water from a level significantly below the pump centerline. As vacuum increases (more negative), available NPSH decreases. If available

NPSH falls below the pump's required NPSH, cavitation will occur, reducing performance and damaging the impeller.

67. Correct Answer: A — Replace water lost through evaporation, drift, and blowdown to maintain basin level

Cooling towers lose water continuously through evaporation (the primary cooling mechanism), drift (water droplets carried out with the air), and intentional blowdown. The makeup water system, controlled by a float valve or level switch, automatically adds fresh water to maintain the design basin water level.

68. Correct Answer: B — Mix supply and return water to achieve a desired mixed supply temperature

A three-way mixing valve blends hot supply water with cooler return water in variable proportions to achieve a target mixed supply temperature — allowing the system to modulate heat delivery to zones based on outdoor temperature (reset control) without cycling the boiler.

69. Correct Answer: C — Bellows (expansion) joint

Bellows expansion joints use a flexible corrugated metal or rubber element that can compress, extend, and deflect laterally to absorb thermal expansion in piping systems. They do not require guide pipes or anchor points to absorb axial movement — a significant advantage in confined mechanical spaces.

70. Correct Answer: A — Remove dissolved oxygen and non-condensable gases from feedwater before it enters the boiler

The deaerator heats feedwater to saturation temperature at the deaerator operating pressure, which drives dissolved oxygen and carbon dioxide out of solution. These gases are vented to atmosphere — if allowed into the boiler, oxygen causes aggressive pitting corrosion and CO_2 attacks condensate return piping.

71. Correct Answer: B — Direct air pressure to one of two actuator ports or exhaust it

A three-way solenoid valve has three ports: supply, actuator port, and exhaust. In the energized position, it connects supply pressure to the actuator; in the de-energized position, it connects the actuator port to exhaust while blocking supply. This allows single-acting actuators to both extend and retract.

72. Correct Answer: B — R-410A

R-410A is the dominant HFC refrigerant replacement for R-22 in commercial HVAC systems — it operates at higher pressures than R-22 and has zero ozone depletion potential. R-11 and R-123 are CFC/HCFC refrigerants used in centrifugal chillers; R-134a is used primarily in automotive and small commercial applications.

CONSTRUCTION, TOOLS, AND RIGGING (Questions 73–80)

73. Correct Answer: C — Smoothly and steadily to maintain controlled load movement

Smooth, steady pulling on a chain hoist hand chain ensures controlled, predictable load movement and prevents the shock loading that jerking motions create. Shock loads can momentarily exceed the static load by two to three times, potentially exceeding the hoist's working load limit and causing chain or hook failure.

74. Correct Answer: C — Allow the load to rotate freely without twisting the sling or hoist chain

A swivel hook contains a bearing that allows the hook to rotate freely relative to the hoist or sling attachment point. This prevents torsional stress from accumulating in the chain or sling when a load rotates during lifting — a common occurrence with asymmetric loads.

75. Correct Answer: C — 15 inches

The developed length of conduit consumed by a 90° bend is calculated as: developed length = 0.7854 × (radius + ½ × conduit OD) × 2 for a 90° bend. For a 1-inch conduit with a standard hand bender, the developed length is approximately 15 inches — the length of conduit that becomes the curved section of the bend.

76. Correct Answer: C — The shaft diameter must fall within 0.005" above or below the specified nominal dimension

A bilateral tolerance of ±0.005" means the actual manufactured dimension may be no more than 0.005 inches larger or smaller than the nominal specified dimension. This defines the acceptable range within which the part is considered dimensionally conforming.

77. Correct Answer: B — Reducer (concentric or eccentric)

A reducer connects two pipes of different sizes in a straight run — a concentric reducer maintains the centerline of both pipes, while an eccentric reducer offsets the centerline, keeping one side of the pipe flat (important for draining piping systems and preventing air pockets in suction lines).

78. Correct Answer: A — The eyebolt shank experiences bending stress in addition to tensile stress

When a load is applied at an angle to the eyebolt axis, the shank is subjected to a combination of tensile stress (along the axis) and bending stress (perpendicular to the axis). Bending stress significantly reduces the load capacity — an eyebolt loaded at 45° may be derated to 30% of its vertical rating; at 90°, to just 25%.

79. Correct Answer: B — To pull conductors through conduit using a ratcheting pulling force

A come-along (lever hoist) used in cable pulling operations provides a ratcheting mechanical advantage that allows one or two workers to develop substantial pulling tension on a conductor pull line — useful when the available pull tension from a manual pull is insufficient for the run length and conduit fill.

80. Correct Answer: A — Locate wall studs, joists, and concealed structural members behind finished surfaces

A stud finder uses electronic sensing (capacitance or magnetic detection) to locate the edges of wood or metal framing members concealed behind drywall or plaster — essential for safely drilling, cutting, or fastening to walls and ceilings without damaging hidden structural members or utility lines.

HAZARDOUS MATERIALS AND ENVIRONMENTAL COMPLIANCE (Questions 81–89)

81. Correct Answer: B — 0.1 fibers per cubic centimeter (f/cc) as an 8-hour TWA

OSHA's asbestos standard (29 CFR 1910.1001) sets the PEL at 0.1 f/cc as an 8-hour TWA and 1.0 f/cc as a 30-minute short-term excursion limit. The action level is 0.1 f/cc — at or above this level, employers must implement exposure monitoring and medical surveillance.

82. Correct Answer: D — The chemical is acutely toxic by ingestion, inhalation, or skin contact

The GHS skull and crossbones pictogram (Exclamation mark is for lesser hazards) indicates acute toxicity Category 1–3 — chemicals that can cause death or severe injury from a single exposure by any route. This is the most severe acute health hazard pictogram in the GHS system.

83. Correct Answer: C — Section 7

SDS Section 7 — Handling and Storage — contains information on safe handling practices, storage conditions (temperature, ventilation, segregation from incompatibles), and precautions to prevent exposure during normal use. Section 6 covers accidental release measures; Section 9 covers physical properties.

84. Correct Answer: B — The first annual inspection report after discovery

EPA's PCB regulations (40 CFR Part 761) require that transformers containing 500 PPM or more PCBs be marked, inspected annually, and recorded in facility records. Notification and registration requirements vary by concentration and use — facilities must report findings in annual inspection documentation submitted to the EPA regional office.

85. Correct Answer: A — NYC Fire Code petroleum storage requirements and obtain FDNY permits

NYC Fire Code Chapter 34 governs the storage of flammable and combustible liquids including petroleum products within New York City. Facilities storing petroleum products above threshold quantities must obtain FDNY storage permits and comply with tank installation, containment, and inspection requirements.

86. Correct Answer: B — 29 CFR 1910.95

OSHA's Occupational Noise Exposure standard is codified at 29 CFR 1910.95. It establishes the 90 dBA PEL, the 85 dBA action level for hearing conservation programs, permissible noise exposure time limits

for various dBA levels, and requirements for audiometric testing, hearing protection, and employee training.

87. Correct Answer: D — Mixed waste

Mixed waste contains both RCRA-regulated hazardous waste components and radioactive material regulated under the Atomic Energy Act. Mixed waste is subject to dual regulation by both the EPA (for the hazardous component) and the Nuclear Regulatory Commission or state radiation control agency (for the radioactive component).

88. Correct Answer: B — Asbestos emissions from demolition and renovation are controlled and reported to the EPA

The NESHAP for asbestos (40 CFR Part 61, Subpart M) requires facility owners to notify the EPA before demolition or renovation activities that will disturb regulated amounts of asbestos-containing material, ensure proper wet methods and containment are used, and dispose of ACM in approved landfills.

89. Correct Answer: A — PCBs — prohibiting their manufacture, processing, distribution, and requiring proper disposal

TSCA Section 6(e) specifically addresses polychlorinated biphenyls (PCBs) — it banned their manufacture after 1979, prohibits their processing and distribution in commerce, and establishes requirements for marking, use authorization, storage, and disposal of PCB-containing equipment such as transformers and capacitors.

SAFETY, LOTO, ARC FLASH, AND EMERGENCY PROCEDURES (Questions 90–100)

90. Correct Answer: C — A periodic inspection reveals it is inadequate, or when equipment or process changes affect it

OSHA 1910.147 requires the energy control procedure to be reviewed during the annual periodic inspection and updated whenever the inspection reveals deficiencies, or whenever changes in equipment, process, or personnel affect the accuracy or effectiveness of the written procedure.

91. Correct Answer: D — Warn workers of the minimum safe working distance and required PPE before opening the equipment

Arc flash labels — required by NEC 110.16 and detailed by NFPA 70E — provide the critical information workers need before opening electrical equipment: the incident energy at the labeled working distance, the minimum arc-rated PPE required, and the arc flash boundary beyond which no additional PPE is needed.

92. Correct Answer: D — Order immediate evacuation of all entrants and cancel the permit

The attendant has authority and responsibility to order immediate evacuation under any condition that was not anticipated by the permit or that poses an increased risk to entrants. Smoke entering the space is an

immediately dangerous condition requiring instant evacuation — the attendant never enters the space to warn entrants personally.

93. Correct Answer: B — Working faster to minimize exposure time

NFPA 70E does not recognize working faster as a valid arc flash hazard control. Recognized controls include: de-energizing and LOTO, increasing working distance, using current-limiting overcurrent devices to reduce clearing time, and wearing appropriate arc-rated PPE. Speed of work is not a controllable, measurable, or reliable protection method.

94. Correct Answer: B — A licensed healthcare professional before initial use

OSHA 29 CFR 1910.134 requires that workers be medically evaluated by a physician or other licensed healthcare professional (PLHCP) and found medically fit before being required to wear a respirator. This evaluation must occur before initial use and must be repeated when conditions change.

95. Correct Answer: B — Voltage-rated gloves with leather protectors and appropriate arc-rated clothing

Working within the restricted approach boundary of exposed 480V energized conductors requires Class 00 or Class 0 voltage-rated rubber insulating gloves with leather protectors (to protect against electric shock) and arc-rated clothing appropriate for the calculated incident energy level at that working distance.

96. Correct Answer: A — Evacuate the area, avoid creating any ignition source, and activate the emergency response plan

A gas leak is an immediately dangerous condition — even a small spark from a light switch, phone, or power tool can ignite an explosive atmosphere. The correct first action is to evacuate immediately without creating ignition sources (no light switches, no cell phones, no running equipment), then activate the emergency response plan from a safe location.

97. Correct Answer: D — Means of egress, exit signage, and occupant safety in buildings

NFPA 101 — the Life Safety Code — establishes requirements for building construction, protection, and occupancy features necessary to minimize danger to life from fire, smoke, fumes, and panic. It covers exit locations, corridor widths, exit signage, emergency lighting, and occupant load calculations.

98. Correct Answer: C — ANSI Z87.1

ANSI Z87.1 is the American National Standard for Occupational and Educational Personal Eye and Face Protection Devices — it establishes performance requirements for safety glasses, goggles, face shields, and welding filters. ANSI Z89.1 covers head protection; Z535 covers safety signs; Z41 covered foot protection (now ASTM F2413).

99. Correct Answer: D — Identify hazards, assess risks, and determine protective measures before work begins

A Job Hazard Analysis (JHA) — also called a Job Safety Analysis (JSA) — systematically breaks the task into steps, identifies hazards at each step, assesses the risk severity, and establishes the specific protective measures (PPE, procedures, controls) needed before the first tool is picked up.

100. Correct Answer: A — Stop the unsafe activity or work immediately and report the condition through the chain of command

Every worker has both the right and the responsibility to stop work when they observe an immediately dangerous condition. OSHA's General Duty Clause supports workers stopping unsafe activities. The condition must be reported immediately through the chain of command — waiting for a supervisor or contacting external agencies first is not appropriate when immediate danger exists.