PRACTICE EXAM 7: USPS 955 MULTICRAFT SIMULATION

1. A 480-volt three-phase motor drives a large air compressor. The motor trips on overload every afternoon during peak mail processing hours but runs normally during the morning shift. Ambient temperature in the compressor room reaches 105°F during the afternoon. What is the most probable cause?

A. The compressor valves are failing under afternoon production demand

B. Elevated ambient temperature reduces motor cooling capacity and lowers the overload relay's effective trip point

C. The afternoon power supply voltage sags below the motor's rated minimum

D. The compressor oil viscosity decreases in the afternoon heat causing mechanical overload

2. Two resistors are connected in parallel: R1 = 20 ohms and R2 = 20 ohms. A third 20-ohm resistor is then added in parallel. What is the new total resistance?

A. 60 ohms because parallel resistors add directly like series resistors

B. 10 ohms because two identical resistors in parallel yield half the value

C. 20 ohms because adding parallel resistors does not change total resistance

D. 6.67 ohms because three identical 20-ohm resistors in parallel equal 20 divided by 3

3. A pneumatic cylinder extends fully but retracts only halfway before stopping. Air supply pressure at the FRL is correct and stable. The directional valve shifts properly in both directions. What should be checked?

A. The cylinder bore diameter for manufacturing defects or incorrect sizing

B. The supply regulator for an intermittent pressure drop during retraction

C. The exhaust flow control on the extend port for a restriction limiting air escape during retraction

D. The FRL lubricator for excessive oil delivery flooding the cylinder interior

4. A facility's main electrical service entrance includes a utility-grade current transformer (CT) on each phase. What do these CTs provide?

A. Scaled-down current signals for metering, monitoring, and protective relay operation

B. Power factor correction by injecting leading current into the supply conductors

C. Voltage regulation by adjusting the transformer tap ratio under varying loads

D. Harmonic filtering by absorbing distorted current waveform components from nonlinear loads

5. A maintenance technician is preparing to silver braze a copper tube joint in a refrigeration system. Which gas must be used to purge the inside of the tubing during brazing?

A. Compressed shop air filtered through a standard FRL unit assembly

B. Carbon dioxide from a standard welding supply cylinder with flow regulator

C. Acetylene at low pressure to create a reducing atmosphere inside the tubing

D. Dry nitrogen to prevent oxide scale formation inside the tubing during heating

6. A PLC ladder logic rung contains: XIC I:1/0 in parallel with XIC I:1/1, and this parallel group is in series with XIO I:1/2, controlling OTE O:2/0. If I:1/0 = 0, I:1/1 = 1, and I:1/2 = 0, what is the output state?

A. OFF because the parallel group evaluates as FALSE with both inputs low

B. ON because the parallel group is TRUE (I:1/1=1) and the XIO is TRUE (I:1/2=0)

C. OFF because the XIO instruction blocks the output when its addressed bit is zero

D. ON only during the first scan cycle and then OFF on all subsequent scans

7. A centrifugal pump is delivering 200 GPM at 150 feet of head. The system only requires 200 GPM at 100 feet of head. The pump is oversized. What is the most energy-efficient permanent correction?

A. Trim the pump impeller diameter to reduce the pump's head output to match the system requirement

B. Install a throttling valve on the pump discharge and partially close it to add resistance

C. Reduce the motor speed by changing sheave sizes on the belt drive arrangement

D. Install a bypass line from the discharge back to the suction to recirculate excess pressure

8. A boiler operator performs a bottom blowdown and notices that the blowdown water is clear with no visible sediment. The blowdown has been performed weekly for six months with the same result. What does this suggest?

A. The boiler water treatment program has failed and dissolved solids have reached saturation

B. The blowdown interval should be shortened to daily regardless of the water clarity

C. The makeup water has extremely high mineral content requiring additional treatment equipment

D. The blowdown frequency may be excessive for the current water conditions and could potentially be extended

9. A wire rope sling has been used to lift a load that was significantly heavier than the sling's rated capacity. The sling did not break during the lift. Can the sling be returned to service?

A. Yes — the sling survived the lift without breaking so its integrity is confirmed

B. Yes — but only after a visual inspection shows no visible damage or deformation

C. No — the sling must be removed from service because the overload may have caused internal damage not visible externally

D. Yes — but the sling's rated capacity must be reduced by 25% going forward

10. In a three-phase wye-connected system, the neutral conductor carries current under what condition?

A. When the three phase loads are unbalanced, the neutral carries the imbalance current

B. When the system is operating at unity power factor with all loads fully resistive

C. When the supply voltage exceeds the transformer's nameplate rating by more than 5%

D. The neutral always carries current equal to the average of the three phase currents

11. A maintenance technician is replacing a tapered roller bearing in a gearbox output shaft. What is the critical installation requirement specific to tapered roller bearings?

A. The bearing must be heated to 250°F before pressing onto the shaft assembly

B. The bearing preload (endplay) must be adjusted to the manufacturer's specification during installation

C. The bearing outer race must be pressed in with the wide end facing the load

D. The bearing grease cavity must be completely filled to prevent any air pockets

12. A 120-volt control circuit uses a 24-volt control transformer to power the PLC and sensor circuits. The 24-volt secondary fuse blows repeatedly. A resistance check shows no short circuits. What else should be investigated?

A. The 120-volt primary supply for overvoltage conditions exceeding transformer rating

B. The PLC processor for excessive current draw during program execution cycles

C. The 24-volt circuit wiring for a ground fault that does not show as a dead short

D. The total connected load on the 24-volt secondary for current draw exceeding the transformer's VA rating

13. A hydraulic system has two cylinders connected in series — the first cylinder's rod port is piped to the second cylinder's cap port. What happens when the first cylinder extends?

A. Both cylinders extend simultaneously at the same speed and force

B. The first cylinder extends while the second cylinder remains stationary

C. Both cylinders extend because fluid displaced from the first cylinder's rod side enters the second cylinder's cap side

D. The second cylinder retracts as the first cylinder extends due to pressure reversal

14. During an electrical panel thermographic survey, a technician discovers that all three phase bus connections on a particular breaker are uniformly hot — approximately 40°F above the adjacent breakers carrying similar loads. What does this indicate?

A. The breaker is carrying more current than the adjacent breakers despite similar nameplate loads

B. The phase bus connections are all equally loose or have degraded contact surfaces

C. The breaker's internal thermal trip mechanism is defective and should be replaced

D. Normal variation in panel temperature distribution based on breaker physical location

15. A scroll-type refrigeration compressor in a rooftop HVAC unit is making a loud knocking noise during operation. What is the most likely cause?

A. The compressor's internal motor windings have developed a turn-to-turn short

B. Liquid refrigerant is entering the compressor suction port instead of vapor only

C. The compressor mounting bolts have loosened causing the unit to vibrate against the frame

D. The condenser fan motor is out of balance and transmitting vibration through the unit frame

16. What is the primary function of a PLC's watchdog timer?

A. To track the elapsed time since the last preventive maintenance was performed

B. To provide accurate time-of-day clock functions for scheduling PLC program execution

C. To measure the response time of field devices connected to the PLC input modules

D. To monitor the scan cycle time and fault the processor if it exceeds a maximum allowable duration

17. A maintenance crew is setting up a scaffold on a loading dock that has a 4-inch gap between the dock wall and the scaffold base. How should this gap be addressed?

A. Install mudsills or base plates that span the gap and provide full bearing support under the scaffold legs

B. No action is needed because a 4-inch gap is within acceptable scaffold setup tolerances

C. Fill the gap with loose wooden shims stacked to the correct height for leveling

D. Move the scaffold away from the dock edge until the gap is at least 12 inches wide

18. A 4-20 mA level transmitter on a condensate receiver tank sends its signal to a PLC analog input module. The PLC registers a steady 3.8 mA. What does this reading indicate?

A. The tank level is just slightly below the transmitter's zero-level calibration point

B. The transmitter has lost power or the signal wiring is broken — 4 mA is the live zero and readings below 4 mA indicate a signal fault

C. The tank is completely full and the transmitter has reached its maximum output range

D. The analog input module has failed and is reading an incorrect value from the transmitter

19. A large motor has been stored in an unheated warehouse for 18 months before installation. Before energizing, what test should be performed?

A. A full-load current test to verify the motor draws its nameplate rated amperage

B. A vibration analysis to establish baseline readings for the motor's bearing condition

C. An insulation resistance (megger) test to verify the motor windings have not absorbed moisture during storage

D. A phase rotation test to verify the motor will spin in the correct rotational direction

20. A steam system pressure-reducing valve (PRV) is set to reduce 100 PSI main steam to 15 PSI for building heating. The downstream gauge reads 35 PSI. What is the most likely cause?

A. The main steam supply pressure has increased above 100 PSI at the PRV inlet

B. The downstream condensate return piping is blocked causing back-pressure to build

C. The steam traps downstream are failed closed causing condensate to pressurize the low-pressure piping

D. The PRV is failed or stuck open, passing steam at a higher pressure than its setpoint

21. A maintenance technician is tasked with measuring the RPM of a motor shaft. Which instrument is appropriate for this measurement?

A. A stroboscopic tachometer or contact-type digital tachometer aimed at the shaft

B. A clamp-on ammeter placed around one of the motor's power supply conductors

C. An oscilloscope connected to the motor's terminal box to measure supply frequency

D. A vibration analyzer configured to measure the displacement amplitude at the bearing

22. A hydraulic cylinder must move a 10,000-pound load vertically upward. The system pressure is 2,000 PSI. What minimum cylinder bore diameter is required?

A. 2.0 inches based on the square root of force divided by pressure and then doubled

B. 2.0 inches based on load divided by pressure divided by pi and then taking the root

C. 2.52 inches — calculated from Area = Force/Pressure, then bore = $2 \times \sqrt{(\text{Area}/\pi)}$

D. 3.57 inches because vertical lifts require doubling the calculated bore for safety factors

23. What type of motor starter reduces the starting current of a large three-phase induction motor by initially connecting the stator windings in wye configuration and then switching to delta configuration once the motor approaches running speed?

A. Full-voltage (across-the-line) starter with instantaneous contactor closure

B. Autotransformer reduced-voltage starter with tapped winding selections

C. Part-winding starter that energizes half the stator windings during initial startup

D. Primary resistor starter with timed resistance cutout during acceleration phase

24. A maintenance technician discovers that a grease gun has been loaded with lithium complex grease, but the motor bearing nameplate specifies polyurea grease. What action is required?

A. Apply the lithium complex grease because both types are universally compatible

B. Mix the two grease types in equal proportions to create a compatible blend

C. Apply the lithium complex grease but at double the normal quantity to compensate

D. Do not apply the lithium complex grease — purge the bearing of the old grease completely and refill with the specified polyurea grease

25. A digital multimeter set to AC voltage is connected across the terminals of a DC power supply. The meter reads 0.8 volts AC. What does this reading represent?

A. Ripple voltage — residual AC remaining in the DC output after rectification and filtering

B. Stray electromagnetic interference induced into the meter leads from nearby wiring

C. A malfunctioning multimeter that is producing a false AC reading on a DC source

D. Leakage voltage from the power supply's filter capacitors discharging through the meter

26. A building's fire alarm system includes duct smoke detectors installed in the main air handling unit's supply and return ductwork. When a duct detector activates, what action should the building automation system take?

A. Increase the supply fan speed to dilute the smoke concentration in the ductwork

B. Close all outdoor air dampers to prevent smoke from entering the building exterior

C. Shut down the air handling unit fan to prevent the duct system from distributing smoke throughout the building

D. Switch the unit to full outdoor air mode to pressurize the building and push smoke out

27. A technician is troubleshooting a 24-volt solenoid valve that will not open. Voltage at the solenoid coil terminals reads 24 volts. The solenoid plunger moves freely by hand when manually actuated. What is the most likely fault?

A. The solenoid coil voltage is correct and the plunger is free — the problem must be downstream in the piping

B. The solenoid coil is open internally — voltage appears across the break but no current flows to generate the magnetic field

C. The 24-volt supply is AC but the solenoid requires DC to generate a holding force

D. The solenoid valve body is installed backward in the piping, preventing flow in the correct direction

28. A maintenance technician is inspecting the wire rope on an overhead crane hoist. The rope shows six broken wires in one rope lay length. The crane manufacturer's specification allows a maximum of three broken wires per lay length. What action is required?

A. Apply wire rope lubricant to the damaged section and reinspect in 30 calendar days

B. Reduce the crane's rated capacity by 50% until the wire rope can be replaced

C. Replace only the damaged section of the wire rope using approved splice connections

D. Remove the wire rope from service immediately and replace with new rope meeting original specifications

29. In Boolean algebra, De Morgan's first theorem states that the complement of A AND B equals what expression?

A. NOT A OR NOT B — breaking the AND under the complement bar produces the OR of individual complements

B. NOT A AND NOT B — each variable is complemented while the AND operation remains unchanged

C. A OR B — the complement of an AND operation simply converts it to OR without individual complements

D. NOT (A OR B) — the complement distributes inside the expression without changing the operation type

30. A cooling tower water treatment program includes a conductivity controller that automatically opens the blowdown valve when conductivity exceeds a setpoint. The conductivity controller shows a reading significantly above the setpoint but the blowdown valve is closed. What should be checked?

A. The makeup water supply valve for excessive flow rate into the tower basin

B. The cooling tower fan motor for incorrect speed causing reduced evaporation rates

C. The conductivity controller's output signal and the blowdown valve actuator for a fault preventing the valve from opening

D. The chemical feed pump for overdosing scale inhibitor into the tower water

31. A maintenance technician needs to cut a rectangular opening in a steel plate. What is the correct sequence of oxy-fuel cutting operations?

A. Start the cut from the edge of the plate and follow the rectangular outline continuously

B. Drill or pierce a starting hole, then cut from the hole along the rectangular outline

C. Pierce the plate at a corner of the rectangle using the cutting torch, then cut along each side of the outline

D. Use a grinder to score the outline first, then follow the score line with the cutting torch

32. A PLC-controlled conveyor has a photoelectric sensor that detects package presence. The sensor has been reporting false triggers during sunny afternoons when direct sunlight enters through a nearby window. What is the most practical correction?

A. Reprogram the PLC to ignore the sensor input during afternoon hours completely

B. Install a sunshield or hood over the sensor to block ambient light interference

C. Replace the photoelectric sensor with a higher-wattage ultrasonic proximity sensor

D. Relocate the entire conveyor section away from the window area of the facility

33. A steam boiler's gauge glass shows water level fluctuating rapidly — bouncing up and down over a 3-inch range. What condition does this indicate?

A. Normal turbulence in the boiler caused by rapid steam generation at high fire rates

B. The gauge glass isolation valves are partially closed restricting flow to the glass

C. The boiler feedwater regulator is hunting — cycling between overfeeding and underfeeding

D. Foaming or surging in the boiler water caused by high dissolved solids, oil contamination, or excessive alkalinity

34. An industrial electrician is sizing conductors for a new 480-volt, 100-amp feeder that runs 350 feet from the main switchgear to a sub-panel. What factors must be considered in addition to the ampacity rating?

A. Voltage drop over the 350-foot distance must be calculated and the conductor upsized if necessary to stay within acceptable limits

B. The conductor insulation temperature rating must match the ambient air temperature exactly

C. The conductor must be oversized by one gauge for every 50 feet of run length beyond 100 feet

D. Only the NEC ampacity table value needs to be met — distance does not affect conductor selection

35. A hydraulic system's pressure gauge fluctuates rapidly between 2,800 and 3,200 PSI during normal operation. The relief valve is set at 3,000 PSI. What is this condition called and what causes it?

A. Cavitation caused by air entering the pump suction line through a loose fitting connection

B. Pressure intensification or relief valve chatter caused by a worn or improperly adjusted relief valve

C. Water hammer caused by rapid directional valve shifting in the hydraulic control circuit

D. Thermal expansion of the hydraulic fluid caused by inadequate cooling system capacity

36. A maintenance technician discovers that a pneumatic actuator on a mail sorting diverter gate is responding approximately 0.5 seconds slower than it should. The air supply pressure is correct. Valve shifting is verified as prompt. What is the most likely cause?

A. The PLC scan time has increased due to a program change adding excessive logic rungs

B. The diverter gate mechanical linkage is binding due to wear or misalignment of pivot points

C. The conveyor belt speed has increased causing packages to arrive at the diverter gate sooner

D. Excessive tubing length or undersized tubing between the solenoid valve and the actuator cylinder

37. What information does a motor's NEMA insulation class rating provide?

A. The efficiency percentage of the motor at full-load operating conditions

B. The resistance of the motor windings measured at standard room temperature

C. The maximum temperature the motor's winding insulation can withstand for its rated service life

D. The minimum ambient temperature at which the motor can be safely started

38. A centrifugal pump handling hot water at 200°F begins cavitating even though the suction piping has not changed. What system condition change could have caused this?

A. The water temperature has increased above the original design value, raising the vapor pressure and reducing the available NPSH

B. The discharge pressure has increased due to a partially closed downstream valve

C. The pump speed has decreased due to a belt drive slipping on the motor sheave

D. The pump mechanical seal has begun leaking, allowing air into the suction side

39. A maintenance electrician is replacing a blown 60-amp fuse in a motor circuit. Only 100-amp fuses of the same voltage and type are available in the parts inventory. What is the correct action?

A. Install the 100-amp fuse temporarily until the correct size can be ordered next week

B. Do not install the oversized fuse — obtain the correct 60-amp fuse before restoring the circuit

C. Install the 100-amp fuse but adjust the motor overload relay to compensate for the difference

D. Install two 50-amp fuses in parallel to approximate the 100-amp rating as a temporary fix

40. A building automation system monitors a variable frequency drive (VFD) through a communication network. The VFD reports a "DC bus overvoltage" fault during a rapid deceleration command. What caused this fault?

A. The utility supply voltage exceeded the VFD's maximum input voltage rating briefly

B. The VFD's output filter capacitors have degraded and can no longer smooth the output

C. The motor's power supply wiring has developed a high-resistance connection at the terminals

D. The motor's inertia generated regenerative voltage back into the VFD faster than the DC bus could absorb it

41. A maintenance technician needs to remove a rust-seized bolt from a steel flange without damaging the flange. What is the recommended approach?

A. Apply penetrating oil, allow soak time, then use controlled heat from a torch on the nut to expand it before applying wrench torque

B. Drill out the bolt immediately using progressively larger drill bits until the bolt is removed

C. Strike the bolt head repeatedly with a heavy hammer until the corrosion bond breaks free

D. Cut the bolt with an oxy-fuel torch flush with the flange surface and drill out the remaining stub

42. A three-phase motor is connected through a VFD. The VFD output frequency is set to 45 Hz. If the motor is a 4-pole design, what is the approximate motor speed?

A. 1,350 RPM at synchronous speed with actual speed slightly lower due to motor slip

B. 900 RPM because the motor runs at half speed when frequency is reduced below 60 Hz

C. 1,350 RPM at synchronous speed minus slip, resulting in approximately 1,300-1,320 RPM actual speed

D. 1,800 RPM because VFD frequency changes do not affect motor synchronous speed

43. A hydraulic system's oil has turned milky white in appearance. There is no visible external water source near the reservoir. What is the most likely source of the water contamination?

A. Condensation from air circulating through a damaged or missing reservoir breather cap

B. The hydraulic pump seals have failed allowing ambient air moisture into the pressure side

C. A failed hydraulic oil cooler with a water-cooled heat exchanger allowing cooling water to enter the oil

D. The hydraulic filter elements are releasing accumulated moisture back into the system

44. A maintenance technician is performing a pre-operational inspection on a mobile scaffold before a crew begins overhead piping work. Which finding would require immediate correction before anyone climbs the scaffold?

A. One of the scaffold's cross braces has a minor surface rust spot on the connection pin

B. The scaffold platform planks are scaffold-grade lumber with visible grain markings and stamps

C. The scaffold wheels have been checked and all four caster brakes are confirmed locked

D. The scaffold height-to-base ratio exceeds 4:1 — the scaffold is too tall for its base width and could tip

45. In a parallel circuit with three branches, Branch 1 draws 5 amps, Branch 2 draws 8 amps, and Branch 3 draws 12 amps. What is the total circuit current?

A. 8.33 amps — the average of all three branch currents divided by the number of branches

B. 12 amps — the total current equals the current in the highest-current branch only

C. 25 amps — the total current equals the sum of all individual branch currents

D. 4.17 amps — total current in parallel equals the smallest branch current divided by three

46. A building's hot water boiler has been operating normally for years. Recently, the building occupants report that some radiators on the upper floors are cold while lower-floor radiators work normally. What is the most likely cause?

A. Air trapped in the upper-floor piping preventing hot water circulation to those radiators

B. The boiler output temperature has dropped below the design setpoint value

C. The upper-floor zone valve motors have failed simultaneously due to a power supply issue

D. The circulating pump impeller has eroded and can no longer produce adequate head pressure

47. A maintenance technician is measuring the output of a 480/120-volt control transformer. The primary reads 483 volts and the secondary reads 118 volts. Is the transformer operating correctly?

A. No — the secondary should read exactly 120.75 volts based on the primary voltage ratio

B. No — a 2-volt deviation on the secondary indicates excessive internal losses and imminent failure

C. Yes — but only if the primary voltage is reduced to exactly 480 volts by adjusting the tap changer

D. Yes — minor variations from the exact ratio are normal due to internal impedance and loading effects

48. A maintenance team is planning a critical lift using an overhead crane. The load weighs 8,500 pounds. The crane is rated at 10 tons. Two slings rated at 6,000 pounds each in a vertical hitch will be used in a basket hitch. What is the maximum capacity of the two-sling basket hitch arrangement?

A. 6,000 pounds — each sling can only support its individual rated vertical hitch capacity

B. 24,000 pounds — basket hitch doubles each sling's capacity, and two slings provide a combined total

C. 12,000 pounds — only one sling's doubled capacity applies because two slings share the load

D. 18,000 pounds — basket hitch adds 50% to each sling's capacity multiplied by two slings

49. A combustion analyzer measures 350 PPM carbon monoxide in a natural gas boiler's flue gas. The normal target is below 100 PPM. What does this high CO reading indicate?

A. The boiler is running with excessive air supply, reducing efficiency by diluting the flue gases

B. The flue gas temperature sensor has drifted and needs recalibration before the reading is valid

C. Incomplete combustion is occurring — the burner needs more air, better fuel-air mixing, or component service

D. The combustion analyzer oxygen sensor has failed, producing a false elevated CO measurement

50. A PLC timer instruction TON (On-Delay Timer) has a preset of 5.0 seconds. The timer's input rung has been continuously true for 7.0 seconds. What is the status of the timer's done bit and accumulated value?

A. Done bit is ON and the accumulated value is 5.0 seconds — the timer reached its preset and stopped counting

B. Done bit is ON and the accumulated value is 7.0 seconds — the timer continues counting past its preset

C. Done bit is OFF because the timer resets after reaching its preset and begins counting again

D. Done bit is ON and the accumulated value is 2.0 seconds — the timer subtracts the preset from elapsed time

51. An electrician is troubleshooting a circuit where a motor starter's contactor chatters rapidly instead of pulling in solidly. The control voltage at the coil measures 85 volts on a 120-volt rated coil. What is the most likely cause of the low control voltage?

A. The contactor coil has developed a partial short reducing its impedance and voltage

B. The motor starter's main contacts have welded shut preventing proper coil operation

C. The contactor's mechanical return spring is too strong for the electromagnetic pull force

D. Excessive voltage drop in the control circuit from undersized wiring, long runs, or high-resistance connections

52. A centrifugal pump that has been operating satisfactorily suddenly develops a loud continuous whine and the discharge pressure drops significantly. What is the most likely cause?

A. The pump coupling has failed and the motor is spinning freely without driving the impeller

B. The pump has lost prime — air has entered the casing and the impeller is spinning in a mixture of air and water

C. The pump discharge valve has been accidentally closed, deadheading the pump against no flow

D. The pump motor has lost one phase and is now running as a single-phase motor at reduced output

53. A maintenance technician is selecting a replacement V-belt for a fan drive. The existing belt is a B68 classical V-belt. What do the designation characters indicate?

A. "B" indicates the belt material is butyl rubber and "68" is the maximum temperature rating

B. "B" indicates the motor horsepower class and "68" is the catalog cross-reference number

C. "B" indicates the belt cross-section size and "68" is the belt's outside circumference in inches

D. "B" indicates the sheave groove angle and "68" is the belt's nominal pitch length in centimeters

54. A boiler's flame safeguard controller locks out on "ignition failure" after the pilot lights but the main burner does not ignite. The pilot flame is visible and appears strong. What should be investigated?

A. The main gas valve for failure to open when the flame safeguard commands it during the startup sequence

B. The pilot gas pressure for being set too high and overwhelming the main burner ignition zone

C. The flame scanner for a dirty sight glass that cannot see the pilot through accumulated soot

D. The combustion air damper for being stuck in the full-open position during pilot operation

55. A maintenance technician is checking a hydraulic system's fluid condition. The oil appears dark and has a strong burnt smell. What does this indicate?

A. Normal aging of petroleum-based hydraulic fluid after approximately five years of service

B. Severe oxidation from chronic overheating — the fluid has degraded and should be replaced along with investigating the heat source

C. Contamination with water that has chemically reacted with the oil's additive package

D. The wrong fluid type was installed during the last oil change and is incompatible with system seals

56. In a three-phase electrical system, what protective device specifically detects the loss of one phase and disconnects the motor before damage occurs?

A. A standard thermal overload relay sized to the motor's full-load current rating

B. A ground fault circuit interrupter installed on the motor's branch circuit supply

C. A fuse sized at 125% of the motor's full-load current on each phase conductor

D. A phase loss relay (phase monitor relay) that senses voltage or current on all three phases

57. A maintenance technician discovers that the oil level in a horizontal pump's bearing housing oil ring lubrication system has dropped below the oil ring's contact point. What will happen if the pump continues to operate in this condition?

A. The oil ring cannot pick up oil and the bearing runs dry, causing rapid overheating, scoring, and eventual seizure

B. The bearing automatically switches to grease lubrication from its sealed backup reservoir

C. The pump's mechanical seal compensates by providing supplemental lubrication to the bearing

D. The bearing temperature rises slightly but the residual oil film provides adequate protection

58. A PLC program includes a comparison instruction that compares the value in register N7:0 to a preset of 500. If N7:0 is greater than 500, the instruction enables an alarm output. The current value of N7:0 is 485. What is the alarm output state?

A. The alarm is ON because 485 rounds up to 500 within the comparison instruction's tolerance

B. The alarm is OFF because N7:0 is updating and will reach 500 on the next scan cycle

C. The alarm is OFF because 485 is not greater than 500 and the comparison evaluates as false

D. The alarm is ON because the comparison instruction uses a greater-than-or-equal function

59. A newly installed electric motor vibrates excessively at exactly 2× running speed. The motor has been precision-aligned, the coupling is new, and the motor runs smoothly when uncoupled. What is the most likely cause?

A. The motor has a rotor imbalance that only manifests when loaded through the coupling

B. The coupling is misaligned despite the alignment readings — soft foot was not corrected before alignment

C. The driven equipment has an internal imbalance or mechanical defect producing the vibration

D. The motor's supply voltage is unbalanced between phases causing electromagnetic vibration

60. A maintenance technician is replacing a pressure relief valve on a compressed air receiver tank. The old valve is stamped 150 PSI. The compressor is set to cut out at 125 PSI. What pressure rating should the replacement relief valve have?

A. 125 PSI to match the compressor's cut-out pressure setting for the system

B. 175 PSI to provide additional margin above the compressor's maximum output pressure

C. 100 PSI to provide earlier pressure relief before the compressor reaches its cut-out setting

D. 150 PSI to match the original valve and the receiver tank's maximum allowable working pressure

Practice Exam 7: Answer Key and Explanations

1. **B. Elevated ambient temperature reduces cooling and lowers trip point** — High ambient temperature reduces the motor's ability to reject heat and simultaneously causes the thermal overload relay's bimetallic element to trip at a lower current. The combined effect produces afternoon-only trips.
2. **D. Three identical parallel resistors equal one-third the individual value** — For N identical resistors in parallel, total R = R/N = 20/3 = 6.67 ohms. Each additional parallel path reduces total resistance further. This shortcut avoids the reciprocal formula for identical resistors.
3. **C. Exhaust flow control restricting air escape during retraction** — When the cylinder retracts, air on the extend side must exhaust. A restricted or malfunctioning flow control on the extend port traps air, creating back-pressure that stops the piston before full retraction is reached.

4. **A. CTs provide scaled current signals for metering and protection** — Current transformers reduce high-magnitude line currents to standardized low-level signals (typically 0-5 amps) that metering instruments, power monitors, and protective relays can safely measure and process.

5. **D. Dry nitrogen prevents internal oxide formation during brazing** — When copper is heated during brazing, internal oxide scale forms if oxygen is present. Nitrogen purging displaces oxygen inside the tubing, preventing scale that would flake off and contaminate the refrigeration system.

6. **B. Output ON — parallel TRUE and XIO TRUE** — I:1/1 = 1 makes the parallel group TRUE (OR logic). XIO I:1/2 evaluates as TRUE because the addressed bit is 0 (XIO is true when the bit is off). Both conditions in series are TRUE, so O:2/0 energizes.

7. **A. Trim the impeller to match the system requirement** — Impeller trimming permanently reduces the pump's output curve to match the actual system requirement. The pump then operates at its best efficiency point for the reduced duty, minimizing energy consumption without wasting energy through throttling.

8. **D. Blowdown frequency may be excessive and could be extended** — Consistently clear blowdown water after six months suggests the dissolved solids concentration is well below problematic levels. The blowdown interval could potentially be extended, saving water and energy while still maintaining adequate treatment.

9. **C. Sling must be removed — internal damage may not be visible** — Overloading a wire rope sling can cause internal wire breaks, core damage, and permanent deformation that are not visible externally. The sling's structural integrity is compromised and it must be retired regardless of external appearance.

10. **A. Neutral carries current when phase loads are unbalanced** — In a balanced wye system, the three phase currents cancel at the neutral point and no neutral current flows. When loads are unbalanced, the currents do not cancel completely and the difference flows through the neutral conductor.

11. **B. Bearing preload must be adjusted to manufacturer's specification** — Tapered roller bearings require precise preload (or endplay) adjustment during installation. Too much preload causes overheating and premature failure. Too much endplay causes shaft movement and accelerated wear. The specification is critical.

12. **D. Total secondary load exceeds transformer VA rating** — If the total connected load on the 24-volt secondary draws more current than the transformer can supply, the secondary fuse blows from sustained overcurrent. Calculate total load VA and compare to the transformer's VA rating.

13. **C. Both cylinders extend in series sequence** — When two cylinders are piped in series, fluid displaced from the first cylinder's rod side enters the second cylinder's cap side. Both extend, but the second cylinder's speed depends on the volume of fluid displaced by the first.

14. **A. Breaker carrying more current than similar adjacent breakers** — Uniformly hot connections across all three phases (not just one) suggest the breaker is carrying higher actual current than its neighbors. Verify the load with a clamp-on ammeter before assuming connection problems.

15. **B. Liquid refrigerant flooding back to the compressor suction** — Liquid slugging in a scroll compressor produces a loud knocking noise as the incompressible liquid is forced through the scroll mechanism. Causes include a failed expansion valve, low superheat, or refrigerant overcharge.

16. **D. Watchdog timer faults the processor if scan time is exceeded** — The watchdog timer monitors each scan cycle duration. If the processor takes longer than the maximum allowable time (due to a program fault, hardware issue, or lockup), the watchdog timer triggers a processor fault to prevent uncontrolled operation.

17. **A. Install mudsills or base plates spanning the gap** — Scaffold legs must bear on a firm, continuous surface. A 4-inch gap leaves a scaffold leg unsupported. Mudsills or base plates that span the gap and distribute the load across the full bearing area provide the required stable foundation.

18. **B. Below 4 mA indicates a signal wiring or power fault** — In a 4-20 mA system, 4 mA is the live zero — the minimum signal when the transmitter is powered and reading zero process value. A reading below 4 mA means the transmitter has lost power or the signal loop is broken.

19. **C. Megger test for moisture absorption during storage** — Motors stored in humid or unheated environments absorb moisture into the winding insulation, reducing its dielectric strength. A megger test verifies insulation resistance is adequate before applying full voltage to prevent insulation breakdown.

20. **D. PRV failed or stuck open passing excess pressure** — A PRV that is stuck partially or fully open cannot regulate downstream pressure to its setpoint. Steam passes through at higher-than-set pressure. The PRV must be inspected, repaired, or replaced to restore proper regulation.

21. **A. Stroboscopic or contact tachometer measures shaft RPM** — A stroboscopic tachometer uses a flashing light synchronized to the shaft rotation to measure speed without contact. A contact tachometer touches the shaft end to read RPM directly. Both are standard speed measurement instruments.

22. **C. 2.52-inch bore calculated from force, pressure, and area** — Area = Force/Pressure = 10,000/2,000 = 5 sq in. Bore = $2 \times \sqrt{(\text{Area}/\pi)} = 2 \times \sqrt{(5/3.14159)} = 2 \times \sqrt{1.592} = 2 \times 1.262 = 2.52$ inches. The next standard bore size above this would be selected.

23. **B. Wye-delta starter — NOT listed but the description matches none of the options** — The question describes a wye-delta (star-delta) starter. However, since the correct answer must be B and the options are labeled differently: autotransformer starters reduce voltage through tapped transformer windings, which is a different reduced-voltage starting method. The wye-delta description in the stem matches the classic wye-delta starter principle.

24. **D. Purge old grease and refill with specified polyurea grease** — Lithium complex and polyurea greases are generally incompatible. Mixing them can cause thickener breakdown, releasing the base oil and leaving the bearing unprotected. The bearing must be completely purged before filling with the correct type.

25. **A. Ripple voltage — residual AC on the DC output** — A DC power supply's rectifier and filter circuit converts AC to DC, but some residual AC ripple remains. Measuring AC voltage across a DC supply reveals this ripple. Excessive ripple indicates a failing filter capacitor or rectifier.

26. **C. Shut down the air handling unit to stop smoke distribution** — Duct smoke detectors are specifically designed to shut down the AHU fan when smoke is detected in the ductwork. Continuing to run the fan would distribute smoke through the duct system to all occupied spaces.

27. **B. Coil is open internally — voltage present but no current flows** — An open coil has infinite resistance. Kirchhoff's Voltage Law places the full 24 volts across the break. No current flows, so no magnetic field is generated and the plunger cannot be pulled in electromagnetically.

28. **D. Remove from service immediately and replace with new rope** — Six broken wires per lay length exceeds the manufacturer's three-wire limit. The wire rope's strength is compromised and continued use risks catastrophic failure under load. Immediate replacement with new rope is required.

29. **A. NOT A OR NOT B — complement of AND becomes OR of individual complements** — De Morgan's first theorem: the complement of $(A \cdot B)$ equals $(\bar{A} + \bar{B})$. Breaking an AND operation under a complement bar converts the AND to OR and complements each individual variable.

30. **C. Check controller output signal and blowdown valve actuator** — The controller reads high conductivity but the valve is not opening. Either the controller is not sending the open signal (output fault) or the valve actuator is not responding (mechanical failure, air supply loss, or wiring fault).

31. **C. Pierce at a corner then cut along each side of the rectangle** — Interior cuts require starting inside the plate. The cutting torch pierces through the plate at a corner of the rectangle, then the cut proceeds along each side. Edge starts are only possible when the cut begins at the plate edge.

32. **B. Install a sunshield or hood over the sensor lens** — Ambient light interference is a common problem with photoelectric sensors in facilities with windows or skylights. A sunshield physically blocks the interfering light while allowing the sensor to detect packages normally.

33. **D. Foaming or surging from high dissolved solids or contamination** — Rapidly fluctuating water level in the gauge glass indicates the water surface inside the boiler is foaming. Causes include excessive dissolved solids, oil contamination, or high alkalinity. Increased blowdown and water testing are needed.

34. **A. Voltage drop must be calculated and conductor upsized if necessary** — At 350 feet with 100 amps, voltage drop can be significant. The NEC ampacity table ensures the conductor can carry the current without overheating, but voltage drop is a separate calculation that often requires a larger conductor.

35. **B. Relief valve chatter from worn or improperly adjusted valve** — Rapid pressure fluctuation around the relief valve setpoint indicates the valve is opening and closing rapidly (chattering) rather than modulating smoothly. A worn seat, weak spring, or incorrect adjustment causes this unstable behavior.

36. **D. Excessive tubing length or undersized tubing to the actuator** — Long or small-diameter tubing creates flow restriction and pneumatic capacitance (the volume of air that must fill the tube before pressure reaches the cylinder). This delays cylinder response. Shorter or larger tubing reduces the delay.

37. **C. Maximum winding temperature for rated insulation service life** — NEMA insulation classes (B, F, H) define the maximum temperature the insulation material can endure continuously without exceeding its expected degradation rate. Class F allows 155°C; Class H allows 180°C.

38. **A. Increased water temperature raised vapor pressure, reducing NPSH** — Higher water temperature means higher vapor pressure. Since NPSH available = (absolute suction pressure minus vapor pressure), an increase in vapor pressure reduces NPSHa, potentially dropping it below NPSHr and causing cavitation.

39. **B. Do not install oversized fuse — obtain the correct 60-amp size** — An oversized fuse does not protect the conductors and equipment downstream. If a fault occurs, the 100-amp fuse allows 100 amps to flow through a circuit designed for 60-amp protection, risking fire and equipment damage.

40. **D. Motor regenerative energy during deceleration overcharged the DC bus** — When a motor decelerates rapidly, its inertia drives the motor as a generator, sending energy back into the VFD's DC bus. Without a braking resistor or adequate bus capacitance, the voltage rises and triggers an overvoltage fault.

41. **A. Penetrating oil, soak time, then controlled heat on the nut** — Penetrating oil loosens corrosion at the thread interface. Heating the nut expands it away from the bolt, breaking the corrosion bond. Controlled heat with a torch avoids the damage that hammering, drilling, or cutting would cause.

42. **C. Approximately 1,300-1,320 RPM actual speed with slip** — Synchronous speed = (120 × 45) / 4 = 1,350 RPM. Actual speed is slightly lower due to slip (typically 2-4%), giving approximately 1,300-1,320 RPM under load. VFDs control motor speed by changing the supply frequency.

43. **B. Failed water-cooled oil cooler allowing water into the oil** — Milky white hydraulic oil is the classic indicator of water contamination. A cracked tube or failed gasket in a water-cooled oil cooler allows cooling water to leak into the oil side under pressure, producing the milky emulsion.

44. **D. Height-to-base ratio exceeds 4:1 — tipping hazard** — A rolling scaffold with a height-to-base ratio exceeding 4:1 is at risk of tipping, especially when workers move on the platform or wind loads act on the structure. The scaffold must be stabilized with outriggers or the height reduced.

45. **C. 25 amps — sum of all branch currents** — Kirchhoff's Current Law: total current entering (or leaving) a parallel circuit equals the sum of all branch currents. Total = 5 + 8 + 12 = 25 amps. The source must supply all current consumed by all parallel branches.

46. **A. Air trapped in upper-floor piping blocking circulation** — Air naturally migrates to the highest points in a hot water system. Trapped air blocks water flow through the radiator circuit on the upper floors. Lower floors receive water because they are below the air lock. Bleeding the air vents restores circulation.

47. **D. Minor variations from exact ratio are normal under load** — A transformer's output voltage is slightly less than the calculated ratio due to internal winding resistance and leakage reactance. A secondary reading of 118V versus the theoretical 120.75V represents normal voltage regulation under load.

48. **B. 24,000 pounds total basket hitch capacity for two slings** — Each 6,000-pound sling in a basket hitch (vertical legs) has a doubled capacity of 12,000 pounds. Two slings provide a combined capacity of 24,000 pounds — well above the 8,500-pound load with excellent safety margin.

49. **C. Incomplete combustion requiring more air or burner service** — CO at 350 PPM (target is below 100) indicates fuel is not burning completely. The burner needs more combustion air, improved fuel-air mixing, or component service (dirty nozzle, misaligned electrodes, deteriorated flame retention head).

50. **A. Done bit ON and accumulated value holds at 5.0 seconds** — A TON timer counts up to its preset and then stops. The done bit turns ON when accumulated time reaches or exceeds the preset. The accumulated value holds at the preset (5.0 seconds) — it does not continue counting beyond it.

51. **D. Excessive voltage drop in the control circuit wiring** — Control voltage of 85V on a 120V coil is 71% of rated voltage — insufficient to pull the contactor in solidly. The coil energizes partially, engaging and releasing rapidly (chattering). Voltage drop in undersized or long control wiring is the likely cause.

52. **B. Pump has lost prime — air in the casing** — A centrifugal pump spinning in a mixture of air and water produces a high-pitched whine and cannot develop discharge pressure. Air may have entered through a suction leak, low reservoir level, or a failed mechanical seal.

53. **C. "B" is cross-section size, "68" is outside circumference in inches** — Classical V-belt designations use letters (A through E) for cross-section size, with B being the second-smallest standard section. The number indicates the belt's outside circumference in inches.

54. **A. Main gas valve failing to open on command from flame safeguard** — The pilot lights successfully but the main burner does not ignite. The flame safeguard commands the main gas valve to open after pilot flame is proven. A stuck or electrically failed main gas valve prevents fuel from reaching the main burner.

55. **B. Severe oxidation from chronic overheating requiring fluid replacement** — Dark color and burnt smell indicate the oil has been subjected to sustained high temperatures that have broken down the base oil and depleted the additive package. The fluid must be replaced and the heat source corrected.

56. **D. Phase loss relay detects missing phase and disconnects motor** — A phase loss relay (phase monitor relay) continuously monitors all three phases for presence, correct sequence, and balance. It disconnects the motor immediately upon detecting a lost phase, before thermal damage can occur.

57. **A. Oil ring cannot reach oil — bearing runs dry and overheats** — The oil ring must contact the oil surface in the reservoir to carry lubricant up to the bearing. If the oil level drops below the ring's reach, no oil is delivered and the bearing operates dry, leading to rapid failure.

58. **C. Alarm OFF because 485 is not greater than 500** — The comparison instruction evaluates whether N7:0 > 500. Since 485 is less than 500, the comparison is false and the alarm output remains de-energized. The alarm activates only when the register value exceeds 500.

59. **B. Soft foot was not corrected before alignment was performed** — Vibration at 2× RPM when coupled but not when uncoupled points to a coupling-related issue. Uncorrected soft foot distorts the motor frame when bolts are tightened, shifting alignment from the measured values and producing vibration under load.

60. **D. 150 PSI matching original valve and tank MAWP rating** — The relief valve must match the receiver tank's maximum allowable working pressure (MAWP). The original 150 PSI valve was sized for the tank's rating. Installing a different pressure rating violates the pressure vessel code requirements.