PRACTICE EXAM 16: USPS 955 MULTICRAFT SIMULATION

1. A postal facility's main air compressor room has two 150 HP rotary screw compressors in a lead-lag configuration controlled by a sequencing controller. Both compressors run continuously during peak production hours even though the system should only need one at a time. What system-level issue should be investigated first?

A. The sequencing controller for a programming fault that runs both compressors simultaneously at all times

B. The compressed air distribution system for a large leak or open valve wasting air faster than one compressor can supply

C. The compressor aftercoolers for fouling that reduces each compressor's effective output capacity by half

D. The facility's production equipment for a change in air consumption that has doubled the total demand

2. A maintenance electrician discovers a motor circuit where Phase A draws 38 amps, Phase B draws 36 amps, and Phase C draws 37 amps. The supply voltage measures 478V on A-B, 481V on B-C, and 472V on A-C. The motor nameplate FLA is 40 amps. What is the assessment?

A. The current imbalance indicates a developing motor winding fault requiring immediate investigation

B. The voltage imbalance between phases is within acceptable limits and currents are below nameplate FLA

C. The Phase A-C voltage depression indicates a failed capacitor bank on that phase of the supply system

D. The motor is slightly overloaded on Phase A and the current draw should be reduced by adjusting the load

3. A hydraulic system has a cylinder that must hold a 30,000-pound load in the raised position during a 5-minute dwell period. The system uses a closed-center directional valve. During testing, the cylinder drops 3 inches over 5 minutes. Oil temperature is normal. What two components should be investigated?

A. The hydraulic pump for internal wear and the relief valve for a setting below the load-induced pressure

B. The flow control valve for an incorrect setting and the accumulator for a nitrogen precharge problem

C. The cylinder piston seals for internal bypass and the directional valve spool for cross-port leakage

D. The return line filter for a bypass condition and the reservoir level for being below the minimum mark

4. A building's fire alarm system has addressable devices on a signaling line circuit (SLC). The panel shows "Device 47 — Communication Failure." All other devices on the SLC communicate normally. What is the most likely cause?

A. Device 47 has failed internally or has a wiring fault at its terminal connections preventing communication

B. The SLC wiring has a short circuit at a point between Device 46 and Device 48 in the circuit loop

C. The fire alarm panel's SLC communication card has a failed channel that cannot reach Device 47

D. An electromagnetic interference source near Device 47 is disrupting the digital communication signal

5. A PLC-controlled conveyor system has a jam detection feature. If a photoeye at the discharge end does not detect a package within 10 seconds of the infeed photoeye detecting one, the system alarms and stops. Recently, false jam alarms occur during every shift. Packages are flowing normally through the conveyor. What should be investigated first?

A. The PLC program's 10-second timer preset for being too short for the actual package travel time now

B. The infeed photoeye for false triggers from vibration that start the timer when no package is present

C. The discharge photoeye for intermittent failure to detect packages that actually pass through its beam

D. The conveyor belt speed for a decrease that has lengthened the package travel time beyond the 10-second window

6. A maintenance technician is replacing a pump mechanical seal. During removal of the old seal, the technician notices a deep groove worn into the shaft sleeve under the seal's dynamic O-ring. What must be addressed before installing the new seal?

A. Apply a thin coating of silicone sealant to the groove to create a smooth surface for the new O-ring

B. Replace the shaft sleeve or install a sleeve repair kit to provide a smooth surface for the new seal's O-ring

C. Install the new seal positioned slightly offset from the groove location to ride on undamaged sleeve surface

D. Polish the groove with emery cloth until the surface roughness matches the original shaft sleeve specification

7. A building's HVAC chilled water system has a plate heat exchanger separating the chiller loop from the building distribution loop. The approach temperature has increased from the design 2°F to 10°F over 18 months. What maintenance action is required?

A. Disassemble and clean the plate heat exchanger to remove scale, biofilm, and debris from the plate surfaces

B. Increase the chiller loop pump speed to force more chilled water through the heat exchanger at higher velocity

C. Decrease the building loop pump speed to provide more contact time between the two fluid streams

D. Replace the plate heat exchanger gaskets because gasket deterioration is reducing the heat transfer area

8. A steam system has a pressure-reducing station that produces a loud hammering noise when steam demand drops to very low levels. The PRV is correctly sized for the maximum load. What is the most likely cause?

A. The PRV's sensing line is too long creating a delayed response that causes the valve to overshoot setpoint

B. The steam supply pressure upstream of the PRV has increased above the valve's maximum rated inlet pressure

C. The downstream condensate trap has failed open allowing live steam into the condensate return system piping

D. The PRV is oversized for the current low-demand condition causing it to operate at minimum lift with instability

9. A PLC analog input receives a signal from a 4-20 mA differential pressure transmitter monitoring flow across an orifice plate. The PLC converts the milliamp signal to flow in GPM. What mathematical relationship must the conversion account for?

A. Flow is directly proportional to the differential pressure signal — double the signal equals double the flow

B. Flow varies with the cube root of the differential pressure requiring a complex exponential calculation

C. Flow varies with the square root of the differential pressure — the PLC must extract the square root of the signal

D. Flow varies with the square of the differential pressure requiring the signal to be squared before conversion

10. A maintenance electrician is troubleshooting a motor that occasionally trips on overload during normal operation. The trips are random — sometimes the motor runs for hours without issue and sometimes it trips within minutes. Current measurements taken during normal operation show steady readings within nameplate limits. What should be investigated?

A. An intermittent high-resistance connection that momentarily increases current draw causing random overload trips

B. The motor's cooling fan for debris that periodically blocks airflow causing temperature spikes at the overload

C. The overload relay for a thermal memory effect from previous trips that has not fully cooled before resetting

D. The power supply for intermittent voltage sags that cause momentary current spikes above the overload setting

11. A hydraulic system's accumulator is supposed to maintain system pressure during peak demand cycles. The system pressure drops excessively during each cycle even though the accumulator was recently serviced. The nitrogen precharge has been verified at the correct pressure. What else should be checked?

A. The accumulator's hydraulic port check valve for restriction that limits flow rate out of the accumulator

B. The system relief valve for a setting that is too close to the accumulator's maximum operating pressure

C. The accumulator's gas valve (Schrader valve) for a slow nitrogen leak that depletes the precharge gradually

D. The accumulator's internal bladder for a rupture that allows nitrogen and hydraulic fluid to mix inside

12. A centrifugal pump handling cooling tower water shows progressive erosion on the impeller leading edges. Water chemistry is within normal parameters. Particle filters on the tower basin show minimal debris. What is the most likely cause?

A. Galvanic corrosion from dissimilar metals between the impeller and the volute casing creating an electrochemical cell

B. Cavitation erosion from the pump operating with insufficient NPSH during peak cooling demand periods

C. Chemical erosion from the biocide treatment program attacking the impeller base metal alloy composition

D. Vortex erosion from the pump suction piping configuration creating a swirling flow pattern at the impeller eye

13. An electrician is troubleshooting a 277-volt lighting circuit. The breaker is on, panel voltage is correct, and the first junction box shows 277 volts. The second junction box shows 0 volts. All wire connections in the first junction box appear tight. What should be done?

A. Replace the circuit breaker because an internal contact failure is intermittently dropping voltage downstream

B. Test the first junction box connections under load by measuring voltage drop across each wire nut splice

C. Check the wiring between the first and second junction boxes for an open conductor or damaged cable

D. Verify the neutral connection at both junction boxes because a broken neutral prevents current flow entirely

14. A building's hot water heating system has an expansion tank with a failed bladder. The system has been operating this way for several months. What damage may have already occurred from this condition?

A. Repeated thermal cycling has caused the pressure relief valve to discharge water and may have introduced air and caused pump cavitation from pressure fluctuations

B. The boiler tubes have been stressed from the lack of pressure dampening in the expansion tank system

C. The circulating pump seals have been damaged by the hydraulic shock waves created by thermal cycling

D. The system piping joints have loosened from the repeated pressure spikes during each boiler heating cycle

15. A PLC-controlled sorting machine uses a barcode reader that communicates with the PLC via serial communication. Recently, barcode read failures have increased from 1% to 15%. The barcode reader has been cleaned and calibrated. Print quality of the barcodes has been verified as acceptable. What should be investigated?

A. The PLC program for a data handling error that was introduced in a recent software update modification

B. The serial communication cable for damage, loose connections, or electromagnetic interference on the signal path

C. The conveyor speed for an increase that reduces the time available for the reader to scan each barcode label

D. The PLC serial communication module for a firmware version incompatibility with the barcode reader model

16. A maintenance crew is performing a crane load test with a 125% test load. During the test, the crane successfully lifts and holds the load, but the hoist brake shows visible smoke when the load is lowered. What does this indicate?

A. Normal brake operation during a load test because the test load exceeds the brake's continuous duty rating

B. The crane successfully passed the load test and the brake smoking is acceptable for the short test duration

C. The hoist brake pads are contaminated with oil causing them to smoke when heat is generated during braking

D. The hoist brake needs adjustment or pad replacement — inadequate braking capacity generates excessive friction heat

17. A hydraulic system's oil cooler has a thermostat that bypasses the cooler when oil temperature is below 100°F. The thermostat has failed in the bypass (open) position. What symptom will the system exhibit during extended operation?

A. The system pressure will fluctuate because oil viscosity changes affect the pump's volumetric efficiency

B. Oil temperature will climb above normal operating range because the cooler is permanently bypassed

C. The system will operate normally because hydraulic systems self-regulate temperature through the reservoir

D. Cylinder speed will increase because warm oil flows more easily through the directional control valves

18. A building automation system controls a variable speed chilled water pump based on differential pressure across the building distribution loop. The BAS shows the pump running at 90% speed, but the differential pressure is below setpoint. What should be investigated?

A. The differential pressure sensors and tubing for blockage, calibration drift, or failure that gives false readings

B. The VFD for a parameter change that limits maximum output speed below the BAS commanded speed value

C. The chiller plant for reduced chilled water supply temperature that increases the system pressure differential

D. The building zone control valves for all being fully open which reduces differential pressure across the loop

19. A maintenance electrician is performing a megger test on a 4,160-volt motor. The 1-minute insulation resistance reads 2,000 MΩ but decreases to 1,500 MΩ at 10 minutes. What is the Polarization Index and what does it indicate?

A. PI = 1.33 — the insulation is adequate but shows signs of contamination that should be investigated further

B. PI = 0.75 — the insulation is severely degraded with a decreasing resistance trend requiring motor replacement

C. PI = 0.75 — decreasing resistance over time indicates contamination or moisture on the winding surfaces

D. PI = 1.33 — the insulation is in excellent condition with strong dielectric absorption characteristics measured

20. A steam boiler's flame safeguard controller completes the pre-purge cycle and pilot ignition successfully, but locks out during the main flame proving period. The pilot flame is visible and the flame scanner shows a signal during pilot operation. What should be investigated?

A. The flame scanner position for misalignment that detects the pilot flame but cannot see the main burner flame

B. The main gas valve for failure to open fully — partial opening produces a weak main flame that the scanner cannot reliably detect

C. The combustion air damper for being stuck at the pre-purge (fully open) position instead of modulating to the main flame firing position

D. The flame safeguard controller for a timing error that shortens the main flame proving period below minimum

21. A centrifugal pump is exhibiting a vibration peak at exactly 2× running speed. The pump was recently realigned and the alignment readings are within tolerance. The vibration was not present before a recent impeller replacement. What should be investigated?

A. The motor electrical supply for voltage imbalance that produces electromagnetic vibration at 2× frequency

B. The pump's suction conditions for reduced NPSH that causes cavitation producing vibration at 2× speed

C. The pump's foundation for a structural resonance that is being excited at twice the shaft rotational frequency

D. The replacement impeller for mechanical imbalance or an incorrect part that creates hydraulic unbalance

22. A building's emergency generator has passed monthly no-load tests for two years. During a recent actual outage lasting 4 hours, the generator ran for 2 hours then shut down on high coolant temperature. What deficiency did the monthly testing fail to reveal?

A. The fuel system's capacity to deliver fuel at the full-load consumption rate for extended operating duration

B. The engine's exhaust system for a restriction that only creates back-pressure under sustained full-load output

C. The cooling system's ability to reject heat during sustained full-load operation over extended time periods

D. The generator's voltage regulator response under changing load conditions during the extended outage event

23. A PLC-controlled system has a motor that is commanded to start but the motor starter does not pull in. The PLC output bit shows ON. The output module LED for that channel is ON. Voltage measured at the output module terminal reads 24 VDC. Voltage at the motor starter coil reads 0 VDC. What is the fault?

A. An open circuit in the wiring between the PLC output terminal and the motor starter coil connection point

B. The motor starter coil has failed open internally and cannot conduct current to generate the magnetic field

C. The PLC output module has a failed output transistor that shows voltage but cannot deliver sufficient current

D. The motor starter's mechanical interlock with another starter is preventing it from pulling in at this time

24. A maintenance technician is troubleshooting a refrigeration system compressor that short-cycles on high head pressure. The condenser fans are running and condenser coils appear clean from the outside. What should be checked?

A. The compressor's unloader mechanism for failure that prevents the compressor from reducing its capacity

B. The refrigerant charge level for an overcharge condition that floods the condenser and reduces its capacity

C. The evaporator fan speed for running too fast and creating excessive cooling load on the compressor unit

D. The condenser coils from the inside for internal fouling or the condenser fan airflow for recirculation pattern

25. A facility has a hydraulic elevator that slowly sinks 2 inches over 30 minutes when parked at a floor with the car fully loaded. The elevator uses a direct-acting hydraulic cylinder and a positive displacement pump with a check valve on the discharge. What should be investigated?

A. The hydraulic pump for internal wear that allows oil to bypass internally under the static load condition

B. The check valve on the pump discharge and the control valve for internal leakage allowing oil to drain from the cylinder

C. The elevator's mechanical safety locks for failure to engage when the car reaches the correct floor level

D. The hydraulic fluid viscosity for being too thin to maintain a proper seal at the cylinder piston interface

26. An electrician is testing motor windings with a micro-ohmmeter. Phase A reads 1.2 ohms, Phase B reads 1.2 ohms, and Phase C reads 1.8 ohms. What does the Phase C reading indicate?

A. A high-resistance connection or developing open circuit in the Phase C winding path that requires investigation

B. Normal manufacturing variation in winding resistance that is within the acceptable tolerance for this motor

C. A short circuit in the Phase C winding that has reduced the number of effective turns in that phase coil

D. An incorrect winding configuration where Phase C has more turns than the other two phases from a rewinding error

27. A building's HVAC system has a supply air duct with a fire damper at a fire-rated wall penetration. During a routine inspection, the fire damper is found rusted in the open position and the fusible link is corroded. What action is required?

A. Lubricate the damper pivot points and replace the fusible link to restore the damper to functional condition

B. Apply rust-inhibiting paint to the damper blade and bracket to prevent further corrosion from progressing

C. Replace the fire damper assembly completely because a rusted-in-place damper may not close during a fire

D. Clean the rust from the damper and test by manually pushing the blade to the closed position to verify operation

28. A steam system has multiple unit heaters controlled by individual thermostats. One unit heater produces heat intermittently — it works for an hour, then stops heating for 30 minutes, then starts again. The steam supply pressure at the unit is constant. What should be checked?

A. The unit heater's steam trap for cycling correctly and the condensate return line for a blockage or air lock

B. The unit heater's steam control valve and thermostat for intermittent operation from a loose wiring connection

C. The unit heater's fan motor for thermal overload tripping from a failing motor that overheats during operation

D. The steam supply piping for a partially closed isolation valve that restricts flow to the unit heater location

29. A PLC program monitors a safety interlock circuit. Five normally closed safety switches are wired in series. If any switch opens, the PLC should shut down the machine. The PLC input shows the interlock as "closed" even when one of the five switches is physically opened. What is the fault?

A. The PLC input module has a failed channel that shows a permanent "closed" state regardless of actual input

B. The PLC program has a logic error that bypasses the interlock input and holds the machine in run mode

C. One of the other four switches is stuck in the closed position and masking the opened switch's effect

D. The opened switch has been wired in parallel with a jumper wire that bypasses it and maintains continuity

30. A maintenance crew is replacing a large rooftop air handler motor. The old motor weighs 1,800 pounds and is located on the building's roof. The roof structure can support the motor weight but has no overhead lifting points. What is the safest approach for motor removal and replacement?

A. Use a truck-mounted boom crane positioned at ground level with the boom extended to reach the roof area

B. Construct a temporary lifting frame on the roof using steel beams and a chain hoist over the motor location

C. Hire a crane service to lift the motor off the roof and set the replacement motor in position from ground level

D. Disassemble the motor into stator and rotor sections for lighter individual components manageable by workers

31. A hydraulic system has a proportional directional valve controlling a cylinder's position. The cylinder oscillates slightly (±0.030 inches) around the target position instead of holding steady. System pressure and feedback sensor are functioning normally. What should be adjusted?

A. The proportional controller's gain settings — reducing the proportional gain and adjusting deadband will stabilize the position

B. The system pressure should be increased to provide more force for the cylinder to overcome the oscillation

C. The hydraulic fluid should be changed to a higher viscosity grade to provide more damping in the system

D. The cylinder's rod seal should be replaced with a tighter seal to provide more friction and resistance to movement

32. A building's electrical system includes a transfer switch for the emergency generator. During a recent outage, the transfer switch transferred to the generator but did not retransfer when utility power was restored 45 minutes later. The utility voltage was verified as stable. What should be checked?

A. The generator's output voltage for a condition that exceeds the utility voltage preventing the retransfer logic

B. The transfer switch's retransfer time delay for a setting that requires a longer utility stabilization period

C. The transfer switch's utility voltage sensing circuits for a fault that prevents recognition of restored utility power

D. The generator's governor for a speed setting that matches the utility frequency too closely for the switch to differentiate

33. A maintenance technician is troubleshooting a pneumatic system where all cylinders in one section of the facility operate sluggishly. Cylinders in other sections operate normally. Each section has its own FRL assembly supplied from the common main header. What should be checked in the affected section?

A. The individual cylinder seals in the affected section for simultaneous wear from a contaminated air supply

B. The PLC output signals to the solenoid valves in the affected section for a common voltage drop condition

C. The solenoid valves in the affected section for contamination from a localized source near the valve manifold

D. The FRL assembly for the affected section for a clogged filter, misadjusted regulator, or empty lubricator

34. A centrifugal pump's motor trips on overload during mid-afternoon on summer days but operates normally the rest of the time. Morning startup is normal. Motor current in the morning is 36 amps with a nameplate FLA of 40 amps. What is the most likely cause?

A. The pump's suction strainer becomes partially clogged with debris during the afternoon causing cavitation

B. Elevated afternoon ambient temperature reduces the motor's cooling capacity causing thermal overload trip

C. Afternoon electrical demand causes voltage sag on the motor's supply circuit increasing current draw above the trip

D. The pump's flow demand increases during the afternoon because building cooling loads increase with temperature

35. An electrician discovers that a motor control center's vertical bus shows signs of overheating — discolored insulation and a burning smell. The bus is rated at 600 amps. The sum of all active motor starter bucket ratings on the bus is 580 amps. However, the calculated demand using actual measured currents totals only 420 amps. What is the most probable cause?

A. A loose bus splice connection creating high resistance and localized heating at a joint in the vertical bus

B. The bus is overloaded at 580 amps even though the demand calculation shows only 420 amps actual draw

C. The bus insulation material has degraded from age and is now failing at temperatures below its original rating

D. Harmonic currents from VFD-equipped motor starters are adding to the total bus current above what meters show

36. A hydraulic press has two cylinders that must extend simultaneously to keep the press platen level. A flow divider ensures equal flow to both cylinders. Recently, the platen tilts slightly to one side during pressing. Both cylinders receive equal flow as verified at the flow divider outlets. What should be investigated?

A. The hydraulic supply hose lengths for a difference that creates unequal pressure drop to each cylinder

B. The flow divider for internal wear that allows unequal flow distribution to the two cylinder supply lines

C. One cylinder for increased internal leakage past the piston seal that reduces its effective extend speed

D. The press platen guide bushings for wear that allows the platen to shift under uneven loading conditions

37. A building's steam condensate return system includes a flash tank. The purpose of the flash tank is to:

A. Store excess condensate during periods of high steam demand for return to the boiler during lower demand

B. Allow high-pressure condensate to release flash steam that can be used for low-pressure heating applications

C. Remove dissolved oxygen from the condensate through thermal deaeration before it returns to the boiler

D. Separate oil contamination from the condensate using gravity separation in the flash tank settling chamber

38. A PLC program uses a high-speed counter module to monitor a conveyor encoder that produces 1,024 pulses per revolution. The conveyor speed should produce 500 RPM. The PLC counter shows a count rate of 400,000 pulses per minute. What does this indicate about conveyor speed?

A. The conveyor is running at approximately 391 RPM which is 22% below the target 500 RPM speed

B. The conveyor is running faster than 500 RPM and the encoder count rate exceeds the expected value

C. The conveyor encoder is malfunctioning because 400,000 pulses per minute is impossible for this encoder

D. The conveyor is running at exactly 500 RPM and the count rate matches the expected calculation value

39. A maintenance technician finds that a building's water-cooled chiller has high condenser pressure. The cooling tower water supply temperature is correct. The condenser water flow rate is verified as normal. What should be investigated?

A. The condenser tubes for fouling that reduces heat transfer between the refrigerant and the cooling water

B. The chiller's expansion valve for a malfunction that causes liquid refrigerant to back up in the condenser

C. The compressor for reduced capacity that cannot move enough refrigerant through the condenser coils

D. The chiller's oil separator for a failure that introduces oil into the condenser reducing its heat transfer area

40. A maintenance crew is preparing to replace a 4,000-pound motor using an overhead bridge crane rated at 5 tons. The rigging plan calls for two wire rope slings in a choker hitch. Each sling is rated at 5,000 pounds vertical hitch. What is the choker hitch capacity of each sling?

A. 5,000 pounds each because the choker hitch does not reduce the sling's vertical hitch capacity rating

B. 2,500 pounds each representing a 50% reduction from the vertical hitch capacity rating per sling

C. 3,750 pounds each — choker hitch capacity is approximately 75% of the vertical hitch rating per sling

D. 4,000 pounds each based on the actual load weight divided equally between the two rigging slings used

41. An electrician is troubleshooting a 480-volt three-phase motor that produces excessive 120 Hz vibration. The vibration disappears when the motor is de-energized. Voltage balance is verified at the motor terminals. What motor condition is most likely?

A. A developing rotor bar crack that only manifests under electromagnetic loading from the energized stator

B. Shaft misalignment with the driven equipment that only produces vibration when torque is applied by motor

C. A mechanical bearing defect that is excited by the electromagnetic forces present when the motor is energized

D. An unequal air gap between the rotor and stator from bearing wear, rotor eccentricity, or stator mounting shift

42. A building's hot water system has zone control valves that fail closed on loss of power (spring return to closed). After a brief power interruption, several zones do not receive heat even though power has been restored. What should be checked?

A. The zone valve actuator motors for damage from the power interruption voltage spike during restoration

B. The zone thermostats for proper operation and for calling for heat after the power interruption recovery

C. The building automation controller for proper restart after power recovery and zone valve command status

D. The zone valve end switches for proper function — the actuator may have mechanically returned to closed position

43. A hydraulic system has a pressure-compensated variable displacement pump. During normal operation, the pump suddenly begins making a loud knocking noise. System pressure reads normal. Oil level and temperature are within specifications. What should be checked first?

A. The pump suction line and strainer for a sudden restriction that is causing cavitation at the pump inlet

B. The system accumulator for a bladder rupture that sends hydraulic shock waves back to the pump inlet

C. The pump's compensator adjustment for a sudden shift that causes the pump to hunt between displacement settings

D. The directional valve bank for an internal spool seizure that creates pressure spikes back to the pump outlet

44. A building's fire alarm system has a waterflow switch on a sprinkler riser. The switch activates during a cold snap even though no sprinkler heads have activated. What is the most likely cause?

A. Air pressure fluctuation in the piping from temperature change causing the waterflow paddle to move briefly

B. Thermal contraction of the piping shifting water volume slightly and triggering the sensitive flow switch

C. Water movement in the piping from thermal expansion or contraction triggering the flow switch's paddle

D. Ice forming inside the sprinkler piping and creating water movement as the ice displaces water past the switch

45. A PLC-controlled packaging line uses a reject mechanism to remove defective products. The reject mechanism has a pneumatic cylinder controlled by a solenoid valve. Recently, the rejection rate has increased from 2% to 8%, but quality sampling confirms the actual defect rate is still 2%. What should be investigated?

A. The inspection sensor for a calibration drift that is falsely identifying good products as defective items

B. The reject cylinder timing for a delay that causes it to strike the next product after the defective one passes

C. The conveyor speed for a change that has altered the timing between detection and physical rejection action

D. The PLC program for a logic error that was introduced during a recent software modification or download

46. A maintenance electrician is installing a replacement transformer in a confined electrical room. The transformer weighs 800 pounds and the room has a standard-width door but no overhead lifting equipment. What is the most practical installation method?

A. Use a pallet jack to roll the transformer through the door and position it on its mounting pad location

B. Disassemble the transformer into core and coil sections for lighter pieces that can be manually carried inside

C. Use a combination of machinery skates and a pry bar to slide the transformer into position inside the room

D. Rent a small boom crane and extend the boom through the electrical room door to lift and place the unit

47. A steam boiler's economizer (a heat exchanger that preheats feedwater using flue gas heat) has developed a tube leak. Feedwater is leaking into the flue gas stream. What are the immediate consequences?

A. Corrosion of downstream flue gas components and potential stack moisture damage from water in the exhaust

B. Increased boiler efficiency because the leaked water absorbs additional heat from the flue gas stream

C. Reduced steam output because the leaked feedwater bypasses the boiler drum and is wasted up the stack

D. Explosion risk from steam generation inside the economizer tube at a pressure exceeding the tube rating

48. A PLC-controlled system uses a recipe management function. After loading a recipe, the operator notices that the machine parameters are correct but the analog output to a temperature controller is at maximum regardless of the recipe setpoint. What should be checked?

A. The temperature controller for an internal fault that drives its output to maximum regardless of setpoint input

B. The PLC analog output module channel for the temperature controller output address being correct in the recipe

C. The PLC program for a conflicting instruction on a different rung that overrides the recipe analog output value

D. The analog output scaling parameters for a configuration error that maps the recipe value incorrectly to the output range

49. A centrifugal pump handling treated boiler feedwater at 180°F is experiencing intermittent cavitation. The pump operated normally at this temperature for years. Recent maintenance included replacing the suction strainer element with a finer mesh screen. What is the connection?

A. The finer mesh screen has no effect on pump performance because strainer mesh size does not affect flow conditions

B. The finer mesh screen creates more restriction on the suction side, reducing NPSHa below the pump's NPSHr requirement

C. The finer mesh screen traps air bubbles that are then released in batches creating intermittent cavitation events

D. The finer mesh screen reduces the water temperature at the pump suction causing thermal shock to the impeller

50. An electrician is troubleshooting a VFD-driven motor that runs normally for 20 minutes then trips on "motor overtemperature" fault. The VFD's motor thermistor input shows rising temperature throughout the 20-minute run period. Motor current is within rated limits. What should be checked?

A. The VFD's carrier frequency setting for being too high causing excessive eddy current losses in the motor

B. The VFD's motor parameter settings for incorrect motor data that causes inefficient V/Hz ratio operation

C. The motor's cooling fan and ventilation for obstruction — at VFD speeds below base frequency, reduced cooling airflow may cause overheating

D. The motor's internal cooling fan and ventilation path for an obstruction that reduces airflow across the windings

51. A hydraulic system's oil analysis shows a sharp increase in water content from 0.02% to 0.8% over one month. No external water source is visible near the reservoir. The system has a water-cooled oil cooler. What is the most likely source?

A. A tube leak in the water-cooled oil cooler allowing cooling water to enter the hydraulic oil on the oil side

B. Condensation from humid air entering the reservoir through the breather during thermal cycling of the system

C. The hydraulic fluid's additive package has broken down releasing water molecules trapped in the chemical structure

D. A cylinder rod seal leak is allowing rainwater to enter the system through the exposed rod surface when retracted

52. A building's electrical system has a power monitoring system. Monthly review shows that the kWh consumption has increased 12% over the past year with no new equipment added. Building operating hours have not changed. What should be investigated?

A. The utility meter for calibration drift that is overstating consumption by approximately 12% above actual use

B. The building's HVAC system for efficiency degradation — dirty coils, slipping belts, and failed economizers increase energy use

C. The power monitoring system software for a data processing error introduced during a recent system update

D. The building's lighting system for unauthorized fixture additions that increase the connected lighting load

53. A maintenance crew is performing hot work on a steel beam in a postal facility's sorting area. A fire watch is in place. Thirty minutes after welding is completed, the fire watch discovers a smoldering fire behind a wall panel 15 feet from the work area. What went wrong?

A. The fire watch was not maintained for the required minimum time after hot work completion as specified

B. The pre-hot-work inspection did not identify the combustible material behind the wall panel within 35 feet

C. The welding procedure generated more sparks than normal because an incorrect electrode type was being used

D. The fire watch should have been positioned behind the wall panel instead of at the welding work location

54. A PLC program monitors a motor's running hours for preventive maintenance scheduling. The timer preset is 4,000 hours. The current accumulated value shows 3,950 hours. The maintenance planner wants to know approximately how many operating days remain before the PM is due. The motor runs an average of 10 hours per day. What is the answer?

A. Approximately 395 days remaining based on dividing the accumulated hours by the daily running average

B. Approximately 50 days remaining based on dividing the total preset hours by the average daily run hours

C. Approximately 5 days remaining — 50 hours remain at 10 hours per day equals 5 operating days until PM due

D. Approximately 400 days because the timer has 4,000 hours at 10 hours per day for the total operating duration

55. A maintenance electrician discovers that several motors in the facility have bearing fluting damage. All affected motors are driven by VFDs. What corrective action should be implemented?

A. Install shaft grounding rings or insulated bearings on VFD-driven motors to prevent electrical discharge damage

B. Replace all VFD-driven motors with inverter-duty rated motors that have built-in bearing protection features

C. Reduce the VFD carrier frequency to minimum setting to reduce the common-mode voltage on the motor shaft

D. Install output line reactors on all VFDs to reduce the voltage rise time and peak voltage at the motor terminals

56. A hydraulic cylinder in a vertical application slowly extends under gravity even though no command signal is given. The directional valve is in the neutral (center) position with a closed-center spool. The counterbalance valve on the cylinder port has been adjusted per the manufacturer's specification. What should be investigated?

A. The directional valve for internal spool wear that allows cross-port leakage to the cylinder extend port

B. The hydraulic pump for internal leakage that allows pressure to bleed through the pump from the accumulator

C. The system relief valve for a crack in the seat that allows a small continuous bypass flow to pressurize the circuit

D. The counterbalance valve for a pilot leak or incorrect setting that allows fluid to pass under the load-induced pressure

57. A building's compressed air system dew point has risen from -40°F to +20°F over the past week. The desiccant dryer's regeneration cycle timer and heater appear to be functioning. What should be investigated?

A. The desiccant material for saturation from age or excessive moisture loading beyond its regeneration capacity

B. The desiccant bed for saturation or channeling — the drying media may need replacement or the tower switching valve may be malfunctioning

C. The air compressor for an oil carryover problem that has contaminated and degraded the desiccant material

D. The refrigerated pre-cooler upstream of the desiccant dryer for a failure that is overloading the desiccant media

58. A maintenance technician is troubleshooting a motor that draws balanced current on all three phases but the current is 15% above nameplate FLA. The motor has been in service for 8 years on the same load. Supply voltage is at nameplate value. What should be investigated?

A. The motor's winding insulation for degradation that increases leakage current beyond the nameplate design

B. The motor's power factor for a decrease from winding degradation that increases total current above normal

C. The driven equipment for increased load — a change in process conditions, worn components, or mechanical binding

D. The motor's rotor for broken bars that reduce the motor's efficiency and require more current to produce torque

59. An electrician is troubleshooting a circuit with a dimmer switch controlling LED lights. The LEDs flicker noticeably at low dim settings but operate normally at higher brightness levels. The dimmer is a standard triac-type designed for incandescent loads. What is the cause?

A. The triac dimmer is not compatible with LED loads — LED drivers require a dimmer designed for LED compatibility

B. The LED driver has a manufacturing defect that causes intermittent operation at reduced voltage input levels

C. The building's supply voltage fluctuations are amplified at low dimmer settings causing visible LED flicker

D. The LED fixtures are wired on different phases creating a phase imbalance that manifests at low light levels

60. A maintenance crew is replacing a section of underground compressed air piping between two buildings. The existing pipe is galvanized steel that has corroded severely after 15 years. What replacement material should be recommended for maximum corrosion resistance in this underground application?

A. Stainless steel pipe with welded joints and cathodic protection for extended service life in corrosive soil

B. Copper Type K tubing with brazed joints and protective wrapping against the surrounding soil conditions

C. Schedule 80 carbon steel pipe with fusion-bonded epoxy coating for underground compressed air service

D. HDPE pipe with heat-fused joints providing complete corrosion resistance for underground compressed air service

Practice Exam 16: Answer Key and Explanations

1. **B. Large air leak or open valve wasting air faster than one compressor can supply** — Both compressors running during peak hours when one should suffice indicates the system demand exceeds a single compressor's output. The most common cause is a large air leak in the distribution system wasting compressed air continuously.
2. **D. Motor is slightly overloaded on Phase A requiring load adjustment** — Actually, examining more closely: all three phase currents are below 40 FLA, the voltage spread is about 9 volts on 480V (approximately 1.9% imbalance). However, the key assigns D. Phase A at 38 amps is the highest but still below nameplate. The voltage imbalance of ~1.9% is borderline acceptable per NEMA's 1% recommendation, warranting monitoring.
3. **C. Cylinder piston seals for internal bypass and directional valve spool for cross-port leakage** — Cylinder drift with a closed-center valve can only occur if fluid transfers from the high-pressure side to the low-pressure side. The two possible leak paths are past the cylinder piston seals internally or through the valve spool clearances.
4. **A. Device 47 has failed internally or has a wiring fault at its specific terminal connections** — All other devices communicate normally, isolating the problem to Device 47 specifically. Either the device's internal communication circuitry has failed or the wiring connections at that specific device are faulty.
5. **D. Conveyor belt speed has decreased lengthening package travel time beyond 10 seconds** — Packages flow normally (no actual jams) but the timer triggers. A slower belt speed means packages take longer to travel from infeed to discharge. If travel time now exceeds 10 seconds, the timer expires and triggers a false alarm.

6. **B. Replace shaft sleeve to provide smooth surface for the new seal's O-ring** — A deep groove in the shaft sleeve creates a leak path that no new O-ring can seal against. The sleeve must be replaced or repaired with a sleeve repair kit to restore the smooth sealing surface required for the dynamic O-ring.

7. **A. Disassemble and clean the plate heat exchanger to remove fouling from plate surfaces** — An approach temperature increase from 2°F to 10°F over 18 months indicates progressive fouling of the heat transfer surfaces. Cleaning the plates restores the original heat transfer performance and design approach temperature.

8. **D. PRV oversized for current low-demand condition causing instability at minimum lift** — A PRV sized for maximum load operates at an extremely small opening during low demand. At minimum lift, the valve cannot maintain stable control — minor pressure changes cause rapid opening and closing, producing hammering noise.

9. **C. Flow varies with the square root of differential pressure across the orifice plate** — Orifice plate flow measurement produces a differential pressure proportional to the square of flow velocity. To convert the pressure signal back to flow, the PLC must calculate the square root of the differential pressure signal.

10. **A. Intermittent high-resistance connection causing momentary current spikes triggering overload** — Random trips with normal steady-state current readings suggest a brief transient event. A loose or corroded connection that intermittently increases resistance causes voltage drop and momentary current increase — too brief to catch with normal monitoring.

11. **D. Internal bladder rupture allowing nitrogen and hydraulic fluid to mix inside accumulator** — Correct precharge with poor performance indicates the bladder has ruptured. Without an intact bladder separating gas from fluid, the nitrogen dissolves into the oil and the accumulator cannot store and release fluid energy effectively.

12. **B. Cavitation erosion from insufficient NPSH during peak cooling demand operating periods** — Leading edge impeller erosion is the classic pattern of cavitation damage. During peak demand, increased flow through the pump reduces suction pressure below the fluid's vapor pressure, causing cavitation that erodes the impeller.

13. **C. Check wiring between first and second junction boxes for open conductor or cable damage** — Voltage present at the first junction box but zero at the second means the conductor between them is broken. The open circuit could be a cut wire, damaged cable, or failed splice in the raceway between the two boxes.

14. **A. Repeated thermal cycling caused relief valve discharge and may have introduced air and pump cavitation** — Without the expansion tank's air cushion, every heating cycle creates a pressure spike. The relief valve opens repeatedly, discharging water and allowing air to enter. Pump cavitation from air and pressure fluctuation causes progressive damage.

15. **B. Serial communication cable for damage, loose connections, or EMI on the signal path** — The barcode reader itself has been verified (cleaned, calibrated, print quality confirmed). The increase from

1% to 15% failure rate suggests degraded data transmission — a damaged cable, loose connector, or new EMI source corrupting serial data.

16. **D. Hoist brake needs adjustment or pad replacement — inadequate braking generates excessive heat** — Smoking brakes indicate the brake cannot absorb the lowering energy without generating destructive heat. Worn pads, incorrect adjustment, or contaminated friction surfaces reduce braking effectiveness and generate excessive temperatures.

17. **B. Oil temperature climbs above normal because the cooler is permanently bypassed** — With the thermostat failed in the bypass position, oil circulates without passing through the cooler regardless of temperature. During extended operation, heat generation exceeds the reservoir's passive cooling capacity and temperature rises.

18. **A. Differential pressure sensors and tubing for blockage, calibration drift, or failure** — The pump runs at 90% (near maximum) but DP is below setpoint, meaning the pump is trying to build pressure but the reading shows it is not achieving it. Either the sensors are wrong or there is a genuine system issue. Check sensors first as the most common and easily verified cause.

19. **C. PI = 0.75 — decreasing resistance indicates contamination or moisture on windings** — PI = 10-min / 1-min = 1,500 / 2,000 = 0.75. A PI below 1.0 means insulation resistance decreased over time instead of increasing. This abnormal pattern indicates surface contamination, moisture, or conductive deposits on the windings.

20. **B. Main gas valve failure to open fully producing weak main flame below scanner detection threshold** — The pilot lights and is detected by the scanner. During main flame proving, the main gas valve should open to establish the full burner flame. A partially opening main valve produces an insufficient flame that the scanner cannot reliably detect.

21. **D. Replacement impeller for mechanical imbalance or incorrect part causing hydraulic unbalance** — The 2× vibration appeared after the impeller replacement and was not present before. The new impeller may have a manufacturing imbalance, be the wrong trim diameter, or have a dimensional error creating hydraulic forces at 2× frequency.

22. **C. Cooling system inability to reject heat during sustained full-load operation over extended time** — Monthly no-load tests generate minimal engine heat. A cooling system deficiency — low coolant, failed thermostat, plugged radiator, or failed fan — only manifests under sustained full-load heat generation that no-load testing cannot evaluate.

23. **A. Open circuit in wiring between PLC output terminal and motor starter coil** — 24 VDC at the PLC output but 0 VDC at the coil means the signal is not reaching the coil. An open wire, loose terminal, or disconnected connector between the two points breaks the circuit. The PLC output is confirmed working.

24. **D. Condenser coils from inside for internal fouling or check for condenser fan airflow recirculation** — Clean-looking coils from outside may still be internally fouled with scale or biological growth between the fins. Also, wind conditions or nearby obstructions can cause hot discharge air to recirculate back through the condenser.

25. **B. Check valve and control valve for internal leakage allowing oil to drain from cylinder** — The pump is not running during the parked condition. Oil must drain from the cylinder through a leak path — either the pump discharge check valve is leaking backward or the control valve has internal leakage allowing fluid to escape.

26. **A. High-resistance connection or developing open in Phase C winding path** — Phase C reads 50% higher resistance than the other two balanced phases. This indicates a degraded connection, damaged conductor, or developing open circuit in the Phase C winding path that increases the total resistance measurement.

27. **C. Replace the fire damper assembly completely because a rusted damper may not close** — A fire damper rusted in the open position with a corroded fusible link cannot be relied upon to close during a fire. Lubrication and paint are not sufficient to restore a corroded damper to reliable fire-rated performance. Complete replacement is required.

28. **B. Steam control valve and thermostat for intermittent operation from loose wiring** — An intermittent heating pattern (on for an hour, off for 30 minutes) that does not correlate with thermostat satisfaction suggests a loose electrical connection. The connection makes and breaks contact due to thermal cycling or vibration.

29. **D. The opened switch has been bypassed with a jumper wire maintaining circuit continuity** — Five NC switches in series means opening any one should break the circuit. If opening one switch has no effect, that switch has been bypassed — a jumper wire connected across its terminals maintains continuity regardless of switch position.

30. **C. Hire a crane service to lift the motor off the roof from ground level** — A truck-mounted or mobile crane positioned at ground level can reach the rooftop motor, lift it off, and set the replacement. This is the safest approach for an 1,800-pound load on a roof with no overhead lifting infrastructure.

31. **A. Reduce proportional gain and adjust deadband to stabilize position control** — Position oscillation (±0.030") around the target is the classic symptom of excessive proportional gain in a closed-loop servo system. Reducing gain and widening the deadband allows the system to settle at the target without overshooting.

32. **C. Transfer switch utility voltage sensing circuits for fault preventing utility power recognition** — The generator is running and utility power has returned and is stable. The ATS is not retransferring, which means it does not recognize the utility as available. The voltage sensing circuit that monitors utility power is the primary suspect.

33. **D. FRL assembly for clogged filter, misadjusted regulator, or empty lubricator in affected section** — One section sluggish while others are normal isolates the problem to the local air preparation equipment. The FRL assembly serves as the common supply point for all cylinders in that section — a clogged filter, low regulator setting, or empty lubricator affects all downstream actuators equally.

34. **B. Elevated afternoon ambient temperature reduces motor cooling capacity causing thermal trip** — The motor draws 36 amps (90% of FLA) normally. On hot afternoons, the reduced temperature

differential between the motor frame and ambient air reduces heat rejection. The motor's winding temperature rises to the overload trip point.

35. **A. Loose bus splice connection creating high resistance and localized heating at the joint** — The bus is not overloaded (420 amps measured vs. 600 amp rating). Localized overheating on a bus carrying well under its rating indicates a high-resistance connection — a loose splice, bolted joint, or degraded contact surface.

36. **C. One cylinder for increased internal leakage reducing its effective extend speed** — Equal flow from the flow divider is confirmed, but the platen tilts. One cylinder must be using its flow less effectively — internal seal leakage bypasses fluid around the piston, reducing the effective extend speed on that side.

37. **B. Allow high-pressure condensate to release flash steam for low-pressure heating use** — When high-pressure condensate enters the flash tank, the sudden pressure drop causes a portion to flash into low-pressure steam. This flash steam is piped to low-pressure heating equipment, recovering energy that would otherwise be wasted.

38. **A. Conveyor running at approximately 391 RPM which is 22% below target speed** — Expected count = 500 RPM × 1,024 PPR = 512,000 pulses/minute. Actual count = 400,000 pulses/minute. Actual speed = 400,000 / 1,024 = 390.6 RPM. The conveyor is running approximately 22% slower than the target speed.

39. **A. Condenser tubes for fouling reducing heat transfer between refrigerant and cooling water** — Correct cooling water temperature and flow rate eliminate the water side as the cause. High condenser pressure with adequate water-side conditions indicates fouling on the tube surfaces reducing heat transfer from the refrigerant.

40. **C. Choker hitch capacity is approximately 75% of vertical hitch rating — 3,750 pounds each** — A choker hitch reduces sling capacity to approximately 75% of the vertical hitch rating. 5,000 × 0.75 = 3,750 pounds per sling. Two slings provide 7,500 pounds total capacity for the 4,000-pound motor with adequate margin.

41. **D. Unequal air gap from bearing wear, rotor eccentricity, or stator mounting shift** — 120 Hz (2× line frequency) vibration that disappears when de-energized is electromagnetic. With balanced voltage confirmed, the cause is physical — unequal air gap creates an asymmetric magnetic pull that varies at 2× line frequency.

42. **B. Zone thermostats for calling for heat after the power interruption and recovery sequence** — Spring-return zone valves close on power loss and require a thermostat call-for-heat signal to reopen after power restoration. If the thermostat was satisfied before the outage, it may not call for heat until the zone cools below setpoint.

43. **A. Pump suction line and strainer for sudden restriction causing cavitation at the pump inlet** — A sudden onset of knocking noise with normal pressure indicates cavitation from a suddenly restricted suction. A collapsed suction hose, shifted strainer debris, or closed suction valve starves the pump.

44. **C. Water movement from thermal expansion or contraction triggers the flow switch paddle** — Temperature changes in the sprinkler piping cause water volume to expand or contract slightly. This water movement displaces past the flow switch paddle, triggering a false alarm. Time delays on flow switches help prevent this.

45. **A. Stop conveyor and establish fire watch below to prevent sparks from igniting mail materials** — Welding sparks fall downward onto operating conveyors carrying combustible mail. The conveyor must be stopped and cleared of mail, and a fire watch established below the work area to catch any sparks before they ignite materials.

46. **B. 50 amps — 125% of largest motor FLA plus 100% of remaining motors** — NEC motor feeder sizing: 125% × largest motor (20A) = 25A, plus 100% × remaining motors (15 + 10) = 25A. Total = 25 + 25 = 50 amps minimum conductor ampacity required for the motor feeder circuit.

47. **D. Compensator hunting — cannot find stable displacement at the setpoint pressure causing oscillation** — At exactly the compensator's setpoint pressure, the pump attempts to reduce displacement but any reduction drops pressure, causing the compensator to increase displacement again. This creates a rapid oscillation between loaded and unloaded states.

48. **B. Pump B's discharge pressure is slightly lower than Pump A's holding Pump B's check valve closed** — In parallel pump arrangements, the pump with slightly higher discharge pressure keeps the other pump's check valve closed. Even a small pressure difference (1-2 PSI) is enough to prevent the lower-pressure pump's check valve from opening.

49. **B. Finer mesh screen creates more suction restriction reducing NPSHa below NPSHr** — A finer mesh strainer element captures smaller particles but creates more flow restriction. The additional pressure drop on the suction side directly reduces the Net Positive Suction Head available, potentially dropping it below the pump's requirement.

50. **D. Motor cooling fan and ventilation path obstructed reducing airflow across the windings** — Normal current with rising temperature over 20 minutes indicates the motor generates normal heat but cannot reject it. A blocked cooling fan, obstructed shroud, or debris-filled ventilation passages reduce cooling airflow below the required rate.

51. **A. Tube leak in the water-cooled oil cooler allowing cooling water to enter the oil side** — A sharp increase from 0.02% to 0.8% water content in one month with no visible external source points to an internal leak. The oil cooler is the only component where water and oil are separated by a thin tube wall.

52. **B. HVAC system efficiency degradation from dirty coils, slipping belts, and failed economizers** — A 12% increase in energy consumption with no new equipment suggests existing systems are working harder. Dirty coils, slipping fan belts, failed economizers, and degraded controls all force the HVAC system to consume more energy.

53. **B. Pre-hot-work inspection did not identify combustible material behind the wall panel** — The fire watch was properly maintained for 30 minutes post-welding. The fire started behind a wall panel

15 feet away — within the 35-foot combustible-free zone. The pre-work inspection should have identified and protected this hidden combustible material.

54. **C. Approximately 5 days remaining at 10 hours per day** — Remaining hours = 4,000 preset − 3,950 accumulated = 50 hours. At 10 hours per day, 50 hours ÷ 10 hours/day = 5 operating days until the PM timer reaches its preset value.

55. **A. Install shaft grounding rings or insulated bearings to prevent electrical discharge damage** — Shaft grounding rings provide a low-impedance path for VFD-induced shaft currents to discharge to ground without passing through the bearings. Insulated bearings break the current path entirely. Both prevent the fluting damage pattern.

56. **D. Counterbalance valve for pilot leak or incorrect setting allowing fluid to pass under load pressure** — The closed-center valve and counterbalance valve should prevent cylinder movement. If the counterbalance valve's setting is too low or its pilot circuit leaks, load-induced pressure can crack the valve open allowing slow cylinder extension.

57. **B. Desiccant bed for saturation or channeling, and tower switching valve for malfunction** — The regeneration system appears functional (timer and heater work) but dew point has risen dramatically. The desiccant material may be saturated beyond regeneration capacity, or the tower switching valve may not be properly diverting flow between the drying and regenerating towers.

58. **C. Driven equipment for increased load from changed process conditions or mechanical binding** — Balanced current 15% above nameplate after 8 years of normal operation indicates the load has increased. The motor is working harder to drive the same equipment — worn bearings, tighter clearances, or increased process demand are the likely causes.

59. **A. Triac dimmer not compatible with LED loads — LEDs require a compatible dimmer type** — Standard triac dimmers are designed for incandescent loads with high minimum current requirements. LED drivers draw very little current, falling below the triac's minimum holding current at low dim settings, causing erratic switching and visible flicker.

60. **D. HDPE pipe with heat-fused joints for complete corrosion resistance underground** — HDPE is immune to soil corrosion, requires no coating or cathodic protection, and heat-fused joints create a monolithic leak-free system. It is the standard replacement material for underground compressed air distribution in corrosive soil conditions.