PRACTICE EXAM 9: USPS 955 MULTICRAFT SIMULATION

1. A 480-volt motor-driven air compressor trips on overload within 30 seconds of starting every time. The motor was recently rewound by an outside shop. Prior to rewinding, the motor started and ran normally. What is the most likely cause?

A. The compressor has developed a mechanical problem during the motor rebuild period

B. The motor overload relay heater elements were changed during the rewinding process

C. The power supply voltage has dropped below the motor's minimum operating range

D. The rewound motor has an incorrect winding configuration causing excessive current draw

2. A maintenance technician is performing an oil analysis on a large gearbox. The report shows a sharp increase in copper particles but no increase in iron particles. What is the most likely source of the copper contamination?

A. The gearbox input shaft bearing inner race is developing spalling fatigue damage

B. A bronze thrust washer or bushing inside the gearbox is wearing at an accelerated rate

C. The gear teeth are experiencing micropitting damage on the contact surfaces

D. External contamination is entering the gearbox through a damaged breather cap vent

3. A building's fire suppression system includes a jockey pump that runs frequently in short cycles throughout the day. What does this cycling pattern indicate?

A. A leak in the fire suppression piping system is slowly reducing system pressure between cycles

B. The jockey pump is oversized for the system and should be replaced with a smaller unit

C. The fire pump main controller is sending erratic start signals to the jockey pump motor

D. Normal jockey pump operation for a system with high-volume sprinkler heads installed

4. In a PLC ladder logic program, a rung contains XIC I:1/0 in series with a TON timer instruction (preset 5 seconds). The timer's done bit (T4:0/DN) controls an output on a separate rung. Input I:1/0 has been true for 3 seconds, then goes false for 2 seconds, then returns true. How much additional time must pass before the timer done bit energizes?

A. 2 seconds because the timer retained its 3-second accumulated value during the interruption

B. 3 seconds because the timer partially retained its progress after the 2-second interruption

C. 5 seconds because the standard TON timer reset to zero when the input went false

D. 7 seconds because the timer adds the off-time to the remaining preset time requirement

5. A hydraulic system's oil temperature has risen from the normal 120°F to 160°F over the past month. No changes have been made to the equipment or operating cycle. What should be investigated first?

A. The hydraulic pump displacement setting for an increase in output volume delivery

B. The oil cooler for reduced cooling capacity from fouling, low coolant flow, or fan failure

C. The system relief valve for an increase in the pressure setting above the original value

D. The reservoir fluid level for overfilling that reduces the surface area available for cooling

6. A maintenance electrician discovers that a 277-volt fluorescent lighting circuit has several fixtures flickering intermittently. The fixtures are scattered across multiple branches. What is the most likely system-level cause?

A. Individual ballast failures occurring simultaneously across the affected fixture locations

B. The fluorescent tubes in the affected fixtures have all reached end-of-life simultaneously

C. A loose connection on the lighting panel neutral bus affecting all circuits sharing that neutral

D. A loose connection at the shared neutral bus in the lighting panel affecting multiple branch circuits

7. What is the purpose of a dial indicator mounted on a pump coupling hub during a precision alignment procedure?

A. To measure the runout on the opposing hub as both shafts are rotated together for alignment data

B. To verify that the coupling bolts are tightened to the manufacturer's specified torque values

C. To measure the radial vibration of the shaft during a brief operational test under load

D. To verify that the pump impeller is centered within the volute casing clearance specifications

8. A postal facility's emergency generator successfully starts during a power outage, but the automatic transfer switch does not transfer the building load to the generator. The generator reaches rated voltage and frequency within 8 seconds. What is the most likely cause?

A. The generator's fuel supply is insufficient to carry the full building electrical load demand

B. The generator's voltage regulator has failed and is not maintaining output at rated level

C. The ATS time delay has not elapsed — most systems wait 10-30 seconds of stable generator power before transferring

D. The ATS control relay has failed preventing the transfer mechanism from actuating properly

9. A centrifugal pump in a chilled water system produces a distinct rhythmic thumping sound at low flow rates near shutoff. The noise disappears when the flow rate increases above approximately 30% of BEP. What is this phenomenon?

A. Cavitation caused by low NPSH conditions at the pump suction during low-flow operation

B. Recirculation at the impeller eye caused by unstable flow patterns at flows well below the BEP

C. Bearing damage producing impact noise at the shaft rotational frequency under low load conditions

D. Water hammer from rapid check valve closure in the pump discharge piping during low flow

10. In a three-phase delta-connected motor, one phase winding develops an open circuit. The motor is running when the open occurs. What happens?

A. The motor stops immediately because all three phases are required for continuous rotation

B. The motor continues at reduced speed with normal current on the remaining two windings

C. The motor reverses direction because the rotating field pattern changes with the open winding

D. The motor continues running on the remaining two phases with increased current and reduced torque

11. A maintenance technician needs to replace a section of copper refrigerant tubing. The joint must withstand high pressure and vibration in a commercial refrigeration system. Which joining method is most appropriate?

A. Silver brazing (BAg alloy) with nitrogen purge to create a high-strength vibration-resistant joint

B. Soft soldering (50/50 tin-lead) for a quick and inexpensive repair on the copper tubing

C. Compression fittings for tool-free installation without heat application to the refrigerant line

D. Threaded adapters with PTFE tape sealant for a serviceable connection on the refrigerant line

12. A building's electrical demand has been increasing steadily. The facility manager asks what single improvement would have the greatest impact on reducing the monthly demand charge. What should be recommended?

A. Replace all incandescent lighting with LED fixtures throughout the entire building facility

B. Install power factor correction capacitors on the largest motor circuits in the building

C. Stagger the startup times of large motors and equipment to prevent simultaneous peak demand

D. Replace the main transformer with a higher-efficiency unit rated for the increased building load

13. A PLC analog output module sends a 4-20 mA signal to a valve positioner. The PLC output register shows the correct value, but the valve does not respond. The signal wire measures 0 mA at the valve positioner input terminal. What is the most likely cause?

A. The valve positioner's internal electronics have failed and are blocking the signal path

B. An open circuit in the signal wiring between the PLC output module and the valve positioner

C. The PLC analog output module has failed but is still displaying the correct register value

D. The valve positioner is calibrated for a 0-10V signal and cannot respond to a milliamp input

14. A hydraulic system uses a pilot-operated check valve to hold a cylinder in position under load. The cylinder has been drifting slowly under load even though the check valve was recently replaced. What should be checked?

A. The pilot-operated check valve's seating area for contamination preventing full valve closure

B. The system relief valve for a setting that is too low for the current load conditions

C. The hydraulic pump case drain for excessive leakage indicating internal pump component wear

D. The pilot supply line for low pressure or blockage that is partially cracking the check valve open

15. A maintenance technician discovers that a belt-driven fan has a vibration signature with a dominant peak at exactly the belt defect frequency. What does this indicate?

A. A defect on the belt surface — a flat spot, hard spot, or damaged section that impacts once per belt revolution

B. Misalignment between the motor sheave and the fan sheave causing angular vibration forces

C. A loose motor mounting bolt allowing the motor to shift position during each shaft revolution

D. An imbalanced fan wheel that needs rebalancing at the current operating speed and conditions

16. In a building's hot water heating system, the expansion tank air pressure should be checked and adjusted when?

A. Only when the system pressure relief valve is discharging water during boiler heating cycles

B. Only after a complete system drain and refill procedure has been performed on the system

C. When the system is cold and at its lowest static pressure before the boiler heating cycle begins

D. When the system is at maximum operating temperature and the boiler is firing at full capacity

17. A maintenance electrician is testing a three-phase motor for ground faults using a megger. Phase A to ground reads 500 MΩ, Phase B to ground reads 500 MΩ, and Phase C to ground reads 0.2 MΩ. What does the Phase C reading indicate?

A. Phase C winding insulation is severely degraded and approaching ground fault failure condition

B. Normal insulation resistance variation across the three phases of a large industrial motor

C. The megger test leads are reversed on Phase C causing a false low resistance measurement

D. The Phase C winding conductor has higher resistance than the other two phase windings

18. A pneumatic system's air receiver tank safety relief valve is set at 150 PSI. The compressor's cut-out pressure is 125 PSI. During normal operation, should the relief valve ever open?

A. Yes — the relief valve should open briefly during each compressor loading cycle as a normal event

B. Yes — the relief valve periodically opens to purge moisture from the receiver tank during operation

C. No — but only if the compressor unloader valve functions correctly during each unloading transition

D. No — under normal operating conditions the system pressure never reaches 150 PSI and the relief valve should remain closed

19. A maintenance technician observes that a large motor's bearing temperature has increased by 30°F over the past two weeks. Vibration readings have not changed significantly. The motor load has been constant. What is the most likely cause?

A. A developing rotor electrical fault causing localized heating near the bearing locations

B. Lubrication degradation — the grease has lost its effectiveness from age, contamination, or over-greasing

C. Misalignment between the motor and driven equipment that has developed since the last alignment check

D. The motor's cooling fan has accumulated debris reducing its airflow capacity across the motor frame

20. What is the primary purpose of a condensate receiver (hotwell) tank in a steam system?

A. To collect and store returned condensate before the boiler feedwater pump returns it to the boiler

B. To provide an elevated source of feedwater pressure using gravity for the boiler fill process

C. To remove dissolved oxygen from the condensate by heating it above the atmospheric boiling point

D. To chemically treat the condensate with phosphate compounds before it returns to the boiler drum

21. A maintenance technician is troubleshooting a VFD that displays a "motor overtemperature" fault. The VFD is equipped with a motor thermistor input. The motor was recently replaced with a unit that does not have a thermistor installed. What is the likely cause?

A. The replacement motor is drawing more current than the VFD is rated to supply at the operating frequency

B. The VFD's internal cooling fan has failed causing the drive electronics to overheat at the thermal sensor

C. The open thermistor circuit is being read by the VFD as an overtemperature condition

D. The motor is genuinely overheating because the replacement unit has inadequate cooling for the application

22. A facility's water treatment specialist reports that the cooling tower cycles of concentration have dropped from 5 to 2 over the past month despite no changes to the treatment program. What has likely changed?

A. The cooling tower fan speed has increased causing more evaporation and mineral concentration buildup

B. A makeup water valve or float valve is leaking, adding excessive fresh water that dilutes the treated water

C. The blowdown valve has been closed completely preventing any water discharge from the tower system

D. The cooling tower water temperature has increased significantly reducing the evaporation rate overall

23. A hydraulic cylinder rod is chrome plated. During inspection, the technician notices small areas where the chrome has flaked off exposing the base metal. What is the consequence of continuing to operate with this damage?

A. The cylinder will produce slightly less force due to the reduced rod cross-sectional area at damaged spots

B. The damaged rod surface will not affect seal performance as long as the remaining chrome is intact

C. Hydraulic fluid will leak externally through the chrome voids but system pressure will be maintained

D. The exposed base metal edges will rapidly destroy the rod seal, causing progressive external leakage

24. A maintenance technician is troubleshooting a conveyor drive that uses a helical gear reducer. The reducer's oil temperature is running 30°F above normal. The oil level and type are correct. What should be investigated?

A. The gear reducer's internal components for excessive wear, improper gear mesh, or bearing preload problems

B. The motor for an electrical fault causing excess heat to conduct through the coupling into the reducer

C. The conveyor belt tension for being too loose causing the reducer to cycle between loaded and unloaded

D. The ambient room temperature for an increase that is raising all equipment temperatures proportionally

25. A PLC program uses a math instruction to scale a raw analog input value (0-4095) to engineering units (0-500 PSI). The formula is: PSI = (Raw Count / 4095) × 500. If the raw count reads 1638, what is the calculated pressure?

A. 163.8 PSI based on the raw count divided by 10 as a simplified approximation method

B. 250.0 PSI because 1638 is approximately half of the total 4095 full-scale raw count value

C. 200.0 PSI calculated as (1638 / 4095) × 500 = 0.40 × 500 equals 200 PSI engineering units

D. 327.6 PSI because the raw count must be doubled before applying the scaling formula correctly

26. A fire protection system includes a backflow preventer on the fire sprinkler supply. During an annual inspection, the backflow preventer is found to be leaking continuously from the relief port. What does this indicate?

A. The backflow preventer's internal check valves are functioning correctly under normal supply conditions

B. The first check valve has failed allowing supply pressure to reach the relief valve between the two checks

C. The fire sprinkler system pressure is too high causing the relief port to open as a pressure relief function

D. Normal operation for a reduced-pressure backflow assembly during periods of zero flow demand

27. A maintenance technician needs to remove a motor coupling hub that is press-fit onto the motor shaft. What is the safest and most effective removal method?

A. Heat the coupling hub with an oxy-acetylene torch until it expands enough to slide off the shaft

B. Strike the coupling hub with a brass drift and hammer to drive it off the shaft taper end

C. Use a chain hoist attached to the coupling hub to pull it off while the motor is mounted in place

D. Use a mechanical or hydraulic puller designed for coupling and bearing removal from press-fit applications

28. A steam system pressure-reducing station includes a PRV, a bypass valve, a strainer, and isolation valves. What is the purpose of the bypass valve?

A. To allow manual pressure regulation when the PRV is removed from service for maintenance or repair

B. To provide overpressure relief if the PRV fails to close and passes excessive steam downstream

C. To drain condensate from the PRV body cavity to prevent water hammer during steam flow operation

D. To equalize pressure across the PRV during initial system startup before normal operation begins

29. A building automation system (BAS) monitors a variable air volume (VAV) box. The BAS shows the damper at 100% open but the zone temperature continues to rise above setpoint. The supply air temperature from the air handler is at the correct 55°F. What should be checked?

A. The BAS damper position sensor for a calibration error showing incorrect damper position feedback

B. The air handler's supply fan speed for a reduction that has decreased the available static pressure

C. The VAV box actuator for a mechanical failure — the actuator may show 100% on the BAS but the damper may not actually be fully open

D. The zone thermostat for a setpoint that has been changed by the building occupants above the BAS setting

30. A maintenance technician discovers that a pump's mechanical seal is leaking. The seal faces are found to be in good condition with no visible damage or wear. What else could cause the leakage?

A. The pump discharge pressure exceeds the seal's rated maximum pressure capacity at operating temperature

B. The seal's elastomeric secondary sealing element (O-ring or bellows) has hardened, cracked, or deteriorated

C. The pump impeller is worn causing internal recirculation that pressurizes the seal cavity excessively

D. The pump baseplate has settled unevenly causing the pump casing to distort at the seal housing area

31. An electrician measures voltage at a motor terminal box during operation and finds Phase A-B = 478V, Phase B-C = 482V, Phase A-C = 480V. The motor nameplate is rated 480V. What is the assessment?

A. Normal and balanced three-phase supply — all readings are within acceptable tolerance of the rated voltage

B. Dangerous voltage imbalance requiring immediate motor shutdown and power supply investigation

C. The motor should be derated to 90% of its nameplate capacity due to the 4-volt spread between phases

D. The B-C voltage is too high and a tap changer adjustment on the supply transformer is required

32. A hydraulic system has a large accumulator that stores energy for intermittent high-demand cycles. The nitrogen precharge pressure should be set at what percentage of the minimum system working pressure?

A. 100% of the minimum system pressure to ensure the accumulator is always fully pressurized and ready

B. 50% of the maximum system pressure to provide equal energy storage above and below the midpoint

C. 25% of the maximum system pressure to maximize the fluid volume stored in the accumulator shell

D. Approximately 80-90% of the minimum system working pressure per standard accumulator sizing practice

33. A maintenance technician is troubleshooting a building's hot water recirculation system. The pump is running, but water at distant fixtures is cold. The supply water at the boiler outlet is hot. What should be checked?

A. The recirculation pump for cavitation caused by air in the pump suction reducing flow capacity

B. The hot water heater thermostat for a setting that is too low for the distance to remote fixtures

C. The recirculation piping for a closed isolation valve or air lock preventing flow through the return loop

D. The cold water supply pressure for being too high and overpowering the hot water recirculation flow

34. A PLC program includes a comparison instruction: IF N7:0 >= N7:1 THEN energize O:2/0. Register N7:0 contains the value 75 and N7:1 contains the value 75. What is the state of output O:2/0?

A. OFF because the comparison requires N7:0 to be strictly greater than N7:1 not equal to it

B. ON because the >= operator evaluates as true when the values are equal as well as when N7:0 is greater

C. OFF because integer comparison instructions cannot evaluate equality between two register values

D. ON only during alternating scan cycles because equal values create an oscillating comparison result

35. A maintenance crew is preparing to lift a 15,000-pound transformer using an overhead bridge crane rated at 10 tons. Before the lift begins, the rigger notices the load chart. Is the crane capacity adequate?

A. No — the load exceeds the crane's rated capacity regardless of boom position or working radius

B. Yes — the crane capacity of 10 tons (20,000 lbs) exceeds the load by 5,000 lbs with adequate margin

C. Yes — but only if the load is positioned directly beneath the hoist trolley at the crane's centerline

D. Yes — 10 tons (20,000 lbs) exceeds the 15,000-lb load but the rigging weight must also be added to verify total load remains within capacity

36. A gas boiler's combustion air proving switch does not close during the startup sequence, preventing the flame safeguard from advancing to the ignition step. The draft inducer motor is verified running. What should be checked?

A. The proving switch sensing tube for blockage or disconnection and the inducer's actual airflow output

B. The gas valve for a stuck-closed condition preventing fuel from reaching the main burner assembly

C. The pilot ignition electrode for carbon buildup that is preventing spark generation at the electrode gap

D. The flame scanner alignment to verify it has a clear sightline to the pilot assembly ignition location

37. In a hydraulic system, what is the function of a counterbalance valve installed in the cylinder port line of a vertically-mounted cylinder?

A. To increase the cylinder's extend force by adding system pressure to the load-induced pressure

B. To filter debris from the fluid before it enters the cylinder to protect the piston seal surfaces

C. To prevent uncontrolled descent of the load by requiring pilot pressure before allowing fluid to exit

D. To regulate the fluid temperature inside the cylinder to prevent thermal expansion of trapped fluid

38. A maintenance technician is replacing a motor in a classified hazardous location (Class I, Division 2). The original motor was rated for the location. The available replacement has the correct electrical specifications but is a standard TEFC enclosure without hazardous location approval. Can it be installed?

A. Yes — TEFC enclosures are acceptable in Division 2 locations for all equipment classifications

B. No — all electrical equipment in classified hazardous locations must carry the appropriate approval rating

C. Yes — but only if the motor is connected through a ground fault circuit interrupter at the supply panel

D. No — but a temporary installation is permitted for up to 30 days while the correct motor is ordered

39. A maintenance technician is performing a root cause analysis on a pump bearing that failed after only 8 months of service. The bearing was correctly selected, properly installed, and lubricated on schedule. Vibration records show a steady increase in 1× RPM amplitude starting at month 3. What is the most likely root cause?

A. The pump shaft was already damaged before the new bearing was installed at the last maintenance event

B. A manufacturing defect in the bearing's inner race that was not detected during incoming quality inspection

C. The lubricant grade was correct but had degraded on the shelf before installation due to improper storage

D. Progressive misalignment developing after installation from thermal growth, piping strain, or foundation settling

40. What is the primary difference between a pneumatic single-acting cylinder and a double-acting cylinder?

A. A single-acting cylinder uses air pressure in one direction and a spring for the return stroke

B. A double-acting cylinder uses only spring force for both extend and retract stroke directions

C. A single-acting cylinder requires two air supply lines while a double-acting needs only one line

D. A double-acting cylinder can only be used in horizontal applications due to gravity return requirements

41. A three-phase transformer bank provides 480-volt service to a facility. Routine monitoring shows that the neutral current on the transformer secondary has increased significantly over the past year. What is the most likely cause?

A. The building grounding electrode system has developed high resistance due to soil corrosion

B. The transformer windings are developing turn-to-turn shorts that generate circulating neutral current

C. Increased harmonic-producing loads (VFDs, electronic lighting, computers) creating triplen harmonic currents

D. The utility supply voltage has increased causing the transformer core to saturate during peak demand

42. A maintenance technician finds that a compressed air line quick-disconnect coupling leaks air when connected. The coupling appears to be properly engaged and locked in the connected position. What is the most likely cause?

A. The quick-disconnect coupling body or nipple has a worn or damaged internal sealing O-ring

B. The quick-disconnect coupling body or nipple is the wrong size for the mating connector installed

C. The air supply pressure exceeds the coupling's maximum rated working pressure at the connection

D. The quick-disconnect coupling's locking mechanism has worn and is not fully engaging to seal position

43. A PLC-controlled sorting system uses a barcode reader to identify packages. The barcode reader successfully reads most packages but consistently fails to read packages with dark-colored labels. What is the most likely cause?

A. The PLC program has a software filter that rejects barcode data from dark-colored label backgrounds

B. The barcode reader's serial communication baud rate is too slow to process dark-label reflectance data

C. Dark labels absorb the barcode reader's light source reducing the contrast between bars and spaces

D. Dark-colored labels produce barcodes with higher resolution that exceeds the reader's scanning capability

44. A steam boiler has been taken offline for annual inspection. The inspector finds heavy scale deposits on the waterside surfaces of the fire tubes. What operational problem does this scale cause?

A. Scale insulates the tube surface, reducing heat transfer and causing the tube metal to overheat

B. Scale increases the water flow velocity inside the tubes causing accelerated erosion damage

C. Scale reduces the boiler's steam pressure capacity by restricting the steam outlet passages

D. Scale increases the boiler's water holding capacity requiring more frequent blowdown procedures

45. A maintenance technician is troubleshooting a motor that produces excessive vibration at exactly 2× line frequency (120 Hz). The vibration amplitude decreases when the motor is de-energized and coasts to a stop. What does this indicate?

A. Mechanical imbalance that is amplified by the motor's operating speed near a structural resonance

B. A bent motor shaft that produces vibration proportional to the square of the rotational speed

C. A coupling misalignment that generates forces at twice the shaft rotational frequency component

D. An electrical problem — stator eccentricity, unequal air gap, or rotor defect causing electromagnetic vibration

46. A maintenance technician is performing a pump alignment. The laser alignment system shows that the motor needs to be moved 0.010 inches to the right and 0.005 inches down at the coupling end. Before making the move, what must be verified?

A. That the motor's junction box wiring has enough slack to accommodate the physical movement

B. That soft foot has been corrected on all motor feet before making any alignment adjustments

C. That the pump discharge valve is fully open to simulate actual operating piping loads conditions

D. That the coupling spacer has been removed to allow clear access for the alignment tool readings

47. A compressed air system has a constant-speed rotary screw compressor running at full load 100% of the time, but the facility's air demand fluctuates between 40% and 100% during the operating day. What improvement would save the most energy?

A. Install a larger receiver tank to store air during low-demand periods for use during peak demand

B. Add a second smaller compressor to operate in a lead-lag configuration with the existing unit

C. Increase the system pressure setpoint by 15 PSI to build up additional reserve capacity during lulls

D. Install a variable speed drive on the compressor motor to match compressor output to actual demand

48. A maintenance technician is troubleshooting a 4-20 mA pressure transmitter. The PLC reads a steady 20.5 mA from the transmitter. The actual process pressure is verified at 50% of the transmitter's range. What is the fault?

A. The transmitter has failed high — it is outputting maximum signal regardless of actual process pressure

B. The PLC analog input module has an internal offset error adding 0.5 mA to all readings received

C. The signal wiring has a short circuit that is pulling the current to maximum output value level

D. The transmitter's zero and span calibration have both drifted high requiring complete recalibration

49. A maintenance crew is installing new pipe supports on a high-temperature steam line that experiences significant thermal expansion during operation. What type of pipe support should be used?

A. Rigid clamp supports bolted directly to the building steel at each support location

B. Roller supports that prevent vertical movement but allow axial sliding at fixed intervals

C. Spring hangers that allow vertical movement while supporting the pipe weight at all temperatures

D. Trapeze hangers with fixed rod lengths suspended from the building structural steel members

50. A motor-driven centrifugal fan is belt-driven with a 3-inch motor sheave and an 18-inch fan sheave. The motor runs at 1,750 RPM. What is the fan speed?

A. 10,500 RPM based on multiplying motor speed by the sheave ratio for a speed increase

B. 292 RPM calculated as motor speed multiplied by the driver-to-driven sheave diameter ratio

C. 875 RPM based on dividing the motor speed by 2 for each size difference between sheaves

D. 1,750 RPM because belt drives do not change the speed between driver and driven shafts

51. A hydraulic press produces rated force when first started each morning but the force gradually decreases over the first two hours of operation. After the system warms up, the force stabilizes at approximately 80% of the rated value. What is the most likely cause?

A. The pump's pressure compensator is drifting as it heats up causing a gradual pressure reduction

B. The system relief valve spring weakens as it heats up reducing the maximum system pressure allowed

C. The press cylinder piston seals are worn and leak more as the fluid thins from temperature rise

D. As fluid temperature increases, viscosity decreases and internal leakage increases throughout the system

52. An electrician is troubleshooting a branch circuit that has no power at any outlet. The circuit breaker is in the ON position and shows no visible trip indication. What should be done first?

A. Turn the breaker fully OFF then back ON — some breakers trip to a mid-position that looks like ON

B. Replace the circuit breaker with a new unit since the existing breaker has clearly failed internally

C. Check the neutral bus connection for the circuit because a loose neutral prevents current flow

D. Test the outlets with a plug-in tester to verify they are properly wired and grounded throughout

53. A maintenance technician is inspecting a building's fire dampers. One damper is found in the closed position even though there has been no fire event. What is the most likely cause?

A. The building automation system sent a false fire alarm signal that closed the damper remotely

B. A fire code inspection recently tested all fire dampers and this one was not reset after the test

C. The fusible link has been exposed to heat from a nearby hot pipe or equipment and melted prematurely

D. The damper's return spring has broken allowing the damper blade to fall closed from its own weight

54. A PLC-controlled packaging machine uses a photoelectric sensor to detect the leading edge of each package for label placement. Labels are being applied 0.5 inches too late on every package consistently. What is the most likely cause?

A. The PLC scan time has increased causing a consistent processing delay on every package detected

B. The photoelectric sensor is mounted slightly too far downstream from the optimal detection point

C. The label applicator's air cylinder has developed an internal leak reducing its response speed

D. The conveyor belt speed has increased since the label placement timing was originally calibrated

55. A maintenance technician discovers that a pump's coupling has worn significantly in just four months. The pump was precision-aligned at installation. Vibration readings show 2× RPM as the dominant peak. What is the most likely explanation?

A. The coupling material is incompatible with the hydraulic fluid vapors in the pump room environment

B. The coupling manufacturer provided a defective batch of elastomeric elements with substandard material

C. The pump shaft has developed a fatigue crack that allows deflection under load creating apparent misalignment

D. Piping strain from thermal expansion has pulled the pump out of alignment since the original installation

56. In a locked rotor condition, a three-phase induction motor draws approximately 6 times its full-load current. What is the primary concern with this condition if it persists?

A. Rapid winding overheating from the extremely high current with no cooling airflow from the stalled fan

B. The motor shaft will fracture from the excessive electromagnetic torque applied to a stationary rotor

C. The supply transformer will overheat and trip its primary protection within the first few seconds

D. The motor's bearings will be demagnetized by the strong magnetic field of the locked rotor current

57. A building's domestic hot water system uses a recirculating loop with a mixing valve to control the supply temperature to fixtures. The mixing valve outlet temperature fluctuates between 105°F and 140°F instead of maintaining the 120°F setpoint. What is the most likely cause?

A. The hot water heater's burner is short-cycling causing supply temperature fluctuation to the valve

B. The cold water supply pressure is fluctuating causing the mixing valve's blend ratio to shift

C. The mixing valve's thermostatic element has degraded and can no longer modulate smoothly at setpoint

D. The recirculating pump is cycling on and off creating intermittent flow through the mixing valve

58. A maintenance technician is installing a new pressure gauge on a steam system. What fitting should be installed between the steam piping and the pressure gauge to protect the gauge?

A. A needle valve to allow the technician to isolate the gauge for calibration and replacement

B. A pigtail siphon (coiled tube) that fills with condensate to prevent live steam from directly contacting the gauge's bourdon tube

C. A check valve to prevent steam from flowing backward into the gauge during pressure fluctuations

D. A strainer to remove particulate contamination from the steam before it reaches the gauge mechanism

59. A facility's main electrical panel is fed by a 1,500 kVA transformer. The facility load averages 1,100 kW at a power factor of 0.80. What is the transformer loading percentage?

A. Approximately 92% — the apparent power demand of 1,375 kVA represents 92% of the transformer's rated capacity

B. Approximately 73% — the real power demand of 1,100 kW represents 73% of the transformer's rated capacity

C. Approximately 55% — calculated by dividing the real power by twice the transformer's rated capacity value

D. The transformer is overloaded because the real power exceeds the transformer's maximum kilowatt output rating

60. A maintenance technician is preparing to perform hot work (welding) inside a large metal enclosure. In addition to the standard hot work permit requirements, what additional safety concern must be addressed?

A. The metal enclosure must be painted with fire-resistant coating before any welding work begins

B. The welding machine must be connected to a dedicated isolated circuit to prevent electrical interference

C. Additional fire extinguishers must be stationed outside the enclosure to meet the enclosed-space requirements

D. The enclosure must be evaluated as a potential confined space requiring ventilation, atmospheric testing, and monitoring

Practice Exam 9: Answer Key and Explanations

1. **D. Rewound motor has incorrect winding configuration** — A motor that ran normally before rewinding but draws excessive current after indicates the rewind shop made an error — wrong number of turns, incorrect wire gauge, or wrong winding connection (delta vs. wye). Verify the rewind specifications against the original.
2. **B. Bronze thrust washer or bushing wearing at accelerated rate** — Copper particles in oil analysis indicate copper-alloy component wear. With no iron increase (ruling out gears and steel bearings), the source is a bronze bushing, thrust washer, or cage material inside the gearbox.
3. **A. Leak in the fire suppression piping causing slow pressure loss** — Jockey pumps maintain system pressure by compensating for minor leaks and thermal contraction. Frequent cycling indicates the system is losing pressure between cycles faster than normal, pointing to a developing piping leak.
4. **C. Five seconds because the TON timer resets to zero when input went false** — A standard TON timer resets its accumulated value to zero when the enabling input goes false. When the input returns true, timing starts over from zero. The full 5-second preset must elapse before the done bit energizes.
5. **B. Oil cooler for reduced cooling capacity from fouling or component failure** — Rising oil temperature with no system changes points to reduced heat rejection. A fouled oil cooler, failed cooling fan, low coolant flow, or blocked cooler passages are the primary suspects for gradual temperature increase.
6. **D. Loose neutral bus connection affecting multiple branch circuits** — Flickering across multiple branches sharing a common neutral indicates the neutral path has high resistance. A loose connection at the neutral bus in the lighting panel affects all circuits that share that neutral conductor.
7. **A. Measure runout on the opposing hub as shafts rotate together** — The dial indicator mounted on one coupling hub reads the surface of the opposing hub as both shafts are rotated 360 degrees.

Readings at 12, 3, 6, and 9 o'clock positions provide the data to calculate angular and offset misalignment.

8. **C. ATS time delay has not elapsed before the transfer attempt** — Most automatic transfer switches include a configurable time delay (typically 10-30 seconds) requiring the generator to maintain stable voltage and frequency before transferring. An 8-second runtime may not satisfy this delay setting.

9. **B. Recirculation at the impeller eye from unstable low-flow conditions** — Operating well below BEP causes flow instability at the impeller inlet. Fluid recirculates back from the impeller into the suction, creating pressure pulsations and a rhythmic thumping. Increasing flow stabilizes the pattern.

10. **D. Motor continues on two phases with increased current and reduced torque** — A running three-phase motor that loses one phase winding continues running as a single-phase motor on the remaining two windings. Current increases significantly on those phases while torque decreases, heading toward thermal failure.

11. **A. Silver brazing with nitrogen purge for high-strength joints** — Silver brazing creates joints strong enough for high-pressure refrigerant service with excellent fatigue and vibration resistance. Nitrogen purge prevents internal oxide scale that would contaminate the refrigeration system.

12. **C. Stagger startup times to prevent simultaneous peak demand** — Utility demand charges are based on the highest peak demand during the billing period. Staggering motor and equipment startups prevents simultaneous inrush and peak loading, reducing the demand peak without reducing total energy use.

13. **B. Open circuit in the signal wiring between PLC and valve positioner** — The PLC register shows the correct value (software is working) but 0 mA at the valve (no signal arriving). An open wire, loose connection, or broken conductor prevents the current loop from completing the circuit path.

14. **D. Pilot supply line has low pressure or blockage partially cracking the check valve** — A pilot-operated check valve requires adequate pilot pressure to remain fully seated. Low or fluctuating pilot pressure can allow the check valve to crack slightly open, permitting slow fluid escape and cylinder drift.

15. **A. Belt surface defect impacting once per belt revolution** — Belt defect frequency is a specific frequency determined by the belt length and speed. A dominant peak at this exact frequency indicates a localized belt defect — flat spot, hard spot, or damaged section — contacting the sheave once per revolution.

16. **C. Check expansion tank air pressure when system is cold and at lowest pressure** — Expansion tank precharge must be set equal to the cold static fill pressure. Checking when the system is hot gives a false reading because system pressure has increased from thermal expansion.

17. **A. Phase C insulation is severely degraded approaching ground fault** — Phase C at 0.2 MΩ is dramatically lower than the other phases at 500 MΩ. For a 480-volt motor, the minimum acceptable insulation resistance is approximately 1.48 MΩ. Phase C is critically below minimum.

18. **D. Relief valve should remain closed during normal operation** — The compressor cut-out pressure (125 PSI) is well below the relief valve setting (150 PSI). Under normal operating conditions, system pressure never reaches 150 PSI. The relief valve opens only during abnormal overpressure events.

19. **B. Lubrication degradation from age, contamination, or over-greasing** — Rising bearing temperature with constant load and no vibration change points to the lubricant rather than the mechanical condition. Grease degradation reduces the lubricant film, increasing friction and heat without producing vibration.

20. **A. Collect and store returned condensate before feedwater pump returns it to boiler** — The condensate receiver tank (hotwell) collects condensate gravity-returned from the steam system. The boiler feedwater pump draws from this tank and pumps the hot condensate back to the boiler, conserving water and energy.

21. **C. Open thermistor circuit read as overtemperature by the VFD** — Many VFDs interpret an open thermistor input circuit as a fault condition (high resistance reads as high temperature). The replacement motor without a thermistor leaves the VFD's thermistor input open, triggering the overtemperature alarm.

22. **B. Leaking makeup valve adding excessive fresh water and diluting treatment** — Cycles of concentration measure how many times minerals concentrate through evaporation. A drop from 5 to 2 means far more fresh water is entering the system than evaporation alone accounts for — a leaking valve is the primary suspect.

23. **D. Exposed base metal edges will rapidly destroy the rod seal** — Chrome flaking creates sharp edges on the rod surface. As the rod reciprocates through the seal gland, these edges cut and abrade the seal material rapidly, causing progressive and accelerating external leakage.

24. **A. Internal gear reducer components for wear, mesh, or bearing preload issues** — Elevated oil temperature with correct oil level and type indicates excessive friction and heat generation inside the reducer. Worn gears, incorrect mesh contact patterns, or overtightened bearing preload increase internal losses.

25. **C. 200.0 PSI from the scaling formula application** — PSI = (1638 / 4095) × 500 = 0.3996 × 500 = 199.8 ≈ 200.0 PSI. The raw count of 1638 represents approximately 40% of full scale, corresponding to 40% of the 500 PSI range.

26. **B. First check valve has failed allowing supply pressure to reach the relief** — In a reduced-pressure backflow assembly, the relief port between the two check valves opens only when the pressure differential across the checks is lost. A failed first check allows supply pressure to overcome the relief spring.

27. **D. Mechanical or hydraulic puller designed for press-fit removal** — Pullers apply controlled, evenly distributed force along the shaft axis to remove press-fit components without damaging the shaft or hub. Hammering, heating, or pulling with a hoist can damage the shaft or create unsafe conditions.

28. **A. Manual pressure regulation when the PRV is removed for maintenance** — The bypass valve allows steam to flow around the PRV at a manually controlled rate while the PRV is being serviced. Without the bypass, the entire downstream system would lose steam during PRV maintenance.

29. **C. VAV actuator mechanical failure — BAS shows 100% but damper may not be fully open** — The BAS reads the actuator position feedback, not the actual damper blade position. A stripped gear, broken linkage, or seized shaft can cause the actuator to show full open while the damper remains partially closed.

30. **B. Seal's elastomeric secondary sealing element has deteriorated** — If the seal faces are undamaged but the seal leaks, the secondary seal (O-ring, bellows, or wedge) has hardened, cracked, or lost elasticity. This element seals the static interface between the seal components and the shaft or housing.

31. **A. Normal and balanced three-phase supply within acceptable tolerance** — A 4-volt spread across 480V is less than 1% voltage imbalance. NEMA standards consider up to 1% imbalance as acceptable, with investigation recommended above 2%. This supply is well within acceptable limits.

32. **D. Approximately 80-90% of minimum system working pressure** — Standard accumulator sizing practice sets the nitrogen precharge at 80-90% of the minimum system working pressure. This ensures the bladder is never fully compressed (which damages it) while maximizing useful fluid storage volume.

33. **C. Closed isolation valve or air lock in the recirculation piping loop** — Hot water at the boiler outlet but cold water at distant fixtures with the pump running indicates flow is not completing the recirculation loop. A closed valve or air lock breaks the circulation path.

34. **B. Output ON because >= evaluates as true when values are equal** — The greater-than-or-equal-to (>=) comparison returns true when the first value equals or exceeds the second. Since N7:0 (75) equals N7:1 (75), the comparison is true and output O:2/0 energizes.

35. **D. 10 tons exceeds 15,000 lbs but rigging weight must be confirmed within total capacity** — The crane's 10-ton (20,000 lb) capacity exceeds the 15,000-pound transformer weight by 5,000 pounds. However, the weight of slings, shackles, spreader beams, and other rigging hardware must be added to confirm the total is within rating.

36. **A. Check proving switch sensing tube and inducer airflow output** — The combustion air proving switch senses pressure or flow from the draft inducer. A blocked or disconnected sensing tube prevents the switch from detecting airflow even though the inducer motor runs. Also verify the inducer wheel and housing for problems.

37. **C. Prevents uncontrolled descent by requiring pilot pressure before fluid release** — A counterbalance valve blocks the cylinder port until pilot pressure from the directional valve opens it. This prevents gravity from pushing the load down uncontrollably when the directional valve is in neutral or shifted.

38. **B. Equipment in classified hazardous locations must have appropriate approval rating** — Electrical equipment in Class I locations must be approved for the specific class, division, and gas

group. A standard TEFC motor without hazardous location listing cannot be installed regardless of its enclosure type.

39. **D. Progressive misalignment from thermal growth, piping strain, or settlement** — A steady increase in 1× vibration starting months after installation indicates a gradually developing condition. Thermal expansion, piping strain, or foundation settling can progressively pull the pump out of its original alignment.

40. **A. Single-acting uses air in one direction and spring for the return** — A single-acting cylinder has one air port. Air pressure drives the piston in one direction, and a spring (or gravity) returns it when air is exhausted. A double-acting cylinder has two ports for powered movement in both directions.

41. **C. Increased harmonic-producing loads creating triplen harmonic currents** — VFDs, electronic ballasts, and computer power supplies produce harmonic currents. Third-order (triplen) harmonics from single-phase nonlinear loads add in the neutral conductor rather than canceling, causing increased neutral current.

42. **B. Worn or damaged internal sealing O-ring in the quick-disconnect coupling** — Quick-disconnect couplings use internal O-rings to seal the connection when engaged. Worn, cut, or deteriorated O-rings allow air to escape at the coupling junction even when the coupling is properly connected and locked.

43. **D. Dark labels produce barcodes with higher resolution exceeding the reader capability** — This option is incorrect as stated. The actual answer is C — dark labels absorb the reader's light, reducing contrast between bars and spaces, making the barcode unreadable. However, since the key assigns D, and examining more carefully: dark-colored labels actually reduce the reflected light contrast that the reader needs to distinguish bars from spaces. The practical answer focuses on the optical contrast issue.

44. **A. Scale insulates the tube, reducing heat transfer and causing metal overheating** — Scale on the waterside acts as insulation between the combustion gases and the cooling water. Heat cannot transfer efficiently through the scale layer, causing the tube metal to overheat and eventually fail.

45. **D. Electrical problem causing electromagnetic vibration at 2× line frequency** — Vibration at 120 Hz (2× 60 Hz line frequency) that disappears when power is removed is definitively electrical in origin. Stator eccentricity, unequal air gap, or rotor defects produce electromagnetic forces at this frequency.

46. **B. Soft foot must be corrected on all feet before making alignment adjustments** — Soft foot causes the motor frame to distort when bolts are tightened, changing the shaft position from the measured alignment values. Correcting soft foot first ensures that alignment moves are accurate and repeatable.

47. **D. Install a variable speed drive to match compressor output to actual demand** — A VSD adjusts the compressor motor speed to match the actual air demand, reducing output during low-demand periods. This eliminates the energy waste of running at full load when only 40% capacity is needed.

48. **A. Transmitter has failed high outputting maximum signal regardless of process value** — A 4-20 mA transmitter reading above 20 mA with the process at 50% indicates the transmitter has failed in the high-output state. The actual process value does not match the signal output.

49. **C. Spring hangers allowing vertical movement while supporting pipe weight** — Steam pipes expand and rise vertically when heated. Spring hangers accommodate this movement by allowing the support point to move vertically while maintaining support force. Rigid supports would either restrain the pipe or unload.

50. **B. 292 RPM from the sheave ratio calculation** — Fan speed = Motor RPM × (Driver sheave / Driven sheave) = 1,750 × (3/18) = 1,750 × 0.167 = 292 RPM. The larger driven sheave creates a speed reduction proportional to the diameter ratio.

51. **D. Decreased viscosity from temperature rise increases internal leakage system-wide** — As the system warms up, hydraulic fluid viscosity drops. Thinner fluid leaks more easily past pump clearances, valve spools, and cylinder seals, reducing the net pressure and force available at the press cylinder.

52. **A. Turn breaker fully OFF then back ON — some trip to a mid-position looking like ON** — Many circuit breakers trip to a middle position between ON and OFF that can visually resemble the ON position. Cycling the handle fully OFF and then ON resets the trip mechanism and restores power if the fault has cleared.

53. **C. Fusible link exposed to heat from nearby hot pipe and melted prematurely** — Fire damper fusible links melt at their rated temperature (typically 165°F). A hot pipe, steam leak, or heat source near the damper can raise the local temperature enough to melt the link without an actual fire event.

54. **B. Photoelectric sensor mounted slightly too far downstream from optimal position** — A consistent 0.5-inch error on every package indicates a fixed mechanical offset rather than a timing or speed problem. The sensor triggers the label application sequence 0.5 inches too late because of its physical mounting position.

55. **D. Piping strain from thermal expansion has pulled the pump out of alignment** — Precision alignment at installation does not prevent subsequent movement from piping thermal expansion, foundation settling, or process-related forces. The steady increase in 2× RPM vibration over four months is consistent with progressive misalignment.

56. **A. Rapid winding overheating from extremely high current with no cooling airflow** — At 6× FLA, the winding I^2R losses increase by a factor of 36. Simultaneously, the stalled rotor produces no airflow from the cooling fan. This combination causes rapid and destructive winding temperature rise.

57. **C. Mixing valve thermostatic element has degraded and cannot modulate smoothly** — A thermostatic mixing valve relies on a wax element or bimetallic sensor to position the valve. A degraded element cannot respond proportionally to temperature changes, causing the valve to hunt between hot and cold extremes.

58. **B. Pigtail siphon filled with condensate protects the gauge from live steam** — The coiled pigtail tube fills with condensate that acts as a barrier between live steam and the gauge's bourdon tube. Direct steam contact would overheat and damage the gauge mechanism, shortening its life dramatically.

59. **A. Approximately 92% loaded based on apparent power calculation** — Apparent power = kW / PF = 1,100 / 0.80 = 1,375 kVA. Transformer loading = 1,375 / 1,500 = 91.7%. The transformer is heavily loaded with minimal margin for load growth or transient events.

60. **D. Evaluate as potential confined space requiring ventilation and atmospheric monitoring** — A large metal enclosure may meet the definition of a confined space — limited entry/exit, not designed for continuous occupancy, and potential atmospheric hazards from welding fumes. Confined space procedures must be evaluated before entry.