

PRACTICE EXAM 8: RED SEAL 310T

SIMULATION (135 QUESTIONS)

1. A technician is replacing a leaf spring on a heavy-duty truck. The spring has been unbolted from its mounts, but it is still under load from the vehicle's weight resting on the axle. Before removing the spring completely, what must the technician ensure?

- A. The replacement spring is the correct part number and is standing by for immediate installation
- B. The brake hoses and ABS sensor wiring on the affected axle have been disconnected to provide clearance
- C. The axle is properly supported by jack stands or a floor jack independent of the spring — removing a loaded spring without supporting the axle allows the axle to drop uncontrolled, potentially crushing the technician or damaging brake lines, ABS wiring, and suspension components
- D. The other springs on the vehicle are inspected before the removal to determine whether they should also be replaced

2. A shop is performing a diesel particulate filter cleaning using a pneumatic cleaning machine. The technician is blowing compressed air through the DPF channels in reverse to dislodge accumulated ash. What respiratory hazard is present during this operation?

- A. The ash expelled from the DPF contains fine particulate matter including metallic oxides from engine oil additives and potentially carcinogenic compounds — the technician must wear a respirator rated for fine particulates and the operation must be performed in a well-ventilated area or with local exhaust ventilation to capture the expelled ash
- B. The DPF substrate material releases silica fibers when disturbed that are identical to the hazard posed by asbestos removal
- C. The compressed air used for cleaning contains oil vapor from the shop compressor that combines with the DPF ash to create a toxic compound
- D. The cleaning process releases stored nitrogen dioxide gas that was trapped in the DPF channels during the last regeneration cycle

3. A technician is working underneath a cab-over-engine bus that is raised on a two-post surface lift. The technician notices that the lift pads are positioned on the bus's body mounting points rather than the manufacturer's recommended lift points on the frame. What is the concern?

- A. The body mounting points are cosmetically sensitive and the lift pads will damage the paint finish
- B. The body mounting points are structurally weaker than the frame and may not support the vehicle's weight securely
- C. The lift pads positioned on the body mounts may apply force that distorts the body panels and misaligns the doors
- D. The vehicle may not be securely supported — lifting at non-designated points risks the vehicle shifting, slipping off the lift pads, or the mounting points collapsing under the concentrated load; the manufacturer's recommended lift points are engineered to support the vehicle's weight safely

4. A shop uses a parts washing tank that circulates a petroleum-based solvent. What fire prevention measure is required for this equipment?

- A. The parts washer must be located at least 10 metres from any electrical outlet to prevent spark ignition
- B. The parts washer must have a fusible link on the lid that automatically closes the lid if a fire occurs in the tank — the fusible link melts at a specific temperature, releasing the lid to drop closed and smother the fire by cutting off the oxygen supply
- C. The parts washer must be connected to the shop's fire suppression sprinkler system through a dedicated nozzle
- D. The parts washer's solvent must be replaced weekly to prevent the buildup of flammable vapors above the liquid surface

5. A technician sustains a chemical burn on their forearm from contact with a strong alkaline degreaser. The burn area is approximately 10 cm × 5 cm. What is the correct first-aid response?

A. Flush the affected area with large quantities of clean, lukewarm water for a minimum of 20 minutes to dilute and remove the chemical, then seek medical attention — do not attempt to neutralize the alkali with an acid, as the neutralization reaction can generate additional heat and worsen the burn

B. Apply an alkaline-neutralizing cream from the first-aid kit to the burn area and cover with a sterile bandage

C. Wipe the chemical from the skin with a dry cloth and apply petroleum jelly to protect the damaged tissue

D. Immerse the forearm in the eyewash station's basin for 5 minutes, then wrap the area with gauze from the first-aid kit

6. A technician is disconnecting a high-pressure hydraulic line on a truck-mounted crane. The system has been shut down and the engine is off. Before loosening the fitting, what must the technician do?

A. Wear leather gloves to protect against the residual oil that will drip from the disconnected fitting

B. Place a container under the fitting to catch the oil that will drain from the line when it is disconnected

C. Wrap a shop rag around the fitting to absorb any oil spray that occurs when the fitting is loosened

D. Cycle the crane's control levers with the engine off to relieve any trapped hydraulic pressure in the lines and verify that the system is at zero pressure using the gauge or by cracking the fitting very slowly — hydraulic systems can retain dangerous residual pressure even after shutdown

7. A technician discovers that the shop's eyewash station has not been inspected or tested in over 6 months. The station appears to be functional. What action is required?

A. The eyewash station should be tested after the current workday ends to avoid disrupting shop operations

B. The eyewash station must be tested immediately — weekly testing is the ANSI standard to verify that the station produces clean, tepid water at adequate flow and pressure; a station that has not been tested in 6 months may have stagnant water, bacterial contamination, or non-functional valves that would be discovered only when a worker needs it in an emergency

C. The station only needs testing if a chemical spill has occurred in the shop within the last 30 days

D. The station should be replaced entirely since the manufacturer's recommended service life for eyewash stations is 5 years

8. A technician is assigned to work on a truck that has been involved in a collision. The vehicle has deployed airbags. Before beginning any repair work on the vehicle, what safety step is essential?

A. Verify that the vehicle's insurance adjuster has approved the repair before touching any collision-damaged components

B. Take photographs of all damage for documentation before moving or disassembling any components

C. Disconnect the battery and wait the manufacturer-specified time for the SRS capacitors to discharge — deployed and undeployed airbags, seatbelt pretensioners, and other SRS components contain explosive charges that can activate if the system is powered, and collision damage may have created conditions that make undeployed units unstable

D. Verify that the collision report has been filed with the local police before the vehicle is moved into the shop

9. A diesel engine equipped with electronic unit injectors has a condition where one cylinder consistently misfires. The technician performs a relative compression test using the scan tool and finds that all cylinders produce equal cranking RPM variations. What does this result eliminate as the cause of the misfire?

A. It eliminates the fuel injector as the cause because equal cranking compression confirms equal fuel delivery

B. It eliminates a compression problem on the misfiring cylinder — since all cylinders produce equal cranking RPM variations (indicating equal compression), the misfire must be caused by a fuel delivery problem (faulty injector) rather than a mechanical compression problem (worn rings, leaking valve, blown gasket)

C. It eliminates an exhaust restriction as the cause because equal compression proves the exhaust is flowing evenly

D. It eliminates an intake restriction as the cause because equal compression confirms all cylinders receive equal airflow

10. A heavy-duty diesel engine has a condition where the engine oil turns from its normal color to a grey, metalite-flecked appearance within 1,000 km of an oil change. Oil analysis shows elevated levels of chromium and iron. What is the most likely source of these wear metals?

A. The engine's turbocharger bearings, which use chromium-plated bearing surfaces in the center housing

B. The engine's camshaft lobes and lifters, which are case-hardened with a chromium process that wears into the oil

C. The oil pump gears, which are manufactured from a chromium-iron alloy that deteriorates under normal operating conditions

D. The cylinder liners and piston rings — chromium is the primary plating material on compression rings, and iron is the primary material of cylinder liners; elevated levels of both together indicate accelerated ring-to-liner wear that is producing metallic debris at a rate that visibly contaminates the oil

11. A technician is diagnosing a diesel engine with a complaint of low power. The scan tool shows that the actual boost pressure matches the commanded boost pressure, the fuel rail pressure matches the commanded rail pressure, and no fault codes are present. However, the engine produces approximately 80% of its rated power on a chassis dynamometer. What should be investigated?

A. The engine's base mechanical condition — valve timing (through a valve timing check or cam position verification), compression (through a cylinder leakage test), and exhaust restriction (through a backpressure test); if the electronic systems are delivering the commanded air and fuel but the engine cannot convert them to full power, the deficiency is in the engine's mechanical ability to combust the charge efficiently

B. The chassis dynamometer calibration, which may be reading 20% lower than the engine's actual output

C. The engine's oil pressure, which if slightly below specification would reduce the engine's power output by approximately 20%

D. The turbocharger's compressor map, which may show the engine operating in a surge region that limits output to 80%

12. A heavy-duty diesel engine has a condition where the exhaust gas temperature on cylinder number 5 is 100°C higher than the average of the other five cylinders during a loaded road test. What does an elevated EGT on a single cylinder indicate?

- A. The number 5 injector is delivering less fuel than commanded, causing a lean condition in that cylinder
- B. The exhaust valve on number 5 is leaking, allowing hot combustion gas to flow past the valve and elevate the port temperature
- C. The number 5 injector is delivering more fuel than the other injectors — the excess fuel produces a richer combustion event that generates higher exhaust temperatures in that cylinder; an over-fueling injector also contributes to higher emissions and accelerated thermal wear on that cylinder's components
- D. The number 5 cylinder has higher compression than the others, compressing the charge more and producing higher combustion temperature

13. A heavy-duty diesel engine equipped with a mechanical fuel injection pump has a condition where the engine starts and runs normally when cold but develops a rough idle and reduced power as it warms to operating temperature. What mechanical pump condition exhibits this temperature-dependent behavior?

- A. The pump's governor spring has weakened from fatigue and loses tension as it heats up during operation
- B. Worn plunger-and-barrel assemblies in the injection pump — at cold temperature, the fuel's higher viscosity helps seal the worn clearances between the plunger and barrel; as the pump heats up, the fuel thins (viscosity drops) and leaks past the worn surfaces more rapidly, reducing the pump's ability to build adequate injection pressure and deliver precise fuel quantities
- C. The pump's drive coupling has worn splines that expand with heat and create free play in the timing relationship
- D. The pump's transfer pump check valve swells from heat and partially blocks fuel flow to the high-pressure section

14. A diesel engine has a condition where the crankcase pressure measured at the dipstick tube is 2.5 inches of water column. The manufacturer's maximum specification is 3.0 inches of water column. The engine has 400,000 km and is consuming a half-litre of oil per 1,000 km. What is the assessment?

A. The crankcase pressure is approaching the maximum limit and should be monitored at increasing frequency

B. The oil consumption rate is excessive for an engine at 400,000 km and an overhaul should be scheduled regardless of the crankcase pressure

C. The crankcase pressure exceeds the specification and the engine requires immediate attention

D. The crankcase pressure is within specification and the oil consumption rate is within the normal range for a heavy-duty diesel engine at 400,000 km — both measurements indicate the engine is serviceable and does not require overhaul at this time, but they should be trended over subsequent oil analysis intervals

15. A technician is performing a fuel injector balance test on a common rail diesel engine. The test shows that injectors 1 through 5 have balance rates within 2% of each other, while injector 6 has a balance rate that is 12% higher than the average. What does a high balance rate indicate?

A. Injector 6 requires more fuel to maintain its contribution to engine speed — the ECM is compensating for the injector's reduced efficiency by commanding a longer injection duration; this increased fuel delivery (high balance rate) indicates the injector is worn, partially clogged, or has a poor spray pattern that requires more fuel to achieve the same combustion result

B. Injector 6 is delivering too much fuel and overwhelming its cylinder with an excessively rich charge

C. Injector 6 has an electrical fault in its solenoid coil that is causing the ECM to increase voltage to achieve the commanded opening

D. Injector 6 is the most efficient injector in the set and requires less fuel trim from the ECM to maintain idle speed

16. A heavy-duty diesel engine has been diagnosed with a leaking turbocharger turbine-side oil seal. Oil is being pushed into the exhaust stream. What is the primary risk if this condition is not repaired?

- A. The oil will contaminate the SCR catalyst, permanently poisoning its NOx conversion capability
- B. The leaking oil will overheat and ignite inside the exhaust housing, potentially cracking the turbocharger housing
- C. The leaking oil will coat the DPF substrate with a carbon/ash layer that cannot be removed by regeneration — the oil's metalite additive package (zinc, phosphorus, calcium) creates an ash residue that is not combustible at DPF regeneration temperatures, permanently loading the DPF and eventually requiring expensive off-vehicle cleaning or DPF replacement
- D. The oil will cause the exhaust gas temperature sensors to read falsely high, triggering unnecessary power derates

17. A technician discovers that a heavy-duty diesel engine's oil filter has collapsed — the filter element has buckled inward and the media is folded against itself. What caused the filter to collapse?

- A. The oil was changed with the engine running at high idle, creating a pressure surge that exceeded the filter element's structural capacity
- B. The oil filter was the incorrect specification for the application — the filter's burst pressure and structural rating must match the engine's maximum oil pressure, and a filter with insufficient structural strength collapses under the pump's output pressure, particularly during cold starts when oil viscosity is highest and pump pressure peaks
- C. The oil pump relief valve is stuck open, creating a vacuum on the filter's downstream side that collapses the element
- D. The engine oil has degraded to the point where its acidity has dissolved the filter element's adhesive, releasing the media from the end caps

18. A diesel engine's SCR system has a fault code indicating "DEF Pump — Output Below Expected." The DEF tank is full and the DEF quality sensor reads normal. What should be investigated?

- A. The DEF dosing injector, which may be clogged and creating backpressure that the pump interprets as a flow restriction
- B. The DEF return line, which may be kinked and preventing the pump from recirculating excess DEF back to the tank

C. The SCR catalyst, which may be saturated with ammonia and rejecting additional DEF from the dosing injector

D. The DEF pump assembly — check for a failed pump motor, a restricted DEF filter or screen, a cracked suction line that is allowing air ingestion, or frozen DEF lines in cold weather that are preventing the pump from drawing DEF from the tank

19. A technician is testing an engine's cooling system using a coolant refractometer. The refractometer reading shows a freeze point of -20°C . The vehicle operates in an area where winter temperatures regularly reach -35°C . What action is required?

A. The coolant concentration must be adjusted to provide a freeze point at least 5°C below the lowest expected ambient temperature — the current -20°C protection is inadequate for an area that reaches -35°C , and the coolant must be adjusted to at least -40°C freeze protection by increasing the concentration of antifreeze in the mixture

B. The -20°C reading is adequate because the engine's operating temperature prevents the coolant from reaching ambient temperature

C. The coolant should be replaced entirely with a 100% antifreeze solution for maximum freeze protection

D. The refractometer reading is only accurate for ethylene glycol coolant and must be verified with a hydrometer for propylene glycol formulations

20. A heavy-duty diesel engine has a diagnostic trouble code for "Exhaust Gas Recirculation Flow — Below Commanded." The EGR valve responds to scan tool actuation commands. What else should be checked?

A. The DPF regeneration status, which if active would reduce EGR flow to prevent overheating of the intake charge

B. The turbocharger wastegate position, which if fully open would reduce the exhaust pressure differential needed to drive EGR flow

C. The EGR cooler, the EGR supply pipe, and the intake manifold EGR port for carbon buildup or restriction — the valve may open correctly but the flow path is restricted by carbon deposits that have

accumulated in the cooler passages, the supply pipe, or the intake port, preventing the commanded volume of exhaust gas from reaching the intake manifold

D. The fuel injection timing, which if advanced would increase NO_x production and trigger the EGR flow fault code

21. A diesel engine's cooling system has been refilled after a repair. The technician starts the engine and notices that the upper radiator hose remains cold while the engine temperature gauge climbs toward normal operating temperature. What is occurring?

A. The water pump has failed and is not circulating coolant through the engine or the radiator

B. The radiator core is completely blocked internally, preventing any coolant flow through the radiator tubes

C. The coolant mixture is incorrect and the fluid is too thick to flow through the upper hose at the pump's current output

D. The thermostat is closed and functioning normally — it prevents coolant from flowing to the radiator until the engine reaches operating temperature; the upper hose remains cold because the thermostat is blocking the flow path to the radiator while the engine warms up; once the thermostat opens, the hose will become hot as hot coolant flows through it

22. A heavy-duty diesel engine equipped with a variable geometry turbocharger has a fault code indicating "VGT Actuator Over-Temperature." The engine is in a derate. What conditions lead to VGT actuator overheating?

A. Sustained operation at high exhaust temperatures — extended grade climbing under full load, prolonged high-speed highway driving, or operating with a restricted air filter all produce elevated exhaust temperatures that heat the turbine housing and radiate heat to the adjacent VGT actuator

B. The VGT actuator is overheating because it is continuously cycling between fully open and fully closed at a high frequency during normal driving, generating friction heat

C. The engine coolant temperature is elevated and the heat is transferring from the cylinder head to the turbocharger through the exhaust manifold to the actuator

D. The VGT control solenoid is drawing excessive electrical current from a shorted coil winding, generating internal electrical heat in the actuator

23. A diesel engine's fuel system uses a fuel-water separator with a visual sight bowl. The technician observes a clear layer at the bottom of the bowl with the darker diesel fuel floating above it. What is the clear layer?

A. Water that has settled to the bottom of the separator because water is denser than diesel fuel — the fuel-water separator captures water from the fuel supply, and the sight bowl allows the technician to visually identify the accumulated water and drain it before it reaches the fuel injection system where it would cause corrosion and injector damage

B. A fuel system conditioning additive that has separated from the diesel fuel and settled to the bottom of the bowl

C. Condensation from the sight bowl's glass surface that has collected at the bottom due to the temperature difference between the fuel and the ambient air

D. Bio-contamination (algae growth) that has settled to the bottom of the separator from microbial activity in the fuel tank

24. A heavy-duty diesel engine has a condition where the engine starts normally but stalls within 5 seconds of starting every time. No fault codes are stored. Fuel pressure is adequate during cranking. What should be investigated?

A. The crankshaft position sensor, which may be providing a valid signal during cranking but losing signal immediately after the engine starts

B. The intake air heater relay, which if stuck on could be overheating the intake air and causing the engine to stall from excessive air temperature

C. The fuel return line, which may have a check valve that is closing immediately after start and blocking fuel return flow

D. The fuel injection system's transition from cranking mode to running mode — the ECM uses different fueling strategies for cranking versus running; a faulty sensor (such as the camshaft position sensor, throttle position sensor, or MAP sensor) that provides adequate data during the cranking

algorithm but provides incorrect data for the running algorithm could cause the ECM to deliver inappropriate fuel quantity or timing after the engine transitions from cranking to running

25. A technician discovers that a heavy-duty diesel engine's charge air cooler (intercooler) has an internal oil film coating the inside surfaces of the cooler tubes. What is the source of this oil, and what is the consequence?

A. The oil is from the engine's crankcase ventilation system and has no measurable effect on charge air cooler performance

B. The oil is from a leaking fuel injector seal that is spraying raw fuel into the intake manifold, which then condenses in the charge air cooler

C. The oil is from the turbocharger's compressor-side seal — a small amount of oil leaking past the compressor seal enters the intake stream and is deposited on the charge air cooler's internal surfaces; the oil film acts as an insulator that reduces the cooler's heat transfer efficiency, raising the intake manifold temperature and reducing the air's density

D. The oil is condensation from the air compressor that shares the same intake as the turbocharger

26. A diesel engine has a condition where the engine starts immediately when cold but requires extended cranking (10+ seconds) to start when the engine is hot (restarted within 30 minutes of shutdown). What is the most likely cause?

A. A fuel system component that allows fuel to drain back from the high-pressure circuit during the hot-soak period — a leaking check valve, a worn high-pressure pump, or leaking injectors allow the fuel rail pressure to bleed down to zero during the 30-minute hot-soak; the engine must then re-prime the system during cranking before it can start, which takes longer than a cold start where the system retains pressure

B. The glow plug system is interfering with hot restarts by activating and overheating the intake charge

C. The engine oil's viscosity thins during the hot-soak period and allows the compression rings to leak, reducing hot compression below the ignition threshold

D. The ECM switches to a different start-up algorithm for hot restarts that uses a leaner fuel strategy

27. A diesel engine's oil analysis shows a sudden increase in silicon content from 8 ppm to 45 ppm over one sample interval. What is the most probable source of the silicon contamination?

A. Silicone-based gasket sealant that was used during a recent engine repair has been dissolving into the oil

B. Silicon dust from a recently replaced air filter element that shed fibers during installation

C. Coolant contamination from a failed silicone hose connection that is leaking coolant into the oil

D. Dirt and dust ingestion through a compromised air intake system — silicon is the primary component of soil and dust, and a damaged air filter element, a loose intake hose clamp, a cracked intake duct, or a missing gasket allows unfiltered air carrying silicon particles to enter the engine, causing abrasive wear on all internal surfaces

28. A heavy-duty diesel engine's water pump has been replaced. After refilling the cooling system, the technician notices that the heater does not produce hot air even though the engine is at operating temperature. What is the most likely cause?

A. The replacement water pump has its impeller installed backward, reversing the coolant flow direction and bypassing the heater core

B. The new water pump impeller has a smaller diameter than the original, reducing the coolant flow rate to the heater core

C. The heater core has been contaminated by the old pump's failed seal material, blocking the core tubes

D. An air pocket is trapped in the heater core circuit — the heater core is typically the highest point in the cooling system, and air rises to this point during refilling; the trapped air prevents coolant from circulating through the core, and the core produces no heat because there is no hot coolant flowing through it; the system must be bled to remove the trapped air

29. A fleet manager notices that two identical trucks operating on the same route have significantly different DPF regeneration frequencies — Truck A regenerates every 500 km while Truck B regenerates every 1,200 km. Both trucks have the same maintenance history and fuel source. What is the most likely cause of the difference?

A. Truck A has a turbocharger that operates at a slightly higher efficiency, producing more exhaust heat that triggers regeneration more frequently

B. Truck A generates more soot than Truck B due to a condition that reduces combustion efficiency — a slightly restricted air filter, a worn injector with a degraded spray pattern, a leaking EGR cooler that dilutes the intake charge, or a turbocharger that produces slightly less boost all increase soot production, requiring more frequent regeneration to maintain the DPF

C. The DPF substrates on the two trucks have different cell densities from different manufacturing batches

D. Truck B's driver uses the engine brake more frequently, which generates higher exhaust temperatures that passively burn soot and reduce the need for active regeneration

30. A heavy-duty truck's air compressor is water-cooled through the engine's cooling system. The technician discovers that the compressor's cooling circuit is restricted — the inlet and outlet coolant lines are hot but the compressor head is significantly hotter than normal. What is the consequence of operating the compressor without adequate cooling?

A. The compressor will produce less air volume because hot air expands and reduces the compressor's volumetric efficiency

B. The uncooled compressor will overheat the air dryer desiccant from the elevated discharge temperature

C. The overheated compressor will carbonize the oil on its internal surfaces, cause accelerated valve and ring wear, reduce pumping efficiency from thermal expansion of the internal components, and may bake oil into carbon deposits that contaminate the entire air system downstream

D. The uncooled compressor will cause the governor to cut out at a lower-than-normal pressure setting

31. A tractor-trailer combination's trailer brakes apply normally during the first few stops after connecting the trailer, but the braking force progressively weakens over the next 30 minutes of driving until the trailer brakes are nearly ineffective. System pressure remains adequate. What is the most likely cause?

- A. The trailer's relay valve has an internal leak that progressively worsens as the valve heats from repeated cycling — the expanding valve components create larger internal clearances that allow more air to bypass, reducing the delivery pressure to the brake chambers progressively over time
- B. The trailer brake chambers have diaphragms that stretch as they heat from brake operation, reducing their effective area
- C. The trailer's automatic slack adjusters have all failed simultaneously, allowing the brake adjustment to deteriorate over the 30-minute period
- D. The trailer's air reservoir has an internal baffle that has shifted and is progressively blocking the outlet port as air pressure fluctuates during repeated brake applications

32. A transit bus has a condition where the front brakes produce adequate stopping force but emit a strong burning odor after a normal urban driving route. The brake adjustment is correct and the pushrod strokes are within specification. What should the technician investigate?

- A. The brake lining material, which may be a non-asbestos organic (NAO) formulation that produces a distinct odor during normal city driving with frequent stops
- B. The front brake cooling ducts, which may be blocked and preventing airflow from reaching the brake components during driving
- C. The tire inflation pressure, which if low would increase rolling resistance and force the brakes to work harder to stop the vehicle
- D. The front brakes for a dragging condition despite the correct stroke measurement — a binding S-cam bushing, a seized anchor pin, a weak return spring, or a sticking caliper slide pin can keep the shoes or pads in light contact with the drum or rotor between stops, generating heat and the burning odor; the adjustment may appear correct because the stroke measurement does not reveal drag

33. A driver reports that the air pressure builds to cut-out normally, but after the engine is shut off, both circuit gauges drop to zero within 10 minutes. All brakes are released (parking brakes out, service brakes released). What does this rapid, complete pressure loss indicate?

- A. The governor is venting system air through a failed exhaust seal when the compressor stops running

B. A major air leak exists in the system — with all brakes released, the system should hold pressure indefinitely after shutdown; a pressure drop to zero in 10 minutes indicates a substantial leak that is draining both circuits simultaneously, which means the leak is upstream of the one-way check valves (in the supply circuit, the wet tank, or the air dryer) where both circuits share a common supply

C. The air dryer purge valve is stuck open and continuously venting air from the supply tank to atmosphere

D. The compressor's discharge valve is stuck open, allowing air to leak back through the compressor cylinders to atmosphere when the engine is off

34. A heavy-duty truck has a condition where the left front brake applies normally but the right front brake has noticeably delayed application — the right side engages approximately 1 second after the left during a moderate stop. What should be investigated?

A. The ABS modulator on the right front, which may be restricting the initial air flow to the right front brake chamber

B. The tractor protection valve, which may be biasing air delivery to the left side of the primary circuit

C. The air line length between the relay valve and the right front brake chamber — a longer or more convoluted air line path, a partially kinked line, or a restriction in a fitting on the right side creates a delay in air delivery compared to the unrestricted left side; the delay is caused by the time required for air to fill the longer or restricted path before reaching the chamber

D. The right front brake drum, which may be oversized and requiring more pushrod travel that takes longer to achieve

35. A school bus equipped with air disc brakes has a condition where the brake pad wear indicators have activated on the rear axle — the pads are at minimum thickness. However, the front axle pads still have 60% of their lining remaining. What does this significantly uneven wear rate between axles indicate?

A. The rear brakes are performing a disproportionate share of the total braking work — this is likely caused by a rear brake bias condition from a malfunctioning front-axle proportioning valve, an improperly calibrated brake proportioning system, or front brake chambers that are a smaller size than specified, resulting in the rear brakes wearing faster because they are doing more braking than the system was designed for

- B. The rear brake pad material has a lower friction coefficient than the front, requiring more pad material consumption to achieve the same braking force
- C. The rear axle carries significantly more weight than the front axle, naturally causing the rear pads to wear faster proportionally
- D. The ABS system is activating more frequently on the rear axle, cycling the brakes rapidly and accelerating pad wear

36. A technician is testing the tractor protection valve on a tractor-trailer combination. With full system pressure and the trailer connected, the technician slowly reduces the tractor's primary circuit pressure using a drain valve while monitoring the trailer supply pressure. The tractor protection valve should close and exhaust the trailer supply at approximately what tractor system pressure?

- A. 80 to 85 psi, which is the same threshold as the compressor cut-in pressure
- B. 60 psi, which is the same threshold as the low-pressure warning device activation
- C. 20 to 25 psi, which is the minimum pressure needed to hold the tractor's own spring brakes released
- D. 40 to 45 psi — at this pressure, the tractor protection valve closes to protect the tractor's remaining air supply from being drained by the trailer circuit, and simultaneously exhausts the trailer supply line to apply the trailer's spring brakes

37. A heavy-duty truck's brake system has a condition where the foot valve produces a hissing sound continuously from its exhaust port even when the brake pedal is fully released. What does this indicate?

- A. Normal operation — the foot valve exhausts a small amount of air continuously to prevent moisture accumulation in the valve body
- B. The foot valve has an internal seal leak — one of the primary or secondary piston seals is worn or damaged, allowing supply air to bypass past the piston and escape through the exhaust port when the valve should be completely sealed; this leak consumes system air continuously and may reduce brake application pressure
- C. The air dryer purge signal is backfeeding through the foot valve's supply port and exiting the exhaust

D. The relay valve on the rear circuit has a faulty check valve that is sending application pressure back to the foot valve

38. A technician discovers that a truck's front brake drums have been turned (machined) by a previous technician. The machined diameter is 0.010 inches below the maximum allowable diameter. Is this acceptable?

A. The drums are unacceptable because machining to within 0.010 inches of the maximum leaves insufficient margin for normal wear before the drum reaches its condemn limit

B. The drums should be checked for heat discoloration before determining acceptability, regardless of the dimensional measurement

C. The drums are acceptable as long as the current diameter does not exceed the maximum allowable — the 0.010-inch margin provides room for additional wear in service; however, the brake shoes must have adequate contact area and the drum's surface must be free of defects from the machining process

D. The drums must be replaced because any machined drum has compromised structural integrity regardless of the remaining wall thickness

39. A heavy-duty truck has a condition where the spring brakes apply with a loud "bang" rather than a smooth, gradual application when the parking brake valve is pulled. What is the most likely cause?

A. The quick release valve on the spring brake circuit is stuck open, allowing the hold-off air to exhaust instantly rather than through a controlled release — the rapid air release causes the power springs to slam open at maximum velocity, producing the bang; alternatively, the spring brake relay valve may have failed in a way that dumps the hold-off air too quickly

B. The spring brake power springs have been replaced with stronger springs that produce more impact force during application

C. The parking brake valve has a defective detent that snaps from the released to the applied position too quickly

D. The spring brake chambers have lost their internal dampening cushion that normally slows the spring's extension

40. A technician is inspecting the air system components and finds that the compressor discharge line has a flexible section (hose) that is swollen and soft to the touch. The rest of the line is rigid metal tubing. What caused the hose to swell?

- A. The excessive heat from a poorly cooled compressor has thermally degraded the hose material
- B. The system pressure has exceeded the hose's rated working pressure from a malfunctioning governor
- C. Moisture in the air system has chemically reacted with the hose's inner liner, causing it to absorb water and swell
- D. Oil contamination from the compressor passing excessive oil has degraded the hose's inner rubber lining — compressor oil is a petroleum product that attacks many types of rubber; the oil softens and swells the rubber from the inside, weakening the hose structure and potentially causing it to burst under system pressure

41. A trailer equipped with spring brakes on all axle positions has a condition where the spring brakes on one axle do not release when the tractor supplies air to the trailer. All other axle positions release normally. What is the most likely cause?

- A. The spring brake relay valve on the affected axle has a blown diaphragm that prevents the valve from passing supply air to those chambers
- B. The air line between the spring brake relay valve and the affected axle's chambers is kinked, restricted, or frozen (in cold weather) — the supply air cannot reach the spring brake chambers on that axle even though it reaches all other axle positions through their unobstructed lines
- C. The spring brake power springs on that axle have become corroded and seized in the applied position, preventing them from being compressed by the hold-off air
- D. The tractor protection valve is partially restricting the supply air, providing enough pressure for most axle positions but not enough for the furthest one

42. A heavy-duty truck has a condition where the brake pedal feels firm and produces adequate stopping force, but the truck takes a noticeably longer distance to stop than it did previously. The brake adjustment is correct and the air system pressure is adequate. What should be investigated?

- A. The tire tread depth and condition, which if worn would reduce traction and increase stopping distance even with adequate brake force
- B. The brake drum temperature after a stop, which if excessively hot would indicate the brakes are working too hard and fading
- C. The brake lining coefficient of friction — the linings may be glazed from overheating, contaminated with oil from the air system, or may have been replaced with a non-OEM material that has a lower friction rating than the original specification; any of these conditions reduces the friction force generated at the drum for a given application pressure, increasing stopping distance despite correct adjustment and adequate air pressure
- D. The vehicle's cargo weight, which if increased would require more stopping distance regardless of brake condition

43. A technician is performing a brake chamber stroke measurement on a trailer and finds that one Type 30 long-stroke chamber has a pushrod stroke of 2.5 inches with the brakes fully applied. The maximum allowable stroke for this chamber is 2.0 inches. What condition does this over-stroke indicate?

- A. The automatic slack adjuster on that wheel position has failed to maintain proper brake adjustment — the ASA is either defective, or the foundation brake components it serves have worn beyond the ASA's compensation range (severely worn linings, oversized drum, worn anchor pins, worn S-cam bushings); the root cause must be diagnosed and corrected, not simply manually adjusted
- B. The brake chamber diaphragm has stretched and is producing the extra 0.5 inches of stroke beyond normal
- C. The brake chamber pushrod is the incorrect length for the application and should be replaced with a shorter rod
- D. The air pressure supplied to that chamber is higher than the other chambers, pushing the diaphragm further than normal

44. A heavy-duty truck equipped with ABS and automatic traction control (ATC) has a condition where the ATC light flashes during acceleration on a dry paved surface with no wheel spin detected. The ABS functions normally during braking. What should be investigated?

- A. The tire sizes on the drive axle, which if mismatched (different brands with different rolling diameters) would produce different wheel speeds that the ATC interprets as wheel spin even on dry pavement
- B. The ATC pressure control valve, which may be partially applying the brakes to the drive wheels during normal acceleration
- C. The engine ECM, which receives the ATC torque reduction command and may be misinterpreting the signal
- D. The wheel speed sensors on the drive axle — if one sensor produces a signal that differs from the others (from an incorrect air gap, a damaged reluctor ring, or a failing sensor), the ATC module interprets the speed difference as wheel spin and intervenes; since the ABS uses the same sensors and functions normally during braking, the fault may be a marginal signal that only triggers the ATC's more sensitive detection threshold

45. A transit bus has a condition where the brake pedal has a long travel before the brakes engage, but once engaged, the braking force is adequate. The air system pressure is normal and the pushrod strokes are within specification on all wheels. What is the most likely cause?

- A. Air trapped in the hydraulic portion of the brake system (on a bus with air-over-hydraulic brakes) that compresses before the hydraulic fluid can transmit force to the calipers
- B. The foot valve has excessive internal clearance or a worn piston that requires more pedal travel to build the output pressure that activates the relay valves — the pedal must travel further to compress the valve's internal spring and move the worn piston enough to generate the signal pressure needed to crack open the relay valves
- C. The relay valves have a higher-than-normal crack pressure that requires more signal pressure from the foot valve before they open
- D. The brake pedal linkage has excessive free play before it contacts the foot valve's input rod

46. A technician is diagnosing an air brake system where the secondary circuit gauge drops faster than the primary circuit gauge when the brakes are applied and held. Both circuits start at the same pressure before the application. What does this faster secondary drop indicate?

- A. The secondary circuit has a smaller reservoir volume than the primary, causing the pressure to drop faster from the same air consumption
- B. The primary circuit relay valve is biasing more air delivery from the primary reservoir, making the primary gauge appear to drop slower
- C. The secondary circuit has a leak that is consuming air in addition to the normal brake application air consumption — the secondary circuit is losing air to both the brake chambers it serves and the leak, causing its pressure to drop faster than the primary circuit, which is only losing air to its brake chambers
- D. The foot valve is delivering more pressure to the secondary output than the primary output

47. A heavy-duty truck has a condition where the engine cranks normally and starts, but the engine runs for exactly 30 seconds and then shuts off. The engine restarts immediately and runs for another 30 seconds before shutting off again. This 30-second cycle repeats consistently. What is the most likely cause?

- A. The engine's anti-theft immobilizer system is not recognizing the key's transponder signal — the ECM allows the engine to start and run for a predetermined period (30 seconds on this system) to verify the key's identity, and when verification fails, the ECM shuts the engine down; the immediate restart succeeds because the immobilizer allows another 30-second verification window
- B. The fuel filter is partially restricted and the fuel system can only accumulate 30 seconds worth of fuel before running dry
- C. The crankshaft position sensor has an intermittent fault that fails after exactly 30 seconds of engine operation
- D. The engine oil pressure switch has a 30-second delay circuit that shuts the engine down if oil pressure does not reach a specific threshold

48. A heavy-duty truck's alternator has been replaced. After the replacement, the battery warning lamp on the dashboard remains illuminated even though the alternator is producing the correct output voltage at the battery terminals. What is the most likely cause?

- A. The replacement alternator is missing its exciter wire connection or the wire was not reconnected during installation

- B. The dashboard battery lamp circuit tests the voltage at a location other than the battery terminals
- C. The replacement alternator's internal regulator has a different part number that is incompatible with the truck's warning lamp circuit
- D. The alternator exciter circuit (the circuit that initially energizes the alternator's field winding and also controls the warning lamp) is not connected or is not functioning — the lamp illuminates because the exciter circuit is open; the alternator may still charge because residual magnetism in the rotor allows self-excitation, but the lamp circuit requires the exciter connection to extinguish the warning lamp

49. A technician is diagnosing a truck with a CAN bus fault. The scan tool communicates with some modules but not others. The termination resistance reads 120 ohms (should be 60 ohms). What does this indicate?

- A. The CAN bus has three terminating resistors instead of two, adding extra resistance to the bus
- B. The CAN bus backbone has an open circuit at some point that isolates one terminating resistor from the other — the 120-ohm reading is a single terminator because the open prevents the measurement from reaching the second terminator; modules on the same side of the break as the scan tool communicate, while modules on the other side cannot be reached
- C. Both terminating resistors have doubled in value from corrosion, coincidentally reading 120 ohms each in parallel
- D. The scan tool's internal resistance is interfering with the termination measurement

50. A heavy-duty truck has a condition where the electric window on the driver's side goes down normally but will not go up. Pressing the up switch produces no motor sound. What is the most likely cause?

- A. The window motor has failed in a way that allows rotation in one direction only
- B. The window has reached its full-down mechanical stop and the motor cannot reverse because the stop has shifted position
- C. The window switch, the relay, or the wiring in the up-direction circuit has an open — the motor operates in one direction through a separate set of contacts, wiring path, or relay from the other

direction; a fault in the up-direction circuit (corroded switch contact, broken wire, failed relay) prevents current from reaching the motor in the up direction while the down-direction circuit remains functional

D. The window glass has jammed in its channel and the motor cannot generate enough force to push it upward against gravity and friction

51. A heavy-duty truck's scan tool retrieves a fault code from the ABS module for "System Voltage — Above Normal." The charging voltage at the battery terminals reads 14.8 volts. What is the relationship between this voltage and the ABS fault?

A. The charging voltage of 14.8 volts exceeds the ABS module's maximum input voltage specification — electronic modules are designed for the standard charging range of 13.8-14.4 volts, and the overvoltage condition can cause the module to set a fault code, operate erratically, or sustain internal damage; the root cause is the overcharging alternator/regulator, not the ABS module

B. The ABS module requires a minimum of 15 volts to operate and is setting the code because the voltage is too low

C. The ABS fault is unrelated to the charging voltage and the two conditions are coincidental

D. The 14.8-volt reading is within the normal heavy-duty range and the ABS module has a defective voltage sensing circuit

52. A truck has a condition where the marker lights on the right side are brighter than the marker lights on the left side. All bulbs are the correct wattage and type. What is the most likely cause?

A. The right-side wiring is a larger gauge than the left-side wiring, allowing more current to flow to the right-side lamps

B. The tractor's alternator has a stronger output on the right-side circuit than the left-side circuit

C. The left-side wiring or connectors have a higher resistance than the right side, creating voltage drop that reduces the voltage available to the left-side lamps

D. The left-side marker light circuit has a higher resistance in its ground or power path than the right side — this resistance creates voltage drop that reduces the voltage available to the left-side bulbs, making them appear dimmer; the right side has a clean circuit with minimal resistance, so its bulbs receive more voltage and appear brighter

53. A truck equipped with a body controller module (BCM) has a condition where all exterior lights function correctly except the right rear stop lamp, which does not illuminate when the brakes are applied. The BCM fault log shows "Right Rear Stop Lamp — Open Circuit." What does this mean?

A. The BCM has detected an open circuit in the right rear stop lamp's power supply line from the BCM to the lamp

B. The BCM has detected that the right rear stop lamp circuit is drawing zero current — this means the circuit is open (no current flow) at some point between the BCM's output driver and the lamp's ground connection; the open could be at the bulb (burned out), the socket (corroded or loose), the wiring (broken conductor), or the ground (open ground connection)

C. The BCM's internal output driver for the right rear stop lamp has failed in the open (non-conducting) state

D. The BCM requires a software update to recognize the replacement stop lamp that was recently installed

54. A technician is diagnosing a truck with an intermittent no-start condition. The starter sometimes cranks and sometimes does not. When the no-crank condition occurs, the technician taps on the starter solenoid with a hammer and the starter engages. What does this indicate?

A. The starter motor brushes are worn and not making consistent contact with the commutator

B. The starter motor armature has a dead spot that prevents the motor from turning when it stops at a specific rotational position

C. The starter solenoid's internal contacts are worn, burned, or pitted — the contacts do not make a reliable connection when the plunger pulls in; tapping the solenoid physically jars the contacts enough to make temporary contact and pass current to the motor; this confirms the solenoid contacts are the fault, not the motor itself

D. The starter motor is seizing intermittently from worn bushings and the tapping loosens the bushing temporarily

55. A heavy-duty truck has a condition where the trailer ABS lamp on the left front of the trailer illuminates for 3 seconds during the initial power-up self-test, then extinguishes. The driver reports no ABS issues during driving. What does this normal ABS lamp behavior indicate?

A. The trailer ABS system has a stored fault code that is being displayed during the self-test but is not severe enough to keep the lamp on continuously

B. The ABS system has successfully completed its power-up self-test — the lamp illuminates during the self-test to verify the bulb is functional, and the system checks its sensors, modulators, and ECU; when the test passes, the lamp extinguishes, indicating the system is fully operational with no detected faults

C. The trailer ABS module is in a diagnostic mode that requires a scan tool to complete the self-test and transition to normal operation

D. The ABS lamp behavior indicates that the system detected a minor fault during the self-test but cleared it automatically

56. A technician measures the voltage at the starter motor during cranking and reads 8.2 volts. Battery terminal voltage during cranking reads 10.5 volts. What does the 2.3-volt difference indicate?

A. The starter motor is drawing less current than normal due to a weak armature, causing a reduced voltage drop in the cables

B. The battery internal resistance is consuming the 2.3 volts and the cables are not at fault

C. The voltage drop is within the normal specification for a heavy-duty truck starting circuit under cranking load

D. Excessive resistance exists in the cable, connections, or solenoid contacts between the battery and the starter motor — the 2.3-volt drop far exceeds the maximum allowable (typically 1.0 volt total for the positive and negative cables combined) and means the starter is receiving inadequate voltage for normal cranking speed

57. A heavy-duty truck's electronic throttle pedal has two position sensors (APP1 and APP2). During diagnosis, the technician finds that APP1 reads 2.3 volts and APP2 reads 1.15 volts with the pedal at 50% travel. The manufacturer's specification states that APP2 should always read exactly half of APP1. What is the assessment?

A. Both sensors are within specification — APP2 at 1.15 volts is exactly half of APP1 at 2.3 volts, confirming the correlation between the two sensors; the dual-sensor design provides redundancy and the ECM continuously verifies that the ratio remains at 2:1 throughout the pedal's travel range

- B. APP2 is 0.05 volts below the expected value and the pedal assembly should be replaced
- C. The ratio should be 1:3, not 1:2, and both sensors are outside specification
- D. APP1 is reading too high, which makes APP2 appear correct only by coincidence

58. A truck's electric cooling fan is controlled by the ECM through a pulse-width modulated (PWM) signal to the fan controller. The fan runs at full speed continuously even when the engine is cold. The ECM shows no fault codes for the fan circuit. What should be investigated?

- A. The engine coolant temperature sensor, which if reading higher than actual would cause the ECM to command full fan speed
- B. The PWM fan controller module, which may have failed in the full-speed default state
- C. The fan controller or the PWM signal wire — if the controller has failed internally, it defaults to full speed as a protective measure; if the PWM signal wire is open or shorted, the controller may receive no modulation signal and default to full speed; the absence of ECM fan codes means the ECM believes it is sending the correct command, so the fault is downstream of the ECM
- D. The A/C high-pressure switch, which if stuck closed would command full fan speed through a separate circuit that bypasses the ECM

59. A heavy-duty truck has a condition where the horn sounds when the brakes are applied. The horn does not sound at any other time. What is the most likely cause?

- A. The brake light circuit has a short to the horn circuit — when the brake lights are activated, current flows through the unintended connection to the horn relay coil, energizing it and sounding the horn
- B. A wiring fault has connected the horn relay ground to the brake light switch output, completing the horn coil circuit whenever the brakes are applied
- C. The horn relay is located adjacent to the brake light relay and vibration from the brake application is physically jarring the horn relay contacts closed
- D. The body controller module is programmed to sound the horn during brake application as a safety feature that has been inadvertently enabled

60. A technician discovers that a truck's main wiring harness has been repaired with household electrical tape instead of proper automotive-grade wiring repair materials. What is the concern?

- A. Household electrical tape is thinner than automotive tape and will not provide adequate abrasion resistance
- B. Household electrical tape has a different color than the original harness tape and will confuse future technicians during diagnosis
- C. Household electrical tape will not adhere properly to automotive wiring and will unravel within weeks
- D. Household electrical tape is not rated for the temperature extremes, vibration, and chemical exposure of an automotive environment — the tape's adhesive fails in engine bay temperatures (exceeding 100°C), its backing becomes brittle in cold weather (below -20°C), and it provides no protection against fuel, oil, and solvent contact that dissolves its adhesive; proper automotive repairs use heat-shrink tubing, weatherproof connectors, and harness-grade tape

61. A truck's scan tool retrieves a fault code from the transmission control module: "Vehicle Speed Signal — Lost." The speedometer on the dashboard continues to display the correct speed. How can the speedometer work if the TCM has lost the speed signal?

- A. The speedometer and TCM receive the vehicle speed signal from different sources — the speedometer may receive its data from the instrument cluster via the CAN bus (which receives the speed from the ABS module's wheel speed calculation), while the TCM may receive its speed signal from a dedicated vehicle speed sensor on the transmission output shaft; if the TCM's dedicated sensor fails, the CAN bus speed data continues to feed the speedometer
- B. The speedometer uses GPS for speed display and does not depend on the vehicle speed sensor
- C. The TCM fault code is historical and was set during a previous event; the speed signal has since been restored
- D. The speedometer has a built-in buffer that continues to display the last valid speed reading for up to 30 minutes after the signal is lost

62. A technician discovers that a truck's aftermarket fog lights are wired directly into the low-beam headlight circuit through a splice. What is the safety concern with this installation?

- A. The fog lights draw additional current through the low-beam circuit, potentially overloading the wiring, connector, and fuse that were not designed for the additional load
- B. The fog lights will cause the low beams to flicker from the voltage fluctuation of the additional load
- C. The fog lights wired to the low-beam circuit overload the headlight circuit — the original circuit's wire gauge, fuse, connector, and switch are sized for the headlight current draw only; the additional fog light current may exceed the wire's ampacity, cause voltage drop to the headlights (reducing headlight brightness), and potentially blow the fuse or overheat the wiring
- D. The fog lights cannot function on the same circuit as the headlights because the voltage waveforms are incompatible

63. A truck has a condition where the right turn signal on the tractor works correctly, but the trailer's right turn signal flashes at half the normal rate. The left turn signal works normally on both the tractor and trailer. What is the most likely cause?

- A. The flasher module is defective and produces a different flash rate for the left and right circuits
- B. A burned-out bulb on the right side of the trailer has reduced the current draw on the right turn circuit — the flasher detects the reduced current and flashes at a slower rate (on some flasher types) or faster rate (on thermal flashers); in this case the reduced current is slowing the flasher's cycle on the right circuit
- C. The right turn signal wiring has a partial short to ground that is bleeding current from the circuit and slowing the flash rate
- D. The trailer's right turn signal circuit has a bulb with the wrong wattage installed

64. A heavy-duty truck's electronic gauge cluster has a fuel level gauge that fluctuates erratically — moving from empty to full and back several times per minute during driving. The fuel level in the tank is verified at half full. What is the most likely cause?

- A. The fuel sender's float has become saturated with fuel and is no longer floating at the correct level

- B. The fuel is sloshing inside the tank during driving, which is normal for half-full tanks in vehicles without internal baffles
- C. The instrument cluster has an internal processing fault that is adding noise to the fuel level display
- D. The fuel level sender has a worn or corroded resistor card — the wiper (connected to the float arm) makes intermittent contact as it moves across the damaged section of the resistor, causing the resistance to jump erratically between values that the gauge interprets as rapid level changes

65. A technician is measuring the parasitic draw on a heavy-duty truck with the vehicle fully shut down. The ammeter reads 75 milliamps. The specification is 50-85 milliamps. After 45 minutes, the ammeter reading drops to 55 milliamps. What explains the initial higher reading?

- A. The initial 75 mA reading reflects modules that had not yet entered sleep mode — many electronic modules remain active for a manufacturer-specified timeout period (typically 20-45 minutes) after the ignition is turned off before transitioning to their low-power sleep state; the decreasing draw over 45 minutes is the modules progressively entering sleep mode
- B. The battery is absorbing the excess current as a surface charge that diminishes over 45 minutes
- C. The alternator's residual magnetism is producing a small current that decays over 45 minutes as the magnetic field dissipates
- D. The ammeter's internal calibration drifts during extended measurement periods and the reading change is an instrument artifact

66. A truck equipped with a J1939 CAN bus has a condition where the engine ECM communicates normally through the scan tool but the ABS module reports "Configuration Error — Invalid Source Address." What does this fault indicate?

- A. The ABS module and engine ECM are transmitting on the same CAN bus address, creating a conflict
- B. The ABS module has been replaced with a unit from a different vehicle that has a different network configuration
- C. A module on the CAN bus is transmitting data with a source address that the ABS module does not recognize as valid in its configuration table — this can occur after a module replacement where the new

module has a different network address than the original, or after an ECM reprogramming that changed the address assignments

D. The scan tool is interfering with the CAN bus communication by transmitting with an address that conflicts with the ABS module

67. A heavy-duty truck has a condition where the backup camera image is displayed on the dash monitor but the image is upside down. The camera was recently replaced with an aftermarket unit. What is the most likely cause?

A. The aftermarket camera's video output polarity is reversed compared to the original camera's signal format

B. The aftermarket camera is physically mounted upside down relative to the original camera's orientation — most cameras have a specific mounting orientation (right-side up) and the image is processed based on this orientation; mounting the camera inverted produces an inverted image on the display

C. The display monitor has a software setting that flips the image for the new camera's signal format

D. The aftermarket camera uses a different video standard (PAL versus NTSC) that reverses the image scan direction

68. A truck's telematics system reports multiple "Hard Braking" events during a trip, but the driver insists they drove normally and did not brake aggressively. The brake system has been inspected and is functioning correctly. What could explain the false hard-braking alerts?

A. The telematics system's accelerometer sensitivity threshold is set too low for a heavy-duty truck application

B. Road conditions (rough pavement, potholes, railroad crossings) may be generating deceleration spikes that the telematics system interprets as hard braking events

C. The ABS system is activating during normal stops and the rapid pressure modulation triggers the hard-braking accelerometer

D. The telematics system's accelerometer is calibrated for passenger vehicle deceleration rates, and the normal braking deceleration of a heavy-duty truck (which is different from a passenger vehicle) triggers

the alert — alternatively, the accelerometer is mounted at an angle that produces false readings, or the accelerometer's sensitivity threshold needs adjustment for the specific vehicle application

69. A heavy-duty truck equipped with a manual transmission has a condition where the transmission makes a growling or roaring noise in every gear, including neutral, when the clutch pedal is released. The noise disappears when the clutch pedal is depressed. What is the most likely cause?

- A. Worn mainshaft bearings that produce noise proportional to input shaft speed
- B. A worn pilot bearing that is loaded when the clutch is engaged but unloaded when the clutch is disengaged
- C. A worn transmission input shaft bearing (front bearing) — this bearing supports the input shaft and is loaded whenever the clutch is engaged and the shaft is driven by the engine; depressing the clutch disconnects the engine from the input shaft, the shaft slows and stops, and the bearing noise disappears because the shaft is no longer rotating in the worn bearing
- D. Worn countershaft bearings that are loaded only when the transmission is in a forward gear

70. A truck equipped with an 18-speed manual transmission has a condition where the driver can shift into all main-box positions but the range section will not shift from high range back to low range. The shift from low to high range works normally. What is the most likely cause?

- A. The range cylinder's piston seal is leaking on one side only — the seal holds pressure in one direction (for the low-to-high shift) but bypasses in the other direction (for the high-to-low shift), preventing the cylinder from generating adequate force to move the range gears back to the low-range position
- B. The range shift air valve is stuck in the high-range position due to contamination or a worn spool
- C. The transmission output shaft bearing has failed and is physically blocking the range gear from sliding to the low-range position
- D. The range synchronizer for the low-range shift has worn beyond its effective range while the high-range synchronizer remains functional

71. A truck's automatic transmission fluid is checked and found to have a dark brown color with a burnt smell. The fluid was bright red when it was last changed 30,000 km ago. What does the degraded fluid condition indicate?

- A. The transmission cooler bypass valve is stuck open, preventing the fluid from being cooled and causing accelerated thermal degradation
- B. The transmission's internal filter has become restricted, limiting fluid flow and causing localized overheating
- C. The wrong type of transmission fluid was used at the last service, and it has chemically degraded in the application
- D. The transmission has been operating at elevated temperatures — either from overloading, a restricted cooler, extended grade climbing, or a cooling system fault — and the excessive heat has thermally degraded the fluid's base oil and additive package; the dark color and burnt smell confirm that the fluid has been damaged and can no longer provide adequate lubrication, cooling, or clutch engagement characteristics

72. A heavy-duty truck with a single-plate dry clutch has a condition where the clutch engages and disengages normally, but a rattling noise is present from the bellhousing area that increases with engine RPM. The noise is present with the clutch both engaged and disengaged. What is the most likely cause?

- A. Loose flywheel bolts that allow the flywheel to shift microscopically at each combustion pulse, producing a rattle proportional to engine speed
- B. Broken or weakened torsional damper springs in the clutch disc hub — the damper springs absorb engine firing impulses to smooth the transmission of torque; when springs break or weaken, the hub rattles inside the disc at each engine pulse, producing a noise proportional to engine speed that is present regardless of clutch position
- C. A cracked flexplate that resonates at the engine's firing frequency and produces the rattling sound
- D. Loose bellhousing bolts that allow the housing to vibrate against the engine block at a frequency proportional to RPM

73. A technician is installing a new clutch on a heavy-duty truck and notices that the flywheel ring gear has three teeth that are chipped on their leading edges. The starter engages normally. Should the ring gear be replaced?

A. The ring gear can continue in service as long as the starter engages; three chipped teeth will not affect the starter's ability to mesh and crank the engine

B. The chipped teeth should be filed smooth and the ring gear reused since the damage is cosmetic

C. The ring gear must be replaced — even though the starter currently engages, the chipped teeth create points where the starter pinion may not mesh smoothly, causing the starter to grind, skip teeth, or fail to engage in certain flywheel positions; the problem will worsen as the remaining damaged teeth deteriorate further

D. The ring gear damage indicates the starter motor is defective and the ring gear will be damaged again if only the ring gear is replaced

74. A truck equipped with a torque converter automatic transmission has a condition where the transmission fluid level appears to drop when the engine is first started after sitting overnight, then returns to the correct level after a few minutes of running. What is occurring?

A. The torque converter drains some of its fluid back to the transmission pan during the overnight rest period — when the engine starts, the converter pump refills the converter from the pan, temporarily lowering the pan level; once the converter is full, the level stabilizes at the correct mark

B. The transmission fluid is contracting from cold temperature overnight and expanding to the correct level as it warms

C. The transmission pump has an internal leak that drains fluid from the pan into the pump housing overnight

D. The transmission cooler is draining its fluid volume back to the pan overnight, temporarily raising the level above normal

75. A heavy-duty truck with a tandem drive axle has a condition where the truck can be driven normally in all conditions except when making tight turns at low speed — during tight turns, the driveline binds and the truck jerks. The inter-axle differential lock is not engaged. What is the most likely cause?

A. The front drive axle's wheel bearings are adjusted too tightly, preventing the front axle wheels from turning at a different speed than the rear

B. The tire sizes on the front and rear drive axles are different — even a small difference in rolling diameter between the front and rear axle tires creates a speed mismatch that the inter-axle differential must accommodate; if the tires are mismatched, the differential works continuously and may bind during tight turns where the speed difference is greatest

C. The rear drive axle's ring and pinion has a different ratio than the front, creating a speed conflict during turns

D. The inter-axle differential has failed internally even though the lock is not engaged — the differential gears may be seized, worn, or damaged, preventing them from allowing the speed difference between the front and rear axles during turns; the binding is caused by the failed differential forcing both axles to turn at the same speed

76. A heavy-duty truck's driveshaft has a vibration that is felt at all speeds above 30 km/h. The technician places the truck on a hoist and runs it in gear with the wheels off the ground. The vibration is not present. What does this test result indicate?

A. The vibration source is not the driveshaft — when the truck is on the hoist with no road resistance, the driveshaft turns without producing vibration; this eliminates the driveshaft, U-joints, and carrier bearing as the source and points to a road-speed-dependent component such as a tire imbalance, a bent wheel, or a worn wheel bearing that only produces vibration under road-load conditions

B. The driveshaft is the vibration source but it only vibrates under the load of driving, not under the unloaded hoist condition

C. The rear axle is the vibration source because the axle housing resonates differently on the hoist than on the road

D. The transmission is the vibration source because the different load condition on the hoist changes the transmission's internal dynamics

77. A bus equipped with an Allison automatic transmission has a diagnostic fault code for "Range Inhibited." The transmission will not shift out of a single gear. The bus operates at reduced speed. What does "Range Inhibited" mean?

A. The TCM has detected a condition that prevents it from safely executing gear changes — the "range" refers to the gear range, and "inhibited" means the TCM is blocking shifts; the condition may be a sensor fault (turbine speed, output speed), a solenoid fault, a pressure fault, or a temperature fault that prevents the TCM from commanding safe, controlled shifts

B. The TCM has received a driver command to lock the transmission in the current gear for engine braking

C. The park pawl mechanism is partially engaged and preventing the transmission from shifting between ranges

D. The transmission filter pressure differential has exceeded the service limit and the TCM is protecting the filter from collapse

78. A technician discovers that a truck's ring and pinion gear set has a gear tooth contact pattern that is concentrated entirely on the heel (outer edge) of the ring gear teeth. What adjustment is needed?

A. Increase the pinion depth by removing shims behind the pinion bearing to move the pinion closer to the ring gear centerline

B. Decrease the pinion depth by adding shims behind the pinion bearing to move the pinion away from the ring gear centerline

C. Decrease the ring gear backlash to move the contact pattern from the heel toward the toe

D. Decrease the backlash by moving the ring gear closer to the pinion to shift the contact pattern from the heel toward the toe of the ring gear teeth

79. A heavy-duty truck has a condition where the driveshaft U-joints require replacement every 30,000 km. The manufacturer's expected U-joint life is 200,000+ km. What condition most commonly causes premature U-joint failure?

A. Excessive U-joint operating angles from a worn or incorrectly adjusted suspension, a damaged transmission mount, or an improperly shimmed axle that creates angles beyond the U-joint's design capacity — high angles increase the bearing load and the speed fluctuation at each revolution, dramatically accelerating bearing wear and needle roller fatigue

- B. Using non-OEM replacement U-joints with bearing cups that are 0.001 inches smaller than the original specification
- C. Operating the vehicle at highway speed for extended periods, which exceeds the U-joint's designed duty cycle
- D. The driveshaft's critical speed is too close to the vehicle's normal operating speed, creating resonance that fatigues the U-joints

80. A truck equipped with an automated manual transmission (AMT) has a condition where the transmission makes a grinding noise during the 3-4 upshift. All other shifts are smooth and quiet. What is the most likely cause?

- A. The 3rd-4th synchronizer blocker ring is worn and cannot match the speeds adequately before the sliding sleeve engages
- B. The shift actuator motor speed is set too aggressively for the 3-4 shift timing, causing the sleeve to advance before speeds are matched
- C. The 3-4 shift synchronizer is worn — the synchronizer's friction cone or blocker ring cannot match the speeds of the 3rd gear and 4th gear components quickly enough before the AMT's shift actuator advances the sliding sleeve; the grinding is the sleeve's teeth contacting the gear's engagement teeth at mismatched speeds
- D. The engine is not blipping RPM correctly during the 3-4 shift to assist the synchronizer with speed matching

81. A driver reports that the truck's clutch pedal feels "soft" or "mushy" compared to its previous firm feel. The clutch engages and disengages, but the pedal effort has noticeably decreased. What is the most likely cause on a hydraulic clutch system?

- A. The clutch disc has worn thin, reducing the pressure plate's clamping force and the resistance felt at the pedal
- B. Air has entered the hydraulic clutch circuit — the air bubble compresses when the pedal is pressed, absorbing some of the pedal travel and reducing the firm resistance; the clutch still functions because enough hydraulic force reaches the slave cylinder to disengage the clutch, but the mushy feel indicates the system needs bleeding

C. The pressure plate's diaphragm spring has weakened from heat cycling and no longer resists the release bearing's force as firmly

D. The clutch master cylinder bore has enlarged from wear, reducing the hydraulic pressure generated per unit of pedal force

82. A heavy-duty truck has a PTO-driven pump that powers a hydraulic crane. The PTO engages but the crane functions operate very slowly. Engine RPM is at the correct PTO operating speed. The hydraulic fluid level is correct. What should be checked first?

A. The PTO gear mesh, which may have worn and is now slipping under the load of the hydraulic pump

B. The hydraulic pump output pressure and flow rate using a diagnostic flow meter and pressure gauge

C. The hydraulic pump's output pressure and flow rate — connect a flow meter and pressure gauge at the pump outlet to measure actual performance; a pump that reaches adequate pressure but delivers reduced flow has internal wear that allows fluid to bypass instead of being pumped to the system; this directly causes slow cylinder extension and retraction

D. The crane's counterbalance valve, which may be restricting flow to the boom cylinders

83. A truck with an automatic transmission has a condition where the transmission fluid temperature is consistently 20°C above normal during highway driving. The fluid level is correct and the fluid is in good condition. What should be investigated?

A. The transmission oil cooler and its cooling circuit — verify the cooler is not restricted internally or externally, the cooler lines are not kinked or collapsed, the coolant flow through the cooler (if engine-coolant cooled) is adequate, and the cooling fan (if air-cooled) is operating; an elevated fluid temperature with correct level and good fluid condition points to a heat rejection problem rather than a heat generation problem

B. The torque converter, which may be slipping continuously and generating friction heat that exceeds the cooler's capacity

C. The transmission's internal clutch packs, which may be applying with insufficient force and generating heat from continuous slipping

D. The engine's coolant temperature, which if elevated would transfer heat to the transmission fluid through the shared oil cooler

84. A heavy-duty truck with a tandem drive axle has the inter-axle differential lock engaged. The driver makes a sharp turn on dry pavement and hears a loud bang from the rear of the truck. After the turn, the truck drives normally with the lock still engaged. What most likely caused the bang?

A. An axle shaft momentarily twisted beyond its elastic limit and then snapped back — the locked differential forces both drive axles to turn at the same speed during a turn, but the outer wheels need to turn faster than the inner wheels; the resulting torsional stress on the axle shafts can momentarily exceed the shaft's elastic limit, producing the bang as the stressed shaft releases its stored energy

B. The ring gear teeth on one axle momentarily disengaged from the pinion under the torsional stress and then re-engaged

C. A tire momentarily broke traction and chirped on the dry pavement from the binding caused by the locked differential

D. The inter-axle lock mechanism released and re-engaged under the torsional stress of the turn, producing the bang

85. A fleet technician discovers that a truck's automatic transmission is being serviced with the incorrect fluid specification — Dexron III instead of the manufacturer-specified TES-295. What are the potential consequences of using the wrong fluid?

A. No consequences — Dexron III and TES-295 are interchangeable in all Allison automatic transmissions

B. The incorrect fluid may not have the correct friction coefficient for the clutch packs, the proper thermal stability for the operating temperature range, or the correct viscosity characteristics — using the wrong specification can cause clutch shudder, erratic shifts, accelerated clutch wear, seal degradation, and thermal breakdown of the fluid at the transmission's normal operating temperature

C. The only consequence is a slightly different fluid color that may confuse future technicians during diagnosis

D. The incorrect fluid will cause the transmission filter to clog prematurely but will not affect the clutch packs or shift quality

86. A heavy-duty truck has a condition where the steering wheel vibrates at highway speed but the vibration is not present at lower speeds. The front tires have been balanced and the balance is confirmed as correct. The steering linkage has been inspected and is tight. What additional component should be checked?

A. The rear tires, which if out of balance could transmit vibration through the chassis to the steering wheel at highway speed

B. The power steering pump, which may produce pulsating output at higher engine RPM that corresponds to highway speed

C. The engine mounts, which if worn could allow the engine to vibrate at a frequency that transfers to the steering column at highway speed

D. The front wheels for excessive radial or lateral runout, and the hub mounting surfaces for debris or corrosion — a balanced tire on a wheel with runout still vibrates because the wheel's physical deviation from true creates a once-per-revolution disturbance that tire balance cannot correct

87. A heavy-duty truck has a power steering system that produces a whining noise that varies with engine RPM. The fluid level is correct and there are no visible leaks. What is the most likely cause?

A. The power steering gear has internal wear that creates a whistling noise as fluid flows through the worn internal passages

B. The power steering pump is beginning to fail — worn internal vanes, worn cam ring, or scored pump housing creates clearance that allows fluid to bypass at high velocity, producing the whining noise; alternatively, the pump's inlet is partially restricted, causing cavitation that produces the whine

C. The steering column U-joints are binding and creating a noise that sounds like it is coming from the power steering system

D. The drive belt is misaligned on the power steering pump pulley, causing the belt to ride on the pulley's edge and produce a whining noise

88. A truck's steer axle alignment measurements show: total toe is 2 mm toe-in (specification: 1.5-3.0 mm toe-in), left caster is $+3.5^\circ$ (specification: $+3.0^\circ$ to $+4.5^\circ$), right caster is $+3.5^\circ$, left camber is $+0.5^\circ$ (specification: $+0.5^\circ$ to $+1.0^\circ$), right camber is $+0.5^\circ$. All measurements are within specification.

However, the driver reports the truck pulls slightly to the right during straight-line driving. What is the most likely cause?

- A. Road crown — most roads are crowned (higher in the center, sloping to both edges) to drain water, and the slope causes the vehicle to drift toward the lower edge (the right side in North America); this pull is a road characteristic, not a vehicle fault
- B. A worn steering damper that cannot prevent the steering from drifting to the right at highway speed
- C. The steering gear is adjusted too loosely, allowing the road crown to overcome the steering's centering force
- D. The right front tire has lower inflation pressure than the left, creating a rolling resistance difference that pulls the vehicle to the right

89. A heavy-duty truck equipped with air ride suspension on the drive axles has a condition where the ride height drops on one side when the vehicle is parked for several hours but returns to normal within 30 seconds of engine startup. What is the most likely cause?

- A. The height control valve on the affected side is leaking internally when the valve is in its holding position during parking — the valve slowly vents air from the spring during the static parking period; when the engine starts and the air system pressurizes, the valve immediately responds to the low ride height and adds air, restoring the correct height within 30 seconds
- B. The air spring on the affected side has a small leak at its base seal that is only apparent when the vehicle sits for extended periods
- C. The air supply line to the affected side has a check valve that slowly leaks in reverse when the compressor is not running
- D. The shock absorber on the affected side is seized and pulling the frame down on that side over time

90. A heavy-duty truck has a condition where both front tires show cupping (scalped wear) on the outside edges of the tread. The tires are balanced, the alignment is within specification, and the wheel bearings are properly adjusted. What is the most likely cause?

- A. The tires are an incorrect size for the application and the sidewall stiffness does not match the vehicle's weight
- B. The road surface on the vehicle's primary routes has an exceptionally abrasive texture that creates the cupping pattern
- C. The front axle has a twist that is loading the outside edges of both tires during straight-line driving
- D. The front shock absorbers are worn — inadequate damping allows the front tires to bounce during driving, and the intermittent ground contact at the outside edge of the tread creates the scalloped wear pattern; replacing the shock absorbers restores proper tire contact and eliminates the cupping

91. A tandem-axle trailer has a condition where the front axle tires in the tandem group wear significantly faster than the rear axle tires. The alignment has been verified as correct for both axles. What other factor could explain the differential wear rate?

- A. The front axle of the tandem absorbs more of the initial braking force than the rear axle during each stop
- B. The front axle carries a disproportionate share of the load because the center of the trailer's cargo is positioned forward of the tandem group's centerline — the weight distribution places more load on the leading axle, causing its tires to wear faster from the increased contact pressure
- C. The rear axle tires have a harder rubber compound from a different manufacturer than the front axle tires
- D. The suspension equalizer beam is biased forward, transferring more suspension travel to the front axle

92. A heavy-duty truck's fifth wheel coupling makes a loud metallic clunk every time the vehicle transitions from acceleration to braking or vice versa. The locking jaws are confirmed as fully closed around the king pin. What is the most likely cause?

- A. Wear between the king pin and the locking jaw faces has created free play that allows the king pin to shift position during torque reversals — the clunk is the impact of the king pin contacting the jaw faces as the load direction changes; the jaw surfaces and/or king pin must be inspected for wear
- B. The trailer's upper coupler plate is bent and rocks on the fifth wheel surface during load changes

C. The fifth wheel mounting bolts have loosened, allowing the entire fifth wheel assembly to shift during load transitions

D. The fifth wheel plate is dry and the king pin is sticking during articulation, releasing with a clunk during load reversals

93. A truck equipped with leaf spring suspension on the steer axle produces a clunking noise when the vehicle starts from a stop. The noise comes from the front right spring area. The spring center bolt, U-bolts, and shackle pins have been inspected and are tight. What additional component should be checked?

A. The leaf spring's anti-friction pads (the plastic or bronze pads between the spring leaves), which if worn or missing allow the leaves to shift relative to each other under torque loading, producing the clunk as the leaves resettle during the load transition from rest to acceleration

B. The spring's main leaf eye bushing, which if worn would allow the spring eye to shift in the hanger bracket during load changes

C. The spring's main leaf itself for a hairline crack near the eye that allows the spring to flex slightly and clunk when loaded

D. The axle seat pad between the spring and the axle, which if missing would allow the axle to shift on the spring during torque application

94. A heavy-duty truck has been in a minor collision that impacted the right front steer axle area. After the collision, the truck pulls to the right during braking and tracks straight during normal driving. The tires and brakes have been inspected and are functioning correctly. What should be investigated?

A. The right front brake anchor pin, which may have bent in the collision and is now causing the brake shoes to apply at an incorrect angle

B. The power steering gear, which may have been damaged in the collision and is allowing internal bypass when the brakes are applied

C. The front axle alignment — the collision may have bent the steering knuckle or axle in a way that does not affect straight-line tracking but changes the braking geometry; specifically, the collision may have altered the scrub radius or the steering offset on the right side, causing the right wheel to pull toward the curb under braking forces

D. The steering column, which may have shifted in the collision and is providing incorrect steering feedback during braking events

95. A truck's right front wheel has a recurring issue of the wheel bearing overheating and failing prematurely — the bearing has been replaced three times in 100,000 km. Each time, the replacement bearing is installed correctly with proper adjustment, lubrication, and seal. What should be investigated?

A. The brake on the right front — a dragging brake generates heat that transfers through the hub to the wheel bearing, and continuous elevated temperature accelerates grease degradation and bearing wear; even a slight drag that is not noticeable during normal driving can generate enough cumulative heat over time to cause premature bearing failure

B. The spindle surface for scoring or corrosion that damages the inner race seating surface each time a new bearing is installed

C. The hub seal on the right front, which if the wrong size or incorrectly installed could allow contaminants to enter the bearing

D. The tire pressure on the right front, which if chronically overinflated could concentrate the tire load on a smaller contact patch and increase the bearing's radial load

96. A truck equipped with adjustable air ride suspension has a condition where the vehicle sits level when parked but leans noticeably to the left when driving. The air system pressure is adequate and the height control valves appear to function. What could explain the lean only during driving?

A. The right side air spring has a faster response rate than the left side, causing the right side to adjust to driving dynamics more quickly than the left

B. The cargo load is positioned off-center to the left, but the suspension compensates when parked by equalizing pressure

C. The left side height control valve has a delayed response to dynamic inputs — during driving, the road input and body roll cause continuous height corrections; if the left valve cannot respond as quickly as the right valve due to a sluggish valve or restricted air supply, the left side falls behind in maintaining ride height during the dynamic conditions of driving, producing the lean

D. The right side shock absorber is stronger than the left side, holding the right side up during dynamic maneuvers

97. A trailer equipped with a steerable tag axle (self-steering) has a condition where the tag axle tires wear rapidly on both edges (shoulder wear). The inflation pressure is correct. What is the most likely cause?

A. The tag axle's caster angle is set too aggressively, causing the tires to lean during the self-steering action

B. The tag axle's load share is too high, overloading the tires beyond their rated capacity and causing both shoulders to flex excessively

C. The self-steering mechanism's return-to-center device has worn, allowing the axle to oscillate continuously during straight-line driving instead of holding a steady straight-ahead position — the oscillation causes the tires to scrub alternately left and right, wearing both edges

D. The tag axle tires are an incorrect size for the application and the sidewall height does not match the suspension geometry

98. A technician is inspecting a truck's wheel studs and finds one stud with a visible crack approximately halfway down its length. The remaining studs appear undamaged. What is the correct action?

A. Monitor the cracked stud at the next service interval since a single cracked stud among an otherwise intact set is unlikely to fail before the next inspection

B. Apply a threadlocker compound to the cracked stud to prevent the crack from propagating further

C. Replace only the cracked stud and re-torque all wheel nuts to specification

D. Replace the cracked stud and closely inspect all remaining studs on that wheel for signs of fatigue cracking — a cracked stud indicates that the studs on that wheel position have been subjected to excessive stress (from improper torque, a wheel seating problem, or an impact event), and the remaining studs may have incipient fatigue cracks that are not yet visible

99. A heavy-duty truck's steering wheel returns to center after a left turn but does not return to center after a right turn — the driver must manually straighten the wheel. What alignment or steering condition could cause this asymmetric behavior?

- A. Unequal caster side-to-side — the self-centering force from caster is proportional to the caster angle on each side; if the left caster is higher than the right, the left side generates stronger self-centering force that returns the wheel after a left turn, but the right side's lower caster generates insufficient centering force to return the wheel after a right turn
- B. Unequal tie rod end lengths that create a different steering arc in each direction
- C. A binding condition in the steering gear that only occurs during right-turn output shaft rotation
- D. The power steering gear has a directional seal leak that assists left turns but not right turns

100. A trailer with spring suspension has a condition where one spring has taken a set (sagged) approximately 25 mm compared to its partner on the opposite side. The trailer leans to the side with the sagged spring. What is the consequence beyond the visible lean?

- A. The sagged spring's reduced arch decreases the spring's stiffness, allowing that side to bottom out over bumps more easily
- B. The weight on the sagged side is redistributed to the other axle positions, potentially overloading them
- C. The sagged spring changes the axle alignment on the affected side — the reduced arch alters the axle's position in the spring seat, potentially changing the toe, wheelbase, and camber on that side; the lean also shifts cargo weight to the sagged side, potentially overloading that wheel position while underloading the opposite side
- D. The sagged spring will recover its original arch after the trailer is unloaded for an extended period

101. A technician is performing a pre-trip inspection on a tractor-trailer combination and discovers that two adjacent wheel studs on a trailer dual wheel are broken. The remaining studs are intact and the wheel appears secure. Can the trailer continue to operate?

- A. The trailer can continue to the next scheduled service point as long as the remaining studs are torqued correctly
- B. Two broken studs on a single wheel is a critical safety condition — the wheel must be removed, all studs on that hub inspected for fatigue, the broken studs replaced, and the cause of the failure

investigated before the trailer operates; two adjacent broken studs significantly reduce the wheel's clamping force and the remaining studs are likely overloaded

C. The trailer can operate at reduced speed (below 60 km/h) until the broken studs can be replaced at the home terminal

D. Only the outer wheel of the dual pair needs to be removed since the inner wheel carries the primary load

102. A truck equipped with disc brakes on the steer axle has a condition where the brake pedal pulsates during stops from highway speed. The rotors were replaced 10,000 km ago. The technician measures the rotors and finds thickness variation (DTV) of 0.003 inches. The maximum allowable DTV is 0.001 inches. What caused the DTV to develop on relatively new rotors?

A. The brake pads are a non-OEM specification with a harder compound that is creating hot spots on the rotor surface

B. The caliper slide pins are seized on one side, causing uneven pad contact that wears the rotor unevenly

C. Normal rotor wear from 10,000 km of urban driving that will continue until the rotor reaches its minimum thickness

D. The rotor mounting surface on the hub was not clean when the new rotors were installed — corrosion, debris, or a raised ridge on the hub face caused the rotor to mount at a slight angle; as the angled rotor rotates, one point contacts the pads more than others, creating accelerated localized wear that develops into the measured thickness variation

103. A heavy-duty truck's frame has been measured and found to have a sway condition — the frame is bowed to the left when viewed from above. What symptoms does a swayed frame produce?

A. The vehicle pulls to the left during acceleration and to the right during braking because the frame geometry biases the thrust line in opposite directions under different loading conditions

B. The vehicle dog-tracks to the left because the bowed frame shifts the rear axle's thrust line to the left of the front axle's tracking path

C. The vehicle wanders at highway speed because the bowed frame creates an unstable platform for the steering geometry

D. The vehicle tracks with the rear offset from the front (dog-tracking), experiences accelerated tire wear from the misaligned axle geometry, and may have driveline vibration from the driveshaft operating at incorrect angles — the bowed frame shifts all axle positions from their designed alignment with the frame's centerline

104. A heavy-duty truck's cab has a persistent whistling noise at highway speed that was not present previously. The noise appears to come from the driver's door area. The door closes and latches normally. What should be inspected?

A. The door lock mechanism, which may have a loose internal component that vibrates and produces the whistling noise at highway speed

B. The exterior mirror mounting, which may have loosened and created a gap that produces an aerodynamic whistle

C. The door seal (weather strip) for a section that has compressed, cracked, separated, or lost its adhesion — a gap in the door seal allows high-speed air to force its way through the narrow opening, producing the whistling noise; the noise was not present previously because the seal was intact; age, UV exposure, and repeated door openings degrade the seal over time

D. The window glass run channel, which may have accumulated debris that prevents the glass from sealing against the weather strip

105. A transit bus has a condition where the HVAC system produces adequate heating and cooling, but the air distribution is incorrect — all air comes from the defrost vents regardless of the mode selected (panel, floor, defrost). What is the most likely cause?

A. The HVAC mode door actuator has failed in the defrost position or the mode door itself is stuck — the actuator motor, its control signal, or the door's mechanical linkage is preventing the door from moving to the panel or floor positions; the defrost position is the default fail-safe on many vehicles (to ensure the driver can always defog the windshield)

B. The blower motor is running in reverse, pushing air through the duct system backward and out the defrost vents

C. The cabin air filter is installed backward, redirecting airflow to the defrost ducts regardless of mode selection

D. The HVAC control panel's mode selector switch has a broken contact that only completes the circuit for the defrost mode

106. A truck's heated exterior mirrors function correctly in cold weather but the driver reports that the mirror glass sometimes cracks after the heated mirrors are turned on. What is the most likely cause?

A. The mirror heating element has a hot spot that concentrates heat in one area of the glass, creating a thermal gradient that exceeds the glass's thermal shock tolerance — when the element activates in cold weather, the rapid localized heating against the cold glass creates stress that cracks the glass

B. The mirror glass has a manufacturing defect in its tempering process that makes it susceptible to cracking at any temperature

C. The mirror's electrical connection produces a voltage spike when activated that physically stresses the glass through electromagnetic force

D. The mirror's adhesive bond to the heating element has deteriorated, creating an air gap that traps cold air against the glass

107. A heavy-duty truck has a condition where the cab interior has an intermittent electrical burning smell. No smoke is visible and all electrical systems appear to function normally. What should the technician investigate?

A. The exhaust system, which may have a leak that is allowing exhaust fumes to enter the cab through the HVAC fresh air intake

B. An overheated wire, connector, or switch in the cab wiring — the smell of burning insulation is distinctive and indicates a conductor that is carrying more current than its wire gauge or connection can handle; the overheated component has not yet failed but is progressively degrading its insulation, and continued operation risks an electrical fire; all accessible wiring, connectors, and switches in the cab must be inspected for signs of heat discoloration, melted insulation, or deformed connectors

C. The HVAC blower motor, which may be overheating from worn bearings and producing a smell that mimics electrical burning

D. The catalytic converter, which may be running hot and radiating heat that the cab structure absorbs and conducts to the interior

108. A truck driver reports that the driver's seat has developed a lateral rocking motion — the seat rocks approximately 10 mm side to side when the driver shifts their weight. The seat mounting bolts are tight. What is the most likely cause?

A. The seat slider mechanism's rails and bearing surfaces have worn, developing lateral play that allows the seat to rock on its slides — the mounting bolts secure the slider to the floor and the seat to the slider, but the worn interface between the moving and stationary slider components has free play that the bolts cannot eliminate

B. The cab floor has developed a fatigue crack beneath the seat mounting plate that flexes under the driver's weight

C. The seat cushion foam has compressed unevenly, creating a rocking sensation that mimics mechanical play

D. The seat's air suspension has a leak on one side that allows the seat to lean during weight shifts

109. A technician inspecting a trailer discovers that one of the trailer's structural cross members has been repaired with a welded patch plate. The weld quality appears poor — the bead is uneven, has visible porosity, and the patch plate does not fully cover the original damage. What is the concern?

A. A poor-quality weld repair on a structural crossmember introduces more risk than the original damage — the porous weld has reduced strength compared to a sound weld, the heat-affected zone around the weld has altered the base metal's properties, and the incomplete coverage leaves part of the original damage unaddressed; the repair may fail under load, which could result in crossmember collapse, floor failure, and potentially a dropped load

B. The poor weld quality is only a cosmetic concern and the patch plate provides adequate structural reinforcement regardless of the weld condition

C. The weld porosity will allow moisture to penetrate the repair area and cause corrosion, but the structural integrity is not affected

D. The repair is acceptable as long as the trailer passes an annual structural inspection by a certified inspector

110. A trailer's landing gear crank handle requires significantly more effort to turn than normal. The landing gear legs extend and retract but very slowly and with great resistance. What is the most likely cause?

A. The landing gear legs need lubrication at the leg tube-to-outer tube interface and the gearbox requires a grease service

B. The trailer is sitting on the landing gear with the tractor disconnected, and the trailer's full weight is bearing on the legs, creating resistance

C. The landing gear sand shoes have sunk into soft ground, creating suction resistance that makes cranking difficult

D. The landing gear gearbox is contaminated with moisture, corrosion, or old grease that has solidified — the internal gears are turning through a thick, resistant medium that requires more effort; alternatively, the leg tubes may be corroded or bent, creating friction that opposes the crank effort

111. A trailer's air ride suspension has been set to the correct ride height using the manufacturer's measuring procedure. However, the driver reports that the trailer rides roughly compared to other identical trailers. What should be checked?

A. The air spring pressures on each position to verify they match the load and the specification

B. The shock absorbers on the trailer's suspension — with the ride height correctly set, the air springs are at the correct pressure for the load; rough riding indicates inadequate damping from worn shock absorbers that cannot control the spring oscillation, allowing the trailer to bounce excessively over road irregularities

C. The air spring volume, which may be incorrect if the wrong air springs were installed during a previous replacement

D. The height control valve response rate, which if too fast could overreact to road surface changes and create a rough ride

112. A trailer equipped with disc brakes has a condition where one caliper produces a grinding noise during the first few stops after the vehicle has been parked overnight in wet conditions. The noise disappears after 3-4 brake applications. What is occurring?

- A. The brake pads have absorbed moisture overnight and are squealing as the moisture is burned off during the first applications
- B. The caliper slide pins have corroded overnight and are binding during the first applications until the brake heat loosens the corrosion
- C. A thin layer of rust (surface oxidation) has formed on the rotor surface overnight from the moisture exposure — the first few brake applications scrub the rust off the rotor surface with a grinding noise, and once the rust is removed, the clean rotor contacts the pads quietly
- D. The ABS modulator is performing an extended self-test during the first few stops after overnight parking

113. A trailer used for chemical transport has a requirement for a spill containment lip around the base of the tank. During an inspection, the technician finds that the containment lip has a crack that extends approximately 15 cm along one side. What is the significance?

- A. The cracked containment lip compromises the trailer's ability to contain a spill from a leaking valve, fitting, or hose — in the event of a product leak during transport, the crack allows the hazardous material to escape the containment area and contaminate the road surface or surrounding environment; the crack must be repaired before the trailer transports any hazardous cargo
- B. The containment lip crack is a cosmetic issue and does not affect the trailer's ability to transport chemicals safely
- C. The containment lip is only required during loading and unloading operations and the crack does not affect transport safety
- D. The crack is significant only if the chemical being transported is a Class 8 (corrosive) material

114. A trailer's light bar (rear header light assembly) produces intermittent flickering on all lamps in the bar simultaneously. The J560 connector has been inspected and all pins are clean and tight. What is the most likely cause?

- A. The tractor's alternator has an intermittent diode failure that produces voltage spikes affecting only the trailer lighting
- B. The trailer ABS module is cycling power to the light bar as part of a continuous self-test routine

C. The light bar's internal wiring has been exposed to heat or UV radiation that has degraded the insulation

D. The light bar has a common internal ground connection or a common power feed connection that is intermittent — all lamps in the bar share this connection, and when it loses contact momentarily (from vibration, corrosion, or a loose terminal), all lamps flicker simultaneously; the fault is inside the light bar assembly rather than in the external wiring

115. A reefer trailer's TRU (transport refrigeration unit) has adequate cooling capacity but produces excessive noise from the condenser area. The noise is a rattling or buzzing sound. What should be inspected?

A. The condenser fan motor bearings, which may be worn and producing the rattling noise during rotation

B. The condenser coil fins, which may have debris trapped in them that vibrates during fan operation; the fan blade may also be damaged, cracked, or out of balance, producing the rattle; or the condenser mounting hardware may have loosened, allowing the entire condenser assembly to vibrate against the TRU housing

C. The refrigerant charge level, which if low causes the compressor to cavitate and produce a noise that sounds like it comes from the condenser

D. The TRU's diesel engine, which may have a misfire that produces a vibration transmitted through the mounting frame to the condenser

116. A flatbed trailer's stake pockets (the square tubes welded to the trailer's side rail that accept cargo stakes) show visible cracks at the weld joints between the pockets and the side rail. Three of twelve pockets on one side are cracked. What is the concern?

A. The cracked stake pocket welds will allow water to enter the side rail and cause internal corrosion over time

B. The stake pockets are decorative and are not structurally important for cargo securement

C. The cracked welds will only affect the trailer's resale value and do not pose a safety concern during operation

D. The cracked stake pockets may not be able to support the cargo stakes under the forces of cargo securement during braking, cornering, and road vibration — if a stake fails during transport, the cargo restraint at that point is lost and the cargo can shift or fall from the trailer

117. A truck's A/C system has a condition where the compressor cycles on for 5 seconds, then off for 3 seconds, continuously. The system provides inadequate cooling. The manifold gauges show: low side drops to 5 psi during the on cycle and rises to 40 psi during the off cycle. What is the most likely cause?

A. The system has a very low refrigerant charge — the reduced volume of refrigerant drops the suction pressure rapidly to the low-pressure switch's cut-out point (around 25 psi) within 5 seconds of compressor operation; when the compressor stops, pressure equalizes above the cut-in point and the cycle repeats; the rapid cycling with extremely low suction pressure confirms insufficient refrigerant in the system

B. The compressor has a damaged valve plate that cannot maintain pressure during the on cycle

C. The expansion valve is stuck closed, preventing refrigerant from entering the evaporator

D. The condenser fan has failed, causing high-side pressure to spike and the high-pressure switch to cycle the compressor

118. A truck's cab heater produces a gurgling or bubbling noise from behind the dashboard when the engine RPM is increased. The heater produces adequate heat. What is the most likely cause?

A. The heater core has a partial internal blockage that causes turbulent coolant flow at higher pump speeds

B. The heater core supply hose has a kink that creates turbulence as the coolant velocity increases

C. The heater control valve is partially closed and the increased coolant pressure at higher RPM forces coolant through the restricted opening turbulently

D. Air is trapped in the heater core or its supply hoses — the bubbling noise is the trapped air pocket being pushed through the small heater core tubes by the increased coolant flow at higher RPM; the system must be bled to remove the trapped air

119. A truck's A/C system has been recharged after a leak repair. The system cools adequately, but the compressor is noticeably noisier than before the repair. The refrigerant charge weight has been verified as correct. What is the most likely cause?

A. The leak repair introduced a small amount of air into the system that was not fully evacuated before recharging

B. The compressor oil charge was not restored after the leak depleted the system's oil — the compressor is running with insufficient lubrication, causing the internal components to operate with increased metal-to-metal contact and producing the elevated noise level; the leak carried oil out of the system along with the refrigerant

C. The replacement component (hose, O-ring, or fitting) has a slightly different internal diameter that creates turbulence in the refrigerant flow

D. The compressor clutch air gap has changed during the repair process and is producing engagement noise

120. A bus's passenger compartment A/C system has two evaporator units — one in the front and one in the rear. The front evaporator produces cold air but the rear evaporator produces warm air. Both units share the same refrigerant circuit. What is the most likely cause?

A. The rear evaporator's blower motor has failed, preventing air from flowing across the evaporator core

B. The rear evaporator fan is running but the ductwork between the blower and the evaporator is disconnected

C. The rear evaporator's expansion valve is stuck closed, preventing refrigerant from entering the rear evaporator coil — with no refrigerant flow, the rear evaporator cannot absorb heat and produces warm air; the front evaporator receives its normal refrigerant supply and operates correctly because its expansion valve is functional

D. The rear evaporator is iced over and the frost is blocking all airflow through the core

121. A truck's heated windshield washer system is not producing heated washer fluid. The washer pump works normally and the fluid is dispensed at ambient temperature. What should be checked?

- A. The washer fluid heater element, its fuse, and the wiring between the heater and the washer system — the heater element (typically inline in the washer hose or in the washer reservoir) may have failed open, the fuse protecting the heater circuit may have blown, or the wiring may have an open that prevents current from reaching the heater element
- B. The washer fluid concentration, which if too dilute would not retain heat from the heater element
- C. The engine coolant temperature, which must reach operating temperature before the washer heater activates
- D. The washer nozzle design, which may not be compatible with heated fluid and requires replacement with heated-type nozzles

122. A truck's A/C system has a condition where the high-side pressure is significantly higher than normal while the low-side pressure is slightly lower than normal. The ambient temperature is moderate (25°C). The condenser fan is operating. What is the most likely cause?

- A. The system is overcharged with refrigerant — excess refrigerant fills the condenser with more liquid than it can effectively cool, reducing the condenser's heat rejection surface area and raising the high-side pressure; the excess refrigerant also reduces the evaporator's efficiency by flooding it with more liquid than the airflow can evaporate
- B. The condenser has an airflow restriction from debris buildup on the external fins that prevents adequate heat rejection
- C. The compressor is oversized for the system and is producing excessive discharge pressure
- D. The expansion valve is opening too wide, flooding the evaporator and causing the compressor to work harder

123. A transit bus's HVAC system has a condition where the temperature control is erratic — the system oscillates between too hot and too cold, and the cab temperature never stabilizes at the set point. What is the most likely cause?

- A. The refrigerant charge is slightly low, causing the compressor to cycle and the temperature to oscillate

- B. The blend door actuator or the temperature control sensor has a fault — if the temperature sensor provides inaccurate feedback to the control module, the module continuously overcorrects in both directions; if the blend door actuator responds erratically or has a dead zone in its travel, the door hunts between too-hot and too-cold positions without finding the correct intermediate setting
- C. The condenser fan cycles on and off too rapidly, causing the high-side pressure to fluctuate and the cooling capacity to vary
- D. The cabin air filter is clogged and the reduced airflow causes the evaporator to ice over intermittently

124. A hydraulic system on a utility truck has a condition where the hydraulic oil temperature rises steadily during operation even though no hydraulic functions are being used — the system is in standby with the PTO engaged and the pump running. What is the most likely cause?

- A. The PTO is consuming excessive engine power and generating heat through the gear mesh
- B. The pump's internal bypass is leaking — even with no hydraulic function commanded, the pump is building pressure against the system and the internal wear allows fluid to circulate through the pump's clearances, converting hydraulic energy to heat; additionally, if the system relief valve is set too close to the pump's standby pressure, fluid may be crossing the relief continuously
- C. The hydraulic reservoir is absorbing radiant heat from the engine exhaust system
- D. The system's return filter is creating excessive backpressure that converts the pump's output energy to heat in the filter element

125. A hydraulic crane has a condition where the boom extends smoothly but retracts in a jerky, stop-start pattern. The operator can feel each jerk through the control lever. What is the most likely cause?

- A. Air trapped in the rod side of the cylinder — the air compresses and expands during retraction, causing the piston to move in jerky increments as the air alternately compresses (piston stops) and then allows flow past (piston moves); the jerky motion is especially prominent during retraction because the rod side has less volume and the trapped air has a proportionally larger effect
- B. The directional control valve spool is sticking in the retract position from contamination
- C. The cylinder rod is bent slightly, causing it to bind at specific points during retraction

D. The counterbalance valve is chattering from an incorrect pilot ratio setting

126. A dump truck's hydraulic hoist circuit has a condition where the dump body raises to full height but drifts downward approximately 50 mm per minute when the control valve is in the hold position. The technician disconnects the cylinder lines at the directional valve and plugs the cylinder ports. The drift continues at the same rate. What does this confirm?

A. The directional control valve is the source of the leak because the drift continued after the lines were disconnected

B. The hydraulic pump check valve is allowing pressure to bleed back through the pump

C. The relief valve is set too low and is allowing pressure to bypass

D. The cylinder has an internal piston seal leak — blocking the cylinder ports isolates the cylinder from the valve, and the continued drift proves that the leak path is inside the cylinder; fluid is bypassing from the cap end (pressurized by the load) to the rod end through the worn or failed piston seal

127. A hydraulic system uses a suction strainer at the pump inlet inside the reservoir. The system has been in service for 5 years without the strainer being inspected. The pump has recently developed cavitation noise. What is the relationship between the strainer condition and the cavitation?

A. The suction strainer has no relationship to cavitation — cavitation is caused by high-side pressure exceeding the pump's rating

B. The suction strainer has accumulated contamination over 5 years of operation, progressively restricting the flow of fluid to the pump inlet — the restriction creates a partial vacuum at the pump inlet that causes the fluid to vaporize, forming the cavitation bubbles that collapse inside the pump and produce the characteristic noise

C. The suction strainer has dissolved into the hydraulic fluid from chemical incompatibility, releasing particles that cause the cavitation

D. The suction strainer wire mesh has corroded and collapsed, allowing debris to reach the pump and cause the cavitation noise

128. A technician is troubleshooting a hydraulic system where the relief valve opens at 2,200 psi instead of its rated setting of 3,000 psi. The technician adjusts the relief valve screw but cannot achieve the 3,000 psi setting — the maximum achievable pressure is 2,400 psi regardless of adjustment. What is the most likely cause?

A. The relief valve spring has weakened from fatigue or thermal degradation and can no longer generate the force needed to hold the valve closed at 3,000 psi — the spring must be replaced to restore the valve's rated pressure setting

B. The pump cannot generate more than 2,400 psi due to internal wear, and the relief valve is actually set correctly but the pump limits the maximum achievable pressure

C. The pressure gauge is inaccurate at higher readings and the system is actually reaching 3,000 psi

D. The relief valve seat has been damaged by contamination and cannot seal fully, causing a bypass leak that prevents the system from reaching full pressure

129. A hydraulic system on a refuse truck has a condition where all functions operate normally when the engine is at operating RPM but become erratic (jerky and slow) when the engine drops to idle for the hydraulic work cycle. The PTO remains engaged at idle. What is the most likely cause?

A. The hydraulic pump's minimum operating RPM is higher than the engine's idle speed, and the pump produces insufficient flow and inconsistent pressure at idle

B. The directional control valves are designed for a minimum flow rate that the pump cannot achieve at idle speed

C. The engine's idle speed is set too low for the PTO-driven pump to produce adequate, consistent flow — the gear pump's output is directly proportional to its RPM, and at idle the pump output may fall below the minimum flow required for smooth actuator operation; increasing the idle speed to the manufacturer's PTO operating specification resolves the erratic operation

D. The hydraulic reservoir is not pressurized at idle, and the non-pressurized condition causes air ingestion at the pump inlet

130. A hydraulic system has a condition where the pump produces adequate flow and pressure, but the oil level in the reservoir drops slowly over several days even though no external leaks are visible. Where is the oil going?

- A. The oil is evaporating from the reservoir through the breather cap due to elevated operating temperatures
- B. The oil is being absorbed by deteriorated internal hose linings that are swelling from chemical incompatibility
- C. The oil is being consumed by a worn cylinder rod seal that allows a small amount of oil to escape past the seal on each cylinder stroke — the oil drips onto the ground or onto the machine's structure where it is not easily visible as a traditional leak; over days, the cumulative loss becomes measurable at the reservoir level
- D. The oil is leaking into the engine coolant through a shared oil cooler that has developed an internal leak — hydraulic oil at pump pressure (higher than cooling system pressure) forces oil through the leak into the coolant; the oil level drops and the coolant level rises or the coolant becomes discolored with oil contamination

131. A hydraulic tailgate lift's control valve has four positions: raise, lower, float, and hold (neutral). What is the purpose of the float position?

- A. Float allows the pump to circulate oil through the system at zero pressure for warming the fluid before operation
- B. The float position connects both sides of the cylinder to the tank simultaneously, allowing the cylinder to move freely in either direction under external forces — this allows the tailgate platform to rest on the ground and follow the ground contour as cargo is loaded or unloaded, rather than being held rigidly by hydraulic pressure
- C. Float position locks the cylinder in place but relieves the pump pressure to reduce system heat during extended loading operations
- D. The float position diverts all pump flow to the tank for maximum flow during the next commanded function

132. A battery electric transit bus has a condition where the traction motor produces a loud whining noise during acceleration that was not present when the bus was new. The noise increases in pitch with motor speed. What is the most likely cause?

- A. The traction motor's bearings have worn from the high rotational loads of transit operation, and the increased clearance allows the rotor to vibrate against the worn bearing surfaces — the whining noise is the bearing race and rotor vibrating at a frequency proportional to rotational speed
- B. The inverter is producing an incorrect AC waveform that excites a resonance in the motor's stator windings
- C. The motor's cooling fan has lost a blade, creating an imbalanced airflow that produces the whining noise at motor speed
- D. The reduction gearbox between the motor and the drive axle has worn teeth that produce a whine proportional to input speed

133. A hybrid electric delivery truck has a condition where the 12-volt auxiliary battery requires replacement every 6 months. The DC-DC converter tests within specification and the 12-volt system parasitic draw is normal. What could explain the premature battery failures?

- A. The engine's vibration is causing the battery's internal plates to fatigue and fail prematurely
- B. The hybrid system's high-voltage electromagnetic fields are inducing current in the 12-volt battery that accelerates internal corrosion
- C. The DC-DC converter may be producing a charging voltage with excessive AC ripple that, while within the overall voltage specification, causes accelerated battery plate degradation — alternatively, the 12-volt battery may be subjected to deep discharge cycles when the high-voltage system is shut down and the DC-DC converter is inactive, and repeated deep cycling shortens lead-acid battery life dramatically
- D. The 12-volt battery is the wrong group size for the application and has insufficient capacity for the vehicle's auxiliary loads

134. A battery electric truck's regenerative braking system produces a noticeable vibration through the brake pedal during moderate regenerative deceleration. The friction brakes are not applied during this event. What is the most likely cause?

- A. The traction motor has a rotor imbalance that produces vibration when the motor operates as a generator

B. The inverter is producing a pulsating DC output during regeneration that creates a cyclic torque variation in the motor — the variation is transmitted through the drivetrain to the wheels and through the chassis to the brake pedal; the pulsation may be caused by a failing inverter switching device, a software control issue, or a sensor fault that disrupts the smooth regenerative torque command

C. The high-voltage battery has a cell imbalance that creates a varying resistance to the regenerative charging current

D. The ABS system is misinterpreting the regenerative deceleration as wheel lockup and is modulating the friction brakes

135. A technician is servicing a plug-in hybrid electric truck and needs to disconnect the high-voltage charging inlet connector on the vehicle's exterior. The vehicle is not connected to a charger. Is it safe to disconnect the charging inlet without performing the full high-voltage de-energization procedure?

A. Yes — the charging inlet is safe to disconnect without de-energization because the high-voltage interlock on the charging inlet automatically opens the vehicle's contactors when the charger is removed

B. The charging inlet should not be disconnected without consulting the manufacturer's service manual for the specific procedure

C. The charging inlet can be safely disconnected because it only carries voltage when connected to an active charger

D. The technician must perform the full de-energization procedure before disconnecting the charging inlet — even though no charger is connected, some vehicles maintain high voltage at the charging inlet for systems that require constant high-voltage supply, or the contactors may fail to open and leave the inlet energized; the only safe assumption is that any high-voltage connector may be energized until verified otherwise through the proper de-energization and voltage verification procedure

Practice Exam 8: Answer Key and Explanations

1. C — A leaf spring under vehicle load stores significant energy. Removing the spring without independently supporting the axle allows the axle to drop uncontrolled under the vehicle's weight — potentially crushing the technician working underneath, severing brake hoses and ABS wiring, and damaging suspension components. The axle must be supported by jack stands or a floor jack that is completely independent of the spring being removed before any spring bolts are loosened.

2. A — DPF ash contains metallic oxides from engine oil additive packages — zinc, phosphorus, calcium, and magnesium compounds — as well as fine particulate matter from combustion. When

blown out with compressed air, these particles become airborne at respirable sizes. The technician must wear a respirator rated for fine particulates (P100 minimum) and the operation must be performed in a ventilated area or with local exhaust capture to prevent inhalation exposure. Eye protection and skin covering prevent contact with the expelled material.

3. D — Lifting a vehicle at non-designated points risks the lift pads crushing body panels, collapsing mounting brackets, or allowing the vehicle to shift on the pads. The manufacturer's designated lift points are engineered to support the vehicle's full weight safely — they are located on the frame rails or structural crossmembers that can handle the concentrated load. Using incorrect lift points on a cab-over bus is particularly dangerous because the bus's body construction may not have the localized strength to support the concentrated lift pad load.

4. B — Parts washing tanks using petroleum-based solvents are a fire hazard — the solvent's vapors are flammable and a fire can start from a spark, a hot component placed in the tank, or an external ignition source. The fusible link lid is the primary fire safety device — the link is a low-melting-point metal element that holds the lid open during normal use; when a fire occurs and the temperature rises, the fusible link melts, releasing the lid to fall closed and smother the fire by cutting off the oxygen supply.

5. A — Chemical burns from alkaline degreasers continue to damage tissue as long as the chemical remains in contact with the skin. The immediate priority is dilution and removal through continuous flushing with large quantities of clean water for a minimum of 20 minutes. Neutralizing an alkali burn with an acid is dangerous — the exothermic neutralization reaction generates heat that compounds the thermal injury on already-damaged tissue. After thorough flushing, the technician must seek medical attention for evaluation and treatment.

6. D — Hydraulic systems can retain dangerous residual pressure even after the engine is shut off and the pump stops. Trapped fluid between closed valves, loaded cylinders, and accumulators can maintain system pressure indefinitely. The technician must cycle all control levers with the engine off to relieve trapped pressure in each circuit, then verify zero pressure using the system gauge or by very slowly cracking a fitting while wearing eye protection. A high-pressure stream of hydraulic fluid can penetrate skin and cause injection injuries.

7. B — An eyewash station is an emergency device that must function perfectly the instant it is needed — there is no second chance to test it during an actual chemical eye exposure. ANSI Z358.1 requires weekly testing to verify clean water flow, adequate temperature, and proper pressure. A station that has not been tested in 6 months may have stagnant water colonized by bacteria (creating an infection risk), corroded valves that do not open, or blocked nozzles that do not deliver adequate flow.

8. C — A collision-damaged vehicle with deployed airbags still contains live, undeployed SRS components — side curtain airbags, knee airbags, seatbelt pretensioners, and potentially damaged wiring that could trigger any remaining live unit. The SRS system stores electrical energy in capacitors that can fire these devices even after the battery is disconnected. The battery must be disconnected first, then the manufacturer-specified capacitor discharge time (typically 1-5 minutes) must elapse before any work begins near SRS components.

9. B — A relative compression test measures each cylinder's contribution to cranking speed fluctuation. If all cylinders produce equal RPM variations during cranking, all cylinders have approximately equal compression. This eliminates a mechanical compression problem (worn rings, leaking valve, blown gasket) on the misfiring cylinder because it compresses equally to the others. The misfire must therefore be caused by a fuel delivery problem — the injector on that cylinder is not firing, is misfiring, or is delivering incorrect fuel quantity.

10. D — Chromium is the primary plating material on piston compression rings (chrome-faced rings), and iron is the primary material of cylinder liners. When both appear together at elevated levels, the ring-to-liner interface is wearing at an accelerated rate — the chrome ring faces are wearing against the iron liner bores, producing both metals simultaneously. The grey, metallic-flecked appearance of the oil confirms visible metallic contamination from this internal wear process.

11. A — The electronic systems are delivering exactly what the ECM commands — boost pressure matches commanded, fuel pressure matches commanded. Yet the engine produces only 80% of rated power. The electronic systems are doing their job; the engine's mechanical systems are not converting the delivered air and fuel into the expected power. Valve timing errors, low compression, or excessive exhaust restriction all reduce the engine's mechanical efficiency, causing the deficit between commanded inputs and actual output.

12. C — Exhaust gas temperature is a direct indicator of combustion heat in each cylinder. A single cylinder running 100°C hotter than the others is burning more fuel than the ECM commanded. An over-fueling injector delivers excess fuel that produces a richer, hotter combustion event. The elevated temperature accelerates thermal wear on that cylinder's piston, rings, valves, and injector tip, and the excess fuel produces additional soot that loads the DPF.

13. B — A mechanical fuel injection pump uses precision-fitted plunger-and-barrel assemblies to generate injection pressure. When these assemblies wear, the clearances between the plunger and barrel enlarge. At cold temperature, the fuel's higher viscosity partially seals these enlarged clearances, allowing the pump to function adequately. As the pump heats during operation, the fuel thins and leaks

past the worn surfaces more rapidly, reducing the pump's ability to build injection pressure and deliver precise fuel quantities — producing the temperature-dependent deterioration.

14. D — Both measurements — crankcase pressure at 2.5 inches of water column (below the 3.0 maximum) and oil consumption at 0.5 litres per 1,000 km — are within acceptable parameters for a heavy-duty diesel engine at 400,000 km of service. The engine does not require overhaul at this time. However, both values should be trended over subsequent oil analysis intervals to identify the rate of change — a rapidly increasing trend would indicate accelerating wear that approaches the overhaul threshold.

15. A — An injector balance rate represents the ECM's fuel trim correction for that injector — how much additional fuel the ECM must add (or subtract) to maintain that cylinder's contribution to engine speed at the same level as the others. A high balance rate means the ECM is adding more fuel to that cylinder, indicating the injector requires more fuel to achieve the same combustion result. This occurs when the injector is worn, partially clogged, or has a degraded spray pattern that reduces combustion efficiency.

16. C — Engine oil leaking past the turbocharger's turbine-side seal enters the exhaust stream and passes through the DOC and into the DPF. The oil burns, but its metallic additive package (zinc, phosphorus, calcium, magnesium) produces ash that is not combustible at DPF regeneration temperatures. This ash accumulates permanently in the DPF channels, progressively blocking the filter. Unlike soot, which can be oxidized during regeneration, ash can only be removed through off-vehicle cleaning — an expensive and time-consuming service.

17. B — The oil filter element must withstand the full pressure differential across the filter during operation — the difference between the pump's output pressure (upstream of the filter) and the gallery pressure (downstream). During cold starts, oil viscosity is highest and the pressure differential across the filter peaks. A filter with insufficient structural strength (from incorrect specification, counterfeit construction, or a weakened element from aging) cannot withstand this peak differential and the element collapses inward, allowing unfiltered oil to bypass.

18. D — The DEF pump is the component responsible for drawing DEF from the tank and delivering it to the dosing injector at the correct pressure. If the pump motor has failed, the pump cannot operate. If the DEF filter or suction screen is clogged, the pump cannot draw adequate DEF. If the suction line is cracked, the pump draws air instead of DEF. In cold weather, frozen DEF lines prevent the pump from accessing the liquid DEF. All of these conditions reduce the pump's output below the expected level.

19. A — The coolant's freeze point protection must exceed the lowest expected ambient temperature by a safety margin of at least 5°C to account for temperature measurement uncertainty and localized cold spots. A freeze point of -20°C in an area that reaches -35°C leaves the cooling system vulnerable to freezing. Frozen coolant expands and can crack the engine block, cylinder head, radiator, and heater core. The coolant concentration must be increased to achieve at least -40°C freeze protection.

20. C — The EGR valve responds to commands (confirmed by scan tool actuation), proving the valve itself is functional. However, the flow is below commanded — the valve opens but the gas cannot flow through the system at the expected rate. The most common restriction point is the EGR cooler, where exhaust soot and carbon accumulate in the narrow cooler passages over time. The EGR supply pipe and the intake manifold's EGR port are also common restriction locations. The restriction limits the volume of exhaust gas that can reach the intake despite the valve being open.

21. D — The thermostat is a temperature-controlled valve that blocks coolant flow to the radiator until the engine reaches its designed operating temperature. During warm-up, the thermostat is closed — coolant circulates only through the engine block and heater core, bypassing the radiator entirely. The upper radiator hose is on the engine-to-radiator circuit, so it remains cold until the thermostat opens. This is completely normal operation — the technician should verify that the hose becomes hot once the engine reaches the thermostat's opening temperature.

22. A — The VGT actuator is mounted on the turbocharger housing, which operates at exhaust gas temperatures exceeding 600°C during high-load conditions. Sustained high-load operation (grade climbing, high-speed highway driving) produces prolonged elevated exhaust temperatures that radiate heat from the turbine housing to the adjacent actuator. The actuator's electronics and seals have a maximum temperature rating, and prolonged exposure above this rating damages the actuator. A thermal shield between the housing and actuator or adequate cooling airflow prevents the condition.

23. A — Water is denser than diesel fuel (specific gravity ~1.0 versus ~0.85) and settles to the bottom of the fuel-water separator when the fuel slows and spreads in the separator bowl. The clear layer at the bottom is water — its clarity distinguishes it from the darker diesel fuel floating above. The sight bowl allows the technician to visually monitor the water accumulation and drain it before the water level rises high enough to pass through the separator and reach the injection system, where it causes corrosion and injector damage.

24. D — The engine starts on the cranking fueling algorithm (which uses a richer fuel delivery strategy designed for the conditions of cranking — lower RPM, cold cylinders, compressed air as the ignition source). After starting, the ECM transitions to the running algorithm, which uses different sensor inputs for fuel quantity and timing calculations. If a sensor provides valid data during cranking but incorrect

data during running (such as a camshaft position sensor with an intermittent signal, a MAP sensor with a dead spot, or a throttle sensor with a calibration error), the running algorithm delivers inappropriate fuel and the engine stalls.

25. C — The turbocharger compressor pressurizes intake air, and a small amount of oil naturally leaks past the compressor-side seal into the intake stream. This oil is carried by the pressurized air through the charge air cooler, where it deposits on the internal tube surfaces. Over time, the oil film builds into a thick coating that acts as a thermal insulator — reducing the cooler's ability to transfer heat from the hot compressed air to the cooling medium. The insulated cooler delivers hotter air to the intake, reducing air density and engine efficiency.

26. A — The engine starts immediately when cold because the fuel system retains adequate pressure for cold-start cranking. The hot-restart difficulty occurs because a component in the high-pressure circuit allows fuel to drain back during the hot-soak period. A leaking check valve, worn pump seals, or leaking injectors allow the rail pressure to bleed to zero while the engine sits hot. When restarting, the engine must re-prime the empty system from zero pressure — a process that takes longer than the cold start where the system retained pressure.

27. D — Silicon is the primary component of soil, sand, and dust. A sudden jump from 8 ppm to 45 ppm over one sample interval indicates a new, active source of dirt ingestion. The air intake system is the most probable entry point — a damaged air filter element, a loose clamp, a cracked intake duct, or a displaced gasket allows unfiltered ambient air to bypass the filter and carry abrasive silicon particles directly into the engine. These particles cause accelerated wear on cylinder liners, piston rings, valve guides, and turbocharger bearings.

28. D — The heater core is typically the highest point in the cooling system. During a coolant refill, air rises to the highest point and becomes trapped. The trapped air pocket displaces the coolant inside the heater core, preventing hot coolant from flowing through the core's tubes. Without hot coolant flowing through it, the core cannot transfer heat to the cab air and the heater produces no heat. Bleeding the air from the system — typically through a bleed screw at the heater hose connection or at the thermostat housing — restores coolant circulation through the core.

29. B — Identical trucks on the same route should produce similar soot and have similar regeneration frequencies. A truck that regenerates more than twice as frequently as its twin is generating significantly more soot per kilometre. Any condition that reduces combustion efficiency increases soot production: a partially restricted air filter reduces available oxygen, a worn injector produces a poor spray pattern that burns incompletely, a leaking EGR cooler dilutes the intake charge, or a turbocharger producing slightly less boost reduces the air-fuel ratio.

30. C — The air compressor operates at elevated temperatures (the heat of compression raises discharge air to 150-250°C). Without adequate cooling, the compressor head and cylinders overheat beyond their design temperature. The engine oil that lubricates the compressor's rings and valves bakes into hard carbon deposits on the internal surfaces — clogging the discharge valves, scoring the cylinder walls, and accelerating ring wear. The carbonized oil is pumped into the air system, contaminating the air dryer desiccant and every downstream valve and component.

31. A — The relay valve is a dynamic component that cycles thousands of times during normal driving. Internal seals and valves that function correctly when cold can develop leaks as they heat from repeated cycling. As the valve's internal components expand thermally, clearances change and a marginal seal that held at cold temperature begins to bypass at operating temperature. The progressive worsening over 30 minutes matches the time required for the valve to reach its operating temperature and the leak to become significant enough to affect brake performance.

32. D — Correct pushrod stroke confirms the brake adjustment is correct — the shoes contact the drum at the designed position. But a dragging brake keeps the shoes in light contact with the drum between stops, generating continuous friction heat even when the driver is not braking. A binding S-cam bushing, a seized anchor pin, a weak return spring, or a sticking caliper slide pin can all create drag that the pushrod stroke measurement does not reveal because the drag occurs after the brake releases, not during application.

33. B — Both circuit gauges dropping to zero within 10 minutes with all brakes released indicates a substantial leak upstream of the one-way check valves — in the supply circuit common to both circuits. The check valves isolate the primary and secondary circuits from each other, but both circuits receive their air from the supply tank through these check valves. A leak in the supply tank, the air dryer, the compressor discharge line, or the wet tank drains both circuits because the air escapes before it reaches the isolation point.

34. C — The left front brake applies approximately 1 second before the right because the air reaches the left chamber before the right. This delay is caused by a difference in the air delivery path — the right side has a longer hose run, a more convoluted routing, a partially kinked line, or a restricted fitting that slows the air flow compared to the unrestricted left side. The delay produces asymmetric braking during the first second of each application, causing the vehicle to pull toward the side that applies first.

35. A — Dramatically uneven wear between axles (front pads at minimum, rear pads at 60%) indicates the rear brakes are doing a disproportionate share of the braking work. This rear-heavy bias can result from a malfunctioning front axle proportioning valve that is reducing front brake pressure below its intended level, undersized front brake chambers that produce less force than specified, or a brake

proportioning system calibration that biases the rear more heavily than the vehicle manufacturer intended.

36. D — The tractor protection valve closes at approximately 40-45 psi to protect the tractor's remaining air supply. At this threshold, the valve simultaneously cuts off the trailer supply and exhausts the trailer supply line, which applies the trailer's spring brakes. The 40-45 psi threshold is set above the minimum pressure needed for the tractor's own spring brakes (approximately 20-25 psi), ensuring the tractor retains enough air for its own braking after isolating the trailer.

37. B — The foot valve's exhaust port should be completely sealed when the brake pedal is fully released — no air should escape. A continuous hiss from the exhaust indicates an internal seal has failed, allowing pressurized supply air to bypass past a worn piston seal and escape through the exhaust. This constant leak consumes system air (the compressor must cycle more frequently), and it may reduce the application pressure available during braking because some of the supply air escapes through the internal leak rather than being delivered to the output ports.

38. C — A machined drum that is 0.010 inches below the maximum allowable diameter is acceptable for continued service because it has not exceeded the condemn limit. The 0.010-inch margin represents the remaining wall thickness available for normal wear before the drum reaches the maximum diameter. The technician should verify that the machined surface is free of cracks, hard spots, and machining marks that could affect braking performance, and that the drum's surface finish meets the specification for proper lining-to-drum contact.

39. A — Normal spring brake application should be smooth and gradual — the hold-off air exhausts through the relay valve's controlled exhaust port at a rate that allows the springs to extend progressively. A "bang" indicates the hold-off air is exhausting too rapidly, allowing the power springs to slam open at maximum velocity. A stuck-open quick release valve, a relay valve with a failed exhaust restriction, or a parking brake valve with an oversized exhaust port all cause this rapid, uncontrolled air release.

40. D — Petroleum-based products (engine oil, hydraulic fluid, and compressor lubricant) attack many types of rubber. The compressor is passing excessive oil into the discharge air, and this oil contacts the flexible hose section of the discharge line. The petroleum oil penetrates the rubber's molecular structure, softening and swelling it from the inside. The swollen hose loses its pressure rating and structural integrity, creating a burst risk. The compressor's oil pass-by must be corrected and the swollen hose replaced.

41. B — All other axle positions release normally, confirming the supply air pressure and the supply valve are functioning. The fault is in the air delivery path between the relay valve and the specific axle that will not release. A kinked, restricted, or frozen (in cold weather) air line on the run between the relay valve and the affected axle's spring brake chambers prevents the hold-off air from reaching those chambers. The springs remain extended because no air can reach them to compress them into the released position.

42. C — Pedal feel is firm and air pressure is adequate, so the air system is functioning correctly. Pushrod strokes are correct, so the mechanical adjustment is acceptable. The longer stopping distance must come from reduced friction at the drum-to-lining interface. Glazed linings (from overheating), oil-contaminated linings (from compressor oil carryover), or non-OEM linings with a lower friction coefficient all reduce the braking force generated for a given application pressure, increasing the distance needed to stop.

43. A — A pushrod stroke of 2.5 inches on a chamber with a 2.0-inch maximum indicates the automatic slack adjuster has failed to maintain proper brake adjustment. The ASA is either mechanically defective (worn internal worm gear, broken adjuster arm), or the foundation brake components have worn beyond the ASA's compensation range. Simply manually adjusting the ASA without diagnosing and correcting the root cause will result in the stroke returning to the over-limit within a short period.

44. D — The ATC system uses the same wheel speed sensors as the ABS but has different sensitivity thresholds. ABS detects deceleration-rate differences between wheels during braking, while ATC detects acceleration-rate differences during throttle application. A marginal sensor signal — from an incorrect air gap, a damaged reluctor ring tooth, or a deteriorating sensor — may produce a signal that is adequate for the ABS algorithm but falls outside the ATC algorithm's tighter tolerance, causing false ATC activation without triggering an ABS fault.

45. B — Long pedal travel before brake engagement with adequate pressure and correct pushrod strokes indicates the foot valve requires more pedal movement than normal to generate the signal pressure that cracks open the relay valves. A worn foot valve piston, excessive internal clearance, or a worn linkage mechanism all require more pedal travel before the valve builds enough output pressure to activate the relay valves. Once the relay valves open, the braking force is adequate because the downstream system is functioning correctly.

46. C — Both circuits start at equal pressure and are loaded by the same brake application. The secondary circuit's faster pressure drop means it is consuming more air than the primary during the application. The normal consumption (from the brake chambers it serves) is supplemented by a leak that

is exclusively in the secondary circuit. The leak adds to the air consumed during braking, causing the secondary pressure to drop faster than the primary circuit, which is losing air only to its brake chambers.

47. A — Anti-theft immobilizer systems verify the key's transponder code before allowing sustained engine operation. Some systems allow the engine to start and run for a predetermined verification window (typically 2-30 seconds). If the transponder code is not recognized within this window — from a damaged transponder chip, a depleted key battery, or a lost key-to-module synchronization — the ECM shuts the engine down. The consistent 30-second cycle and immediate restart capability are characteristic of an immobilizer verification timeout.

48. D — The alternator exciter circuit serves dual purposes: it provides the initial field current to start the alternator charging (excitation) and it controls the battery warning lamp. If the exciter wire is not connected to the replacement alternator, the lamp stays on because the circuit is open. The alternator may still charge because residual magnetism in the rotor provides enough initial excitation for self-excitation — but the warning lamp requires the exciter connection to close the lamp circuit and extinguish the lamp.

49. B — A properly terminated CAN bus reads 60 ohms (two 120-ohm resistors in parallel). A reading of 120 ohms means only one terminator is being measured — the second terminator is isolated by an open circuit somewhere in the bus backbone. The open creates two electrically separate bus segments. Modules on the scan tool's side of the break communicate normally; modules on the other side cannot be reached. The open must be located by progressively unplugging modules or testing sections of the backbone for continuity.

50. C — The power window motor requires current in one direction to go up and the opposite direction to go down. The switch, relay, or wiring for each direction is a separate electrical path. If the up-direction circuit has an open — a corroded switch contact, a broken wire, or a failed relay — the motor cannot receive current in the up direction. The down-direction circuit functions independently and is unaffected. This directional failure is common in power window systems because each direction uses different switch contacts and may route through different wiring paths.

51. A — The ABS module's maximum input voltage specification is set by its internal electronics design — typically 14.5 to 15.0 volts maximum for a 12-volt system. A charging voltage of 14.8 volts exceeds many modules' maximum rating and triggers the overvoltage fault code. Sustained overvoltage can damage the module's internal voltage regulators, semiconductor devices, and processing electronics. The root cause is the overcharging alternator/voltage regulator, which must be corrected to protect all electronic modules in the vehicle.

52. D — Both sides have identical bulbs, so the brightness difference must come from the circuit. The dimmer left side has more resistance in its power or ground path than the brighter right side. This resistance creates a voltage drop that reduces the voltage reaching the left-side bulbs. Common resistance points include corroded connectors, deteriorated wiring, corroded ground bolts, and high-resistance splices. The right side's clean circuit delivers more voltage, making its bulbs appear brighter.

53. B — The BCM monitors current draw on each lighting circuit. When it detects zero current on the right rear stop lamp circuit, it identifies the circuit as "open" — no current is flowing. The open could be at any point in the circuit: a burned-out bulb (most common), a corroded socket that does not contact the bulb, a broken wire between the BCM and the lamp, or an open ground connection at the lamp fixture. The BCM cannot determine which specific component is open; it only reports that no current flows.

54. C — Tapping the solenoid physically jars the internal contacts enough to make temporary connection and pass current to the starter motor. This confirms that the solenoid's plunger mechanism is pulling in (the coil circuit is functional) but the heavy-duty contacts that connect the battery to the motor are not making reliable contact. The contacts have been worn, pitted, or burned from the thousands of high-current switching events they have performed over the starter's service life.

55. B — The 3-second lamp illumination followed by extinguishment is the ABS system's designed power-up self-test sequence. The lamp lights to verify the bulb is functional (so the driver knows the lamp works if it is ever needed for a fault indication), and the system simultaneously checks all sensors, modulators, and internal circuits. When all tests pass, the lamp extinguishes, confirming the system is fully operational with no detected faults. This sequence occurs every time the trailer is powered up.

56. D — Battery voltage during cranking is 10.5 volts, but only 8.2 volts reaches the starter motor — 2.3 volts is consumed by resistance between the battery and the motor. The maximum allowable total voltage drop for the starter circuit (positive cable + solenoid contacts + negative cable/ground) is typically 1.0 volt. A 2.3-volt drop is more than double the specification, indicating corroded connections, deteriorated cables, or worn solenoid contacts that are stealing voltage from the starter motor.

57. A — The manufacturer specifies that APP2 must always read exactly half of APP1. At 50% pedal travel, APP1 reads 2.3V and APP2 reads 1.15V — exactly a 2:1 ratio. The dual-sensor design with a defined mathematical relationship between the two signals allows the ECM to continuously verify that both sensors agree. If the ratio deviates from 2:1 by more than the allowable tolerance, the ECM sets a correlation fault code and defaults to idle for safety.

58. C — The ECM shows no fault codes for the fan circuit, meaning the ECM believes it is sending the correct PWM command for the current conditions. The full-speed fan operation must be occurring downstream of the ECM — either the fan controller module has failed in the full-speed default state, or the PWM signal wire between the ECM and the controller is open or shorted, causing the controller to receive no modulation signal and default to full speed. The fault is in the controller or the signal path, not the ECM.

59. B — The horn sounds only when the brakes are applied — this means the horn relay coil circuit is being completed by the brake application. The most likely cause is a wiring fault that connects the horn relay's ground circuit to the brake light switch output. When the brakes are applied and the brake switch sends power to the brake lights, that same power reaches the horn relay coil through the unintended connection, energizing the relay and sounding the horn.

60. D — Automotive wiring operates in extreme conditions — engine bay temperatures exceeding 100°C, winter cold below -40°C, constant vibration, and exposure to fuel, oil, coolant, and road chemicals. Household electrical tape is not designed for these conditions: its adhesive fails at automotive temperatures, its backing becomes brittle in cold weather, it provides no chemical resistance, and it cannot withstand the vibration environment. The exposed connection is vulnerable to short circuits, corrosion, and eventual failure.

61. A — Modern vehicles often provide the same data to different modules through different paths. The speedometer may receive its speed data from the ABS module (which calculates vehicle speed from its wheel speed sensors) via the CAN bus, while the TCM receives its speed signal from a dedicated vehicle speed sensor on the transmission output shaft. If the TCM's dedicated sensor fails, the TCM loses its speed input and sets the fault code, but the speedometer continues to display correct speed from the ABS-derived CAN bus data.

62. C — The factory headlight circuit's wire gauge, fuse, connector, and switch were sized for the headlight load only. Adding fog lights through a splice increases the total current draw beyond the circuit's designed capacity. The overloaded wire may overheat, the fuse may blow (or if it doesn't, the wire becomes the weakest link), and the additional current draw creates voltage drop that reduces the headlight brightness. Fog lights must be installed with their own relay, fuse, and properly sized wiring connected directly to the battery.

63. B — On some flasher types, reduced current draw causes a slower flash rate rather than the faster rate typical of thermal flashers. The burned-out trailer bulb reduces the total current on the right turn circuit. The flasher detects this reduced current and its cycle timing changes — the specific response

(faster or slower) depends on the flasher type. Since the left circuit has all bulbs intact, its current draw is normal and the flasher operates at the correct rate on that side.

64. D — The fuel sender uses a resistor card (a printed circuit board with a resistive element) and a wiper arm connected to the float. As the fuel level changes, the float moves the wiper across the resistor card, changing the resistance. A worn or corroded section of the resistor card creates areas where the wiper makes intermittent or no contact, causing the resistance to jump erratically between values. The gauge faithfully displays these rapid resistance changes as erratic needle movement between full and empty.

65. A — Many electronic modules remain active after the ignition is turned off — they perform shutdown routines, save data, close network communications, and transition through progressive power-down states before entering their low-power sleep mode. This transition can take 20-45 minutes depending on the vehicle manufacturer and the number of modules. The initial 75 mA reading reflects modules still in their active shutdown state, and the gradual decrease to 55 mA reflects the modules progressively reaching their final sleep state.

66. C — Every module on a J1939 CAN bus is assigned a unique source address. The ABS module maintains a configuration table of valid source addresses it expects to see on the bus. When a module transmits data with an address that is not in the ABS module's configuration table — from a replacement module with a different address, a reprogrammed ECM with changed address assignments, or an aftermarket device transmitting on an unrecognized address — the ABS module flags the unrecognized address as a configuration error.

67. B — The aftermarket camera is physically mounted upside down relative to the original camera's orientation. Camera manufacturers design the image processing based on a specific mounting orientation — typically with the lens at the top and the connector at the bottom. Installing the camera inverted sends the image to the display upside down because the image sensor is capturing the scene from an inverted perspective. Physically rotating the camera 180 degrees to match the original orientation corrects the image.

68. D — Telematics hard-braking detection uses an accelerometer to measure deceleration rates. If the system's deceleration threshold is calibrated for passenger vehicle braking rates, normal heavy-duty truck braking may trigger false alerts because trucks decelerate at different rates and patterns. Additionally, an accelerometer mounted at an angle to the vehicle's true longitudinal axis introduces a bias that adds or subtracts from the actual deceleration reading. The system's sensitivity and mounting must be appropriate for the specific vehicle application.

69. C — The input shaft bearing (front bearing) supports the transmission input shaft at the front of the transmission, inside the bellhousing. When the clutch is engaged, the engine drives the input shaft through the clutch disc, and the shaft rotates in this bearing at engine speed. A worn bearing produces noise proportional to shaft speed. Depressing the clutch disconnects the engine from the input shaft — the shaft decelerates and stops, and the bearing noise disappears because the shaft is no longer rotating in the worn bearing.

70. A — The range cylinder is a double-acting air cylinder that moves in both directions. If one piston seal has failed, the cylinder can generate force in the direction where the seal holds (low-to-high shift) but cannot generate adequate force in the direction where the seal bypasses (high-to-low shift). The air leaks past the damaged seal instead of pushing the piston, preventing the range mechanism from completing the shift back to low range.

71. D — Automatic transmission fluid degrades when exposed to temperatures above its design operating range. The fluid's base oil molecules break down (oxidize), the friction modifier additives that control clutch engagement are destroyed, and the anti-wear additives are consumed. The dark color and burnt smell are physical evidence of this thermal degradation. Degraded fluid causes harsh shifts (destroyed friction modifiers), clutch slippage (reduced friction coefficient), and accelerated internal wear (depleted anti-wear additives).

72. B — The clutch disc's torsional damper consists of springs inside the disc hub that absorb the engine's firing impulses, smoothing the torque delivery to the transmission. When these springs break or weaken, they no longer absorb the impulses — instead, the hub components rattle loosely inside the disc at each engine firing event. The noise is proportional to engine RPM because the firing frequency increases with speed. The noise is present regardless of clutch position because the disc hub rattles whether the clutch is engaged or not.

73. C — Three chipped ring gear teeth create points where the starter pinion may not mesh smoothly. During starting attempts, the flywheel may stop at a position where the chipped teeth align with the pinion — the starter grinds, skips, or fails to engage. The damaged teeth deteriorate further with each grinding event, and adjacent teeth are progressively damaged by the impact loading. Replacing the ring gear during the clutch service (when the flywheel is already removed) prevents a future no-start or starter damage situation.

74. A — The torque converter is a fluid coupling that contains a significant volume of transmission fluid. When the engine is off, some of this fluid drains from the converter back to the transmission pan through the pump and oil passages, driven by gravity. The next morning, the pan level appears higher because it contains the converter's drained fluid plus its own normal volume. When the engine starts, the

pump refills the converter from the pan, temporarily lowering the pan level until the converter is full and the system stabilizes.

75. D — The inter-axle differential lock is not engaged, so the differential should accommodate the speed difference between axles during turns. If the differential gears have seized, worn, or developed excessive friction internally, they cannot allow the necessary speed difference. The result is the same binding condition that would occur with the lock engaged — both axles are forced to turn at the same speed. The internal failure must be diagnosed by inspecting the differential gears, thrust washers, and cross pin.

76. B — On the hoist with no road load, the driveshaft turns under no-load conditions. Many vibration sources that are apparent under road-load conditions disappear when the load is removed. A tire imbalance, a bent wheel, or a worn wheel bearing all require the road-load condition (weight on the tire, road-surface input) to produce their characteristic vibration. The driveshaft elimination confirms the vibration source is a road-speed-dependent component downstream of the driveshaft in the load path.

77. A — "Range Inhibited" means the TCM has detected a condition that makes gear changes unsafe and has locked the transmission in a single gear. The TCM cannot verify the parameters it needs for safe, controlled shifts — turbine speed sensor data (for slip calculation), output speed data (for ratio verification), solenoid function (for clutch control), pressure data (for apply force), or temperature data (for fluid integrity). Without these verified parameters, the TCM cannot guarantee a controlled shift and defaults to a single safe gear.

78. D — A contact pattern on the heel (outer edge) means the ring gear is too close to the pinion — the mesh is biased toward the outer edge of the tooth. Decreasing the backlash by moving the ring gear closer to the pinion shifts the contact pattern from the heel toward the toe. This adjusts the lateral position of the contact pattern on the tooth face. The pinion depth (shim thickness behind the pinion bearing) controls the vertical position of the pattern on the tooth, not the lateral position.

79. A — U-joint operating angles directly determine bearing life. Each degree of operating angle increases the bearing load and the speed fluctuation per revolution. Angles beyond the U-joint's design limit (typically 3-5 degrees depending on the U-joint series and RPM) accelerate bearing wear exponentially. Worn suspension, incorrect transmission mount height, improper axle shimming, or aftermarket lift kits all change the driveshaft angles. Measuring and correcting the angles to within the U-joint's rated range restores the designed service life.

80. C — The AMT's shift actuator advances the sliding sleeve into the selected gear at a speed determined by the TCU's shift algorithm. The synchronizer must match the gear speed to the mainshaft speed before the sleeve arrives. If the synchronizer's friction cone is worn, it cannot generate adequate friction to match speeds in the time available. The sleeve contacts the engagement teeth while the speeds are still mismatched, producing the grinding noise. Only the 3-4 synchronizer is worn; all others have sufficient friction surface remaining.

81. B — Air in the hydraulic clutch line makes the fluid compressible. When the pedal is pressed, the air bubble compresses before the incompressible hydraulic fluid transmits force to the slave cylinder. The pedal feels soft because the initial pedal travel is absorbed by the compressing air rather than being transmitted as hydraulic force. The clutch still functions because enough force eventually reaches the slave cylinder to disengage the clutch, but the soft, mushy pedal feel indicates the system needs bleeding.

82. C — The PTO engages and the pump turns at the correct RPM — the mechanical drive is functioning. Slow hydraulic functions indicate reduced flow reaching the cylinders. The diagnostic priority is measuring the pump's actual output: connect a flow meter and pressure gauge at the pump outlet. A pump that reaches adequate pressure but delivers reduced flow has internal wear that allows fluid to bypass through enlarged clearances. This single measurement determines whether the pump or the downstream system is responsible for the slow operation.

83. A — Transmission fluid temperature 20°C above normal with correct fluid level and good fluid condition indicates the cooling system cannot reject the heat being generated. The oil cooler is the primary heat rejection component — if its internal passages are fouled, its external surface is blocked, its supply lines are kinked, or its coolant flow (on engine-cooled systems) is restricted, the cooler cannot remove heat at the required rate. Verifying cooler inlet-to-outlet temperature differential confirms whether the cooler is the bottleneck.

84. A — The locked inter-axle differential forces both drive axles to turn at the same speed. During a sharp turn, the outer wheels must travel farther and faster than the inner wheels. With the axles locked, this speed difference cannot be accommodated through the differential — instead, the torsional stress is absorbed by the axle shafts, which twist like springs storing energy. The "bang" occurs when the stored torsional energy exceeds the static friction of one tire and the shaft snaps back, releasing the stored energy explosively.

85. B — Transmission fluids are formulated for specific applications. Dexron III and TES-295 have different friction coefficients (affecting clutch engagement feel and holding capacity), different viscosity characteristics (affecting film thickness and cooling), different additive packages (affecting seal

compatibility and anti-wear protection), and different thermal stability ratings. Using Dexron III in a TES-295 application can cause clutch shudder, erratic shifts, accelerated clutch wear, and seal degradation.

86. D — Balanced tires and tight steering linkage eliminate the two most common vibration sources. The remaining possibility is the wheel itself or the hub interface. A wheel with radial runout (out-of-round) or lateral runout (wobble) creates a once-per-revolution disturbance that tire balance cannot correct because the disturbance is caused by the wheel's physical shape, not its mass distribution. Corrosion or debris on the hub pilot pad prevents the wheel from mounting true, producing the same effect.

87. B — An RPM-proportional whining noise from the power steering system with correct fluid level and no leaks points to internal pump wear. Worn vanes, a worn cam ring, or scored pump housing create internal clearances that allow fluid to bypass at high velocity, producing the whine. The noise increases with RPM because the pump turns faster, amplifying the bypass flow and the noise. A partially restricted pump inlet can also cause cavitation that produces a similar whine.

88. C — All alignment measurements are within specification, yet the truck pulls to the right. On a properly aligned truck driving on a crowned road (which slopes from center to right edge for drainage), the road surface itself creates a gravitational component that biases the vehicle toward the lower edge — the right side in North America. This is a road characteristic, not a vehicle fault. The pull should disappear on a flat surface. If the customer requests, a slight alignment bias toward the left can compensate.

89. A — The height control valve on the affected side has a marginal internal seal that holds during the dynamic conditions of driving (where the valve is continuously adjusting) but leaks slowly during the static conditions of extended parking. The slow leak vents air from the spring over several hours, lowering that side. When the engine starts and the air system pressurizes, the valve immediately detects the low ride height and responds by adding air, restoring the correct height within 30 seconds.

90. D — Both front tires showing cupping on the outside edges with correct balance, alignment, and bearing adjustment leaves only one common cause — inadequate shock absorber damping. Worn front shocks allow the tires to bounce during driving, creating intermittent contact pressure variations. The outside edge of the tread is particularly susceptible because it is at the edge of the contact patch where the ground pressure variations are most pronounced. Replacing the front shock absorbers restores proper damping and stops the scalloped wear pattern.

91. B — Both axles are aligned correctly, so the wear difference is not caused by alignment. The most likely cause is unequal weight distribution — the center of the cargo load is positioned forward of the tandem group's centerline, placing more weight on the leading axle. The heavier-loaded front axle tires operate under greater contact pressure and wear faster proportionally. Repositioning the load or adjusting the slider position to center the weight over the tandem group would equalize the wear rates.

92. A — A metallic clunk during acceleration-to-braking transitions at the fifth wheel coupling indicates free play between the king pin and the locking jaw faces. During acceleration, the trailer resists and loads the jaws in one direction. During braking, the trailer pushes forward and loads the jaws in the opposite direction. The clunk is the king pin shifting from one side of the worn jaw clearance to the other during the load reversal. Inspecting the jaw faces and king pin for wear identifies which component has deteriorated.

93. A — The anti-friction pads (also called liner pads or wear pads) are positioned between the individual leaves of the spring pack to reduce inter-leaf friction during deflection. When these pads wear out or fall out, the bare steel leaves contact each other directly. During the transition from rest to acceleration, the spring deflects under torque reaction, and the bare leaves shift position relative to each other. The sudden movement of the leaves resettling under load produces the clunking noise.

94. C — The truck pulls to the right only during braking — not during normal driving. The alignment is within specification, ruling out alignment as the cause. The most likely explanation is that the collision altered the front axle geometry in a way that specifically affects braking dynamics. A changed scrub radius (from a bent knuckle or shifted king pin position) creates a torque steer effect during braking that pulls the vehicle to one side even though the straight-line tracking remains unaffected.

95. A — Three premature bearing failures in 100,000 km with correct installation, adjustment, and lubrication indicate an external heat source is degrading the bearing. A dragging front brake generates continuous friction heat that transfers through the drum, hub, and spindle to the wheel bearing. The elevated temperature degrades the bearing grease prematurely, reduces the oil film's load-carrying capacity, and accelerates roller and race surface fatigue. Even a slight drag that produces no noticeable performance symptom can generate enough cumulative heat for bearing failure.

96. C — The lean occurs only during driving and disappears when parked. This dynamic-only lean indicates one side's suspension cannot keep up with the continuous height corrections required during driving. The left height control valve's delayed response — from a sluggish valve mechanism, restricted air supply, or worn linkage — means it falls behind the right side in maintaining ride height during the dynamic conditions of driving. When parked, the static conditions allow the slow valve to eventually reach the correct height.

97. C — A self-steering tag axle should hold a steady straight-ahead position during straight-line driving and follow the trailer's turn path during cornering. If the return-to-center mechanism (centering springs, bushings, or dampening device) has worn, the axle oscillates (wanders) continuously during straight-line driving. Each oscillation scrubs the tires alternately left and right, wearing both shoulders simultaneously. The rapid shoulder wear on a self-steering axle with correct inflation is the signature pattern of a worn centering device.

98. D — A cracked stud indicates that the studs on that wheel position have been subjected to excessive stress. While only one stud is visibly cracked, the remaining studs have experienced the same stress environment — they may have incipient fatigue cracks that are not yet visible on the surface. Replacing only the cracked stud and returning the wheel to service risks another stud failure from an undetected crack. All studs should be closely inspected (and ideally magnetic particle tested) for fatigue damage.

99. A — The steering wheel's self-centering force comes from the caster angle on each side. Unequal caster side-to-side means unequal self-centering force in each direction. If the left caster is significantly higher than the right, the left side generates a stronger centering force that successfully returns the wheel after a left turn. The right side's lower caster generates insufficient centering force to return the wheel after a right turn, requiring the driver to manually straighten it.

100. C — A sagged spring on one side produces multiple cascading effects: the reduced arch changes the axle's position in the spring seat (potentially altering toe and wheelbase on that side), the lean shifts cargo weight to the low side (potentially overloading that wheel position), and the reduced suspension travel on the sagged side means it bottoms out sooner over bumps. The spring will not recover — the metal has permanently deformed and must be replaced or re-arched.

101. B — Two adjacent broken studs on a single wheel represent a critical reduction in clamping force and a pattern failure that indicates systemic stress on that wheel position. The remaining studs are carrying the load of the missing studs plus their own, and they are likely fatigued from the same condition that broke the first two. The wheel must be removed, all studs inspected for fatigue, the hub mounting surface checked for damage, and the cause of the failure investigated before the trailer operates.

102. D — Rotor DTV of 0.003 inches on rotors that were new 10,000 km ago is abnormal — the rotors should maintain their manufactured flatness much longer. The most common cause is a contaminated hub mounting surface from the installation. Corrosion, debris, or a raised ridge on the hub face prevented the rotor from seating perfectly flat. The slight angle causes one area of the rotor to contact the pads more heavily than the rest, wearing faster at that point and developing the measured thickness variation.

103. D — A swayed frame (bowed to one side) shifts all axle mounting positions from their designed alignment. The rear axle's thrust line is no longer parallel to the front axle's tracking path, causing the rear to follow an offset path (dog-tracking). The misaligned axle geometry accelerates tire wear on all positions. And the driveshaft operates at angles that differ from the designed geometry, potentially producing vibration. A swayed frame affects every system that depends on the frame's geometry.

104. C — A new whistling noise from the door area at highway speed is almost always caused by a compromised door seal. Weather stripping degrades over time from UV exposure, temperature cycling, compression set, and physical wear from door opening and closing. A section that has compressed, cracked, or lost adhesion creates a gap between the door and the cab body. At highway speed, the pressure differential between the interior and exterior forces air through this narrow gap, producing the characteristic whistle.

105. A — The HVAC mode door directs airflow to the selected vent outlets. When the mode door actuator fails or the door is stuck, airflow is directed to only one outlet position regardless of the mode selected. Many vehicles default to the defrost position as a fail-safe — ensuring the driver can always defog the windshield even if the mode control has failed. The actuator motor, its electrical supply, and the door's mechanical linkage must be inspected.

106. A — A heated mirror element with a hot spot concentrates heat in one area while the surrounding glass remains cold. In cold weather, the rapid localized heating against the cold glass creates a thermal gradient — the hot spot expands while the surrounding cold glass resists. This differential expansion generates stress that exceeds the glass's thermal shock tolerance, cracking it. The heating element must be replaced with one that distributes heat evenly across the mirror surface.

107. B — The smell of burning electrical insulation — a distinct, acrid odor — indicates a conductor is overheating. The insulation is being thermally degraded but has not yet failed completely. Common causes include an overloaded wire (drawing more current than its gauge can safely carry), a corroded connector (creating resistance that generates heat under load), or a damaged switch (internal arcing generates localized heat). The overheated component must be found and corrected before it progresses to a complete failure and potential fire.

108. A — The seat mounting bolts are tight, securing the slider to the floor and the seat to the slider. The lateral play is in the slider mechanism itself — the movable slide rails and their bearing surfaces have worn, developing free play between the stationary and moving components. The mounting bolts cannot eliminate this internal wear because they clamp the assembly at its mounting points, not at the sliding interface. The slider mechanism must be replaced or rebuilt to eliminate the lateral play.

109. A — A poor-quality weld repair on a structural crossmember introduces multiple failure risks. The porous weld has reduced load-bearing strength compared to a sound weld. The heat-affected zone around the weld has altered the base metal's properties. The incomplete coverage leaves part of the original damage unaddressed and potentially propagating. Under the dynamic loads of loaded trailer operation, the substandard repair may fail catastrophically — potentially collapsing the crossmember, failing the floor, and releasing cargo.

110. D — The landing gear gearbox contains internal gears that must turn freely through their lubricant. Contamination with moisture, corrosion products, or old grease that has solidified (from cold weather, extended storage, or age) creates a thick, resistant medium that the gears must force through. The increased resistance is felt at the crank handle as higher-than-normal effort. The legs may also have corroded or bent tubes that create friction resistance. The gearbox needs servicing and the leg tubes need inspection.

111. B — The ride height is correct (the air springs are at the designed pressure for the load) and the system is functioning as designed. Rough riding with correct ride height indicates inadequate damping — the shock absorbers cannot control the air spring oscillation after road irregularities. Air springs have a natural bounce frequency that must be controlled by the shock absorbers. Worn shocks allow the springs to oscillate freely, transmitting every road input to the trailer and its cargo as a harsh, bouncing ride.

112. C — Brake rotors are bare metal surfaces that oxidize (rust) when exposed to moisture. Overnight parking in wet conditions allows a thin rust layer to form on the rotor surface. The first few brake applications scrub this rust off the rotor with a grinding noise as the pad friction material removes the oxide layer. Once the rotor is clean, the noise disappears and normal quiet operation resumes. This is a completely normal phenomenon on disc brake systems exposed to moisture.

113. A — A spill containment lip is a regulatory requirement on chemical transport trailers designed to contain leaks from valves, fittings, hose connections, and minor tank breaches during transport. A 15 cm crack in the containment lip compromises its ability to hold spilled product — the leaked chemical can escape through the crack onto the road surface, creating an environmental contamination event and a potential public safety hazard. The crack must be repaired before the trailer transports hazardous cargo.

114. D — All lamps in the light bar flickering simultaneously indicates a common connection inside the bar that all lamps share. The J560 connector has been verified as clean, so the fault is internal to the light bar. A common ground connection, a common power feed, or a shared internal wiring junction that makes intermittent contact from vibration or corrosion affects all lamps at the same time. The light bar must be disassembled or replaced to correct the internal connection fault.

115. B — Rattling or buzzing from the condenser area has multiple potential sources: loose or damaged condenser fan blades that vibrate during rotation, debris trapped in the condenser fins that vibrates in the airflow, or loose mounting hardware that allows the condenser assembly to vibrate against the TRU housing. Each of these mechanical sources produces the characteristic rattling sound during fan operation. Inspecting the fan, cleaning the fins, and tightening the mounting hardware addresses the most common causes.

116. D — Stake pockets are structural cargo securement attachment points. The cargo stakes that fit into these pockets bear the lateral forces of secured cargo during braking, cornering, and road vibration. Cracked welds at the pocket-to-rail interface weaken the pocket's attachment, and under the dynamic forces of cargo securement, a cracked pocket may fail — releasing the stake and the strap or chain attached to it. The loss of a securement point allows cargo to shift or fall from the trailer.

117. A — The manifold gauge pattern — suction pressure crashing to 5 psi (far below the normal 25-35 psi) within 5 seconds of compressor operation — indicates the compressor is rapidly depleting the available refrigerant on the low side. With a very low charge, the small volume of refrigerant is quickly compressed and moved to the high side, dropping the suction pressure below the low-pressure switch's cut-out threshold. The switch opens, the compressor stops, pressure equalizes, and the cycle repeats. The rapid cycling and extremely low suction pressure confirm a critically low charge.

118. D — A gurgling or bubbling noise from behind the dashboard that increases with engine RPM is trapped air being pushed through the heater core. The air pocket occupies a section of the heater core tube that should be filled with coolant. As the water pump speeds up at higher RPM, the increased flow pushes the air bubble through the narrow core tubes, producing the characteristic gurgling sound. Bleeding the cooling system to remove the trapped air eliminates the noise and restores full heater performance.

119. B — The compressor's internal components require a specific oil charge for lubrication. When the system leaked, refrigerant and oil escaped together. The leak repair and recharge restored the refrigerant but may not have restored the oil. The compressor now operates with insufficient lubrication — the internal components experience increased metal-to-metal contact and friction, producing the elevated noise. The correct amount of compressor oil must be added to replace what was lost with the refrigerant leak.

120. C — Both evaporators share the same refrigerant circuit, so the refrigerant charge and compressor are not the issue. The front evaporator cools because its expansion valve is functional — it meters the correct amount of refrigerant into the front coil. The rear expansion valve is stuck closed, preventing any refrigerant from entering the rear evaporator. Without refrigerant flow, the rear coil cannot absorb heat

and simply passes uncooled air. Replacing or repairing the rear expansion valve restores refrigerant flow to the rear evaporator.

121. A — The washer fluid heater is typically an inline heating element in the washer hose or an immersion heater in the reservoir. If the element has failed (open circuit), its fuse has blown, or the wiring to the element has an open, no current flows through the heating element and the washer fluid is dispensed at ambient temperature. Testing for voltage at the heater connector, checking the fuse, and measuring the element's resistance identify the specific fault in the heating circuit.

122. A — An overcharged system contains more refrigerant than the condenser can effectively cool. The excess liquid refrigerant occupies space in the condenser that should be used for gas-to-liquid phase change (condensation), reducing the effective condensing surface area. The reduced condensing capacity raises the high-side pressure. Simultaneously, the excess refrigerant can flood the evaporator, reducing its efficiency and potentially allowing liquid to return to the compressor. Recovering the excess refrigerant to the correct charge weight resolves both pressure abnormalities.

123. B — Temperature control oscillation (hunting between too hot and too cold) indicates the control loop cannot find a stable setpoint. The two primary control loop components are the temperature sensor (which provides feedback) and the blend door actuator (which adjusts the air temperature). A sensor providing inaccurate or erratic feedback causes the control module to overcorrect continuously. An actuator that responds erratically or has a mechanical dead zone cannot hold the correct intermediate position, causing the door to hunt between extremes.

124. C — The pump is running in standby (no hydraulic function commanded) and the temperature rises. In an open-center system, standby should route the pump's output directly to the tank at near-zero pressure. If the pump has internal wear, fluid bypasses through the worn clearances and the energy that should push fluid through the circuit is converted to heat inside the pump. Additionally, if the relief valve's crack pressure is close to the pump's standby pressure, fluid may trickle across the relief continuously, converting that energy to heat.

125. A — Air trapped in the rod side of the boom retract cylinder compresses when the retract port is pressurized. The air compresses (piston stops), then enough pressure builds to push the air bubble through the fluid, and the piston lurches forward. The cycle repeats at each compression-expansion event. The jerky motion is characteristic of trapped air because air is compressible while hydraulic fluid is not — in an air-free system, the piston would move smoothly because the fluid transmits force instantaneously without compressing.

126. D — Plugging the cylinder ports isolated the cylinder from the directional valve. The drift continued at the same rate, proving the leak is inside the cylinder — not in the valve. Fluid is bypassing from the cap end (pressurized by the load) to the rod end through the worn or failed piston seal. The load slowly pushes fluid across the piston, and the body drifts downward as the cap-side volume decreases. The cylinder must be rebuilt or replaced.

127. B — The suction strainer's purpose is to prevent large contaminants from entering the pump inlet. Over 5 years of operation without inspection, the strainer mesh has accumulated progressively more contamination. The contamination restricts fluid flow through the strainer, and the pump must work harder to draw fluid through the narrowing passages. When the restriction exceeds the pump's suction capability, the inlet pressure drops below the fluid's vapor pressure, forming cavitation bubbles that collapse violently inside the pump.

128. A — The relief valve adjustment screw compresses a spring that holds the valve closed. The valve opens when system pressure overcomes the spring force. If the spring has weakened from fatigue, thermal degradation, or corrosion, it cannot generate the force needed to hold the valve closed at 3,000 psi. Turning the adjustment screw compresses the weak spring further, but even at maximum compression, the weakened spring cannot produce the 3,000 psi force. Replacing the spring with a new one of the correct specification restores the valve's rated pressure.

129. C — A gear pump's output is directly proportional to its rotational speed. At engine idle, the PTO drives the pump at a speed proportional to idle RPM — which may fall below the minimum RPM needed for the pump to produce adequate, consistent flow for the hydraulic functions. The reduced flow causes erratic actuator operation because the cylinders fill slowly and inconsistently. Increasing the engine idle speed to the manufacturer's specified PTO operating RPM provides adequate pump speed for smooth hydraulic function operation.

130. D — A slowly dropping reservoir level with no visible external leaks suggests the oil is leaking into another fluid system through a shared component. The most common shared component is the oil cooler — if the hydraulic circuit shares a cooler with the engine cooling system and the cooler develops an internal leak, the higher-pressure hydraulic oil forces through the leak into the lower-pressure coolant circuit. The hydraulic oil level drops, and the cooling system may show signs of oil contamination (discoloration, oil floating on the coolant surface).

131. B — The float position connects both the cap-end and rod-end cylinder ports to the tank return line simultaneously. This removes all hydraulic resistance from the cylinder — the piston can move freely in either direction under external forces without hydraulic pressure opposing the movement. The tailgate platform rests on the ground under its own weight and can follow the ground contour as cargo is loaded

or unloaded. Without the float position, the cylinder would hold the platform rigidly at its last commanded position.

132. A — The traction motor in a battery electric bus operates under extremely high torque loads during transit operation — frequent stops and starts with a full passenger load. The motor bearings support the rotor at high rotational speeds under these demanding loads for hundreds of thousands of kilometres. As the bearings wear, the increased clearance allows the rotor to vibrate within the worn bearing surfaces, producing a whining noise proportional to rotational speed. The noise increases with motor speed because the vibration frequency rises with rotation.

133. C — The DC-DC converter tests within specification for its overall output voltage, and the parasitic draw is normal. However, the converter may produce a charging voltage with excessive AC ripple — high-frequency voltage fluctuations superimposed on the DC output. While the average voltage is within specification, the ripple accelerates the electrolysis of water in the battery's electrolyte, causing premature plate sulfation and capacity loss. Additionally, if the HV system shuts down during parking and the DC-DC converter stops, the 12V battery may experience deep discharge cycles.

134. B — The regenerative braking vibration occurs without friction brake application, so the vibration source is in the electrical drive system. The inverter converts the motor's AC generator output to DC for battery charging. If an inverter switching device is failing, it produces an inconsistent AC-to-DC conversion that creates a pulsating DC output. This pulsating current creates a cyclic variation in the motor's electromagnetic torque, which is transmitted through the drivetrain as a vibration felt at the brake pedal and through the chassis.

135. D — High-voltage systems must always be treated as potentially energized until verified otherwise through the proper de-energization and voltage measurement procedure. Some vehicles may maintain high voltage at the charging inlet for auxiliary systems, and failed contactors may leave the inlet energized even when no charger is connected. The only safe approach is to perform the complete de-energization procedure, verify zero voltage with a rated meter, and apply personal lockout before disconnecting any high-voltage connector.