PRACTICE EXAM 13: RED SEAL 310T SIMULATION (135 QUESTIONS)

1. A technician is removing a set of dual tires from a drive axle hub using an impact wrench. After removing all the wheel nuts, the technician pulls the outer wheel off and sets it aside. Before pulling the inner wheel, the technician notices that the hub seal has leaked oil onto the inner wheel's mounting surface. What safety precaution is required before pulling the inner wheel?

A. Wipe the oil from the hub with a clean shop rag before removing the inner wheel to prevent the wheel from slipping during handling

B. Spray the oily mounting surface with brake cleaner to dissolve the oil before pulling the wheel off the hub

C. The technician must be aware that the oily inner wheel may slide unexpectedly when pulled from the hub — the oil reduces the friction between the wheel and the hub pilot, and the wheel (weighing 50+ kg) can drop suddenly if the technician is not prepared; proper lifting technique and a helper or wheel dolly should be used to control the heavy, slippery wheel

D. Place a block of wood under the inner wheel before pulling it to prevent damage to the shop floor if the wheel falls

2. A shop is disposing of used diesel fuel filters. The filters contain residual fuel and are contaminated with soot and metallic particles from the fuel system. What is the correct disposal method?

A. Used diesel fuel filters must be disposed of as hazardous waste — they contain petroleum residue, combustion byproducts, and potentially heavy metals; they must be drained of free-flowing fuel (into the waste fuel container), placed in a designated hazardous waste container, and collected by a licensed hazardous waste hauler according to provincial environmental regulations

B. The filters can be placed in the regular shop garbage once they have been drained of all free-flowing fuel

C. The filters should be placed in the waste oil collection drum where the residual fuel will mix with the used oil for recycling

D. The filters must be incinerated in the shop's waste oil furnace to destroy the hazardous contaminants

3. A technician is assigned to replace a fifth wheel on a tractor. The fifth wheel weighs approximately 150 kg. The shop's overhead crane is available but the technician decides to use a floor jack and wood blocks instead, stating the crane takes too long to set up. What is the safety concern?

A. The floor jack and wood blocks are an acceptable alternative to the overhead crane for this weight and should be used to save time

B. The floor jack may not be rated for the weight of the fifth wheel and could fail during the lift

C. The wood blocks may split under the concentrated weight of the fifth wheel and allow it to drop

D. A floor jack and wood blocks are not an engineered lifting solution for this application — the fifth wheel's weight, shape, and mounting position make it difficult to balance on a floor jack safely; the overhead crane with proper rigging (slings or chains through the fifth wheel's mounting holes) is the designed lifting method that controls the load securely; improvised lifting methods risk the heavy component falling and crushing the technician

4. A technician notices that the shop's fire extinguisher near the welding area has a pressure gauge needle in the red "recharge" zone. The extinguisher was last serviced 14 months ago. What action is required?

A. The extinguisher can remain in service because the gauge may be inaccurate and the extinguisher is likely still functional

B. The fire extinguisher must be removed from service immediately and replaced with a charged unit — a discharged or partially discharged extinguisher cannot be relied upon during a fire emergency; the welding area is a high-fire-risk location that must have a fully charged, properly rated extinguisher immediately accessible at all times

C. The extinguisher should be tested by briefly squeezing the handle to verify whether it still discharges before deciding on replacement

D. The extinguisher only needs service at the annual inspection date, which is 2 months away

5. A technician is working on a truck's electrical system and receives a mild electrical shock when touching a bare wire. The shock is brief and the technician feels no lasting effects. What should the technician do?

A. Continue working after wrapping the bare wire with electrical tape to prevent further contact

B. Note the incident in the shop's maintenance log and continue working after verifying the circuit is de-energized

C. Report the electrical shock to the supervisor immediately regardless of how minor it seems — even a mild shock can cause internal injuries (cardiac arrhythmia, muscle damage, or burns) that may not be immediately apparent; the incident must be documented, the technician should be evaluated by a medical professional if there is any concern, and the electrical hazard must be corrected before any further work

D. Disconnect the battery before continuing work to eliminate the electrical hazard

6. A shop technician is tasked with raising a heavy-duty truck on a four-post drive-on surface lift. Before driving the truck onto the lift, what must the technician verify?

A. The lift's rated capacity exceeds the vehicle's gross weight, the lift's runway surfaces are clean and free of oil or debris that could cause the vehicle to slide during positioning, and the lift's safety mechanisms are functional — exceeding the lift capacity risks catastrophic structural failure, and an oily runway surface can cause the vehicle to slide off the lift during raising

B. The truck's parking brake is functioning correctly so it can be set after the truck is positioned on the lift

C. The lift's hydraulic fluid level is at the maximum mark on the reservoir sight glass

D. The shop's ventilation system is running to remove exhaust fumes while the truck is driven onto the lift

7. A technician is removing a turbocharger from a diesel engine. The turbocharger's turbine housing is still warm from recent operation. During removal, the technician's forearm contacts the turbine housing and receives a burn. What should have been done to prevent this injury?

A. The technician should have applied a heat-resistant barrier cream to exposed skin before beginning work on the exhaust system

B. The technician should have worn a long-sleeved fire-resistant shirt during the removal to protect against incidental contact with hot surfaces

C. The technician should have waited for the turbine housing to cool to a safe handling temperature before beginning the removal procedure

D. The technician should have verified the turbocharger's surface temperature before starting the removal — exhaust components retain dangerous heat (300°C+) for an extended period after shutdown; the technician must either wait for the components to cool to a safe handling temperature or wear appropriate heat-resistant protective equipment (leather welding gloves, long-sleeved shirt) during the removal

8. A shop has a policy requiring all technicians to use torque wrenches for critical fastener applications. A technician argues that they have 20 years of experience and can "feel" when a bolt is tight enough without a torque wrench. Why is the torque wrench policy non-negotiable?

A. Using a torque wrench is slower than hand-tightening and the policy exists to standardize labor times across all technicians

B. Human perception of tightness varies with fatigue, hand strength, wrench length, and the fastener's friction coefficient — a torque wrench applies a measured, repeatable, and documented clamping force that ensures every critical fastener meets the manufacturer's specification; under-torqued fasteners loosen and fail, and over-torqued fasteners stretch, yield, and break; no amount of experience can consistently replicate the precision of a calibrated wrench

C. The torque wrench policy exists only for warranty compliance and has no bearing on the actual safety of the fastener installation

D. Torque wrenches are required by provincial motor vehicle safety standards for all fastener applications on commercial vehicles

9. A heavy-duty diesel engine equipped with an electronic unit injector system has a condition where the engine runs rough at idle but smooths out completely above 1,200 RPM. A cylinder contribution test shows all cylinders contributing equally at 1,200 RPM, but at idle, cylinder 3 contributes 30% less than the others. What does this RPM-dependent contribution difference suggest?

A. The cylinder 3 injector has a worn nozzle that produces a poor spray pattern at the low fuel pressures of idle injection but atomizes adequately at the higher pressures of 1,200 RPM injection — the injector's internal clearances leak fuel at the low-pressure idle delivery but seal adequately under the higher pressures of loaded operation

B. The cylinder 3 valve lash is set incorrectly, reducing that cylinder's volumetric efficiency only at idle speeds

C. The cylinder 3 has a compression issue that is masked by the higher cylinder pressures at 1,200 RPM

D. The ECM's idle fuel trim for cylinder 3 has a software calibration error that corrects itself above 1,200 RPM

10. A diesel engine has a condition where the coolant level drops approximately 500 ml per week. There are no visible external leaks. The oil is clean (no milky appearance). The exhaust shows no white smoke. A cooling system pressure test holds for 30 minutes with no drop. What additional test can locate this elusive leak?

A. A chemical analysis of the exhaust condensate to detect coolant chemical signatures in the exhaust stream

B. An ultrasonic leak detection test using the cooling system's pressurized fluid as the sound-conducting medium

C. An ultraviolet dye test — add UV-fluorescent dye to the coolant, operate the vehicle under normal driving conditions for several days, then inspect all cooling system components, exhaust components, and oil with a UV light; the dye concentrates at the leak point and fluoresces under UV illumination, revealing leaks too small to detect by visual inspection or static pressure testing

D. A borescope inspection of each cylinder through the injector port to look for coolant residue on the piston crowns

11. A heavy-duty diesel engine has a condition where the engine produces excessive black smoke under full load but runs clean at all other operating conditions. The turbocharger boost pressure meets specification. The fuel system pressure meets specification. The air filter is clean. What should be investigated?

A. The EGR system, which may be flowing excessively under full load and diluting the intake charge beyond the engine's tolerance

B. The exhaust backpressure, which if elevated from a loaded DPF or restricted exhaust system reduces the turbocharger's efficiency even though the boost pressure at the intake reads correctly

C. The fuel temperature, which if elevated at full load reduces the fuel's density and causes the ECM to command more fuel volume

D. The injector timing and spray pattern — at full load, each injector delivers maximum fuel; if one or more injectors have degraded spray patterns (dribbling nozzle tips, worn spray holes, carbon-restricted orifices), the fuel does not atomize as finely as designed at maximum delivery, producing incomplete combustion and black smoke only at full load when the injector's deficiency is most apparent

12. A diesel engine's oil analysis shows a sudden increase in fuel dilution — the fuel content in the oil has jumped from the normal 1% to 8% in one sample interval. The engine does not have a DPF (no post-injection regeneration events). What is the most likely cause?

A. The fuel return line has a restriction that creates backpressure in the injectors, forcing fuel past the injector barrel seals into the crankcase

B. One or more fuel injectors are leaking fuel into their respective cylinders during the engine-off period — the fuel accumulates on the piston crowns, washes past the rings into the crankcase, and dilutes the oil; additionally, an injector with a severely degraded spray pattern that directs fuel onto the cylinder wall during operation allows fuel to wash past the rings continuously

C. The fuel transfer pump has a diaphragm leak that allows fuel to enter the engine's lubrication circuit through the pump's mounting gasket

D. The engine's crankcase ventilation system is drawing fuel vapors from the fuel tank vent into the crankcase through a cross-connected breather line

13. A heavy-duty diesel engine equipped with a VGT turbocharger has a condition where the engine produces adequate power at steady state but has a noticeable 3-second delay in power delivery during rapid throttle application (tip-in). No fault codes are present. What is the most likely cause of this delayed response?

A. The VGT vanes have carbon buildup that slows their response to the ECM's commanded position change — when the driver tips in the throttle, the ECM commands the vanes to close for maximum boost, but the contaminated vanes resist movement through the carbon deposits; the 3-second delay represents the time for the actuator to push the vanes through the carbon to the commanded position

B. The fuel rail pressure regulator has a slow response that delays fuel delivery during rapid throttle changes

C. The ECM's acceleration enrichment algorithm has an intentional delay programmed for emission compliance

D. The exhaust manifold has developed a crack that leaks exhaust energy during the transient high-pressure spike of rapid acceleration

14. A diesel engine has a condition where the engine's oil consumption has increased from 0.5 L per 1,000 km to 1.5 L per 1,000 km over a 100,000 km period. The crankcase pressure is approaching the maximum specification. The oil analysis shows increasing iron and chromium. What do these combined indicators point to?

A. The turbocharger seals are failing, consuming oil through the intake and exhaust streams while generating metallic debris from the bearing wear

B. The oil cooler has developed an internal restriction that is reducing oil flow and causing accelerated internal wear from inadequate lubrication

C. The piston rings and cylinder liners are wearing progressively — the increased oil consumption (oil passing the worn rings), the rising crankcase pressure (combustion gas leaking past the worn rings), and the increasing iron (liner material) and chromium (ring plating material) collectively confirm accelerating ring-to-liner wear that is trending toward overhaul

D. The valve stem seals and valve guides have worn simultaneously, consuming oil through the intake ports and generating metallic debris from the guide material

15. A heavy-duty diesel engine's cooling system has been flushed and refilled with new coolant. After the refill, the technician starts the engine and the temperature gauge rises rapidly to the red zone within 5 minutes. The upper radiator hose is cold. What is the most likely cause?

A. The flush procedure left debris in the cooling system that has blocked the thermostat in the closed position

B. The new coolant mixture is too concentrated (too much antifreeze, not enough water) and its reduced thermal conductivity is preventing adequate heat transfer

C. The water pump impeller was damaged during the flush procedure from debris passing through the pump

D. A large air pocket is trapped in the cooling system from the refill — the air pocket prevents coolant from circulating through the engine because the water pump cannot pump air; the engine heats the trapped coolant rapidly while the radiator remains cold because no coolant flow reaches it; the upper hose is cold because the thermostat may open but the air pocket blocks circulation; the system must be properly bled to remove the trapped air

16. A diesel engine equipped with a common rail fuel system has a condition where the fuel rail pressure fluctuates by ±200 bar at idle. The pressure should be stable within ±30 bar. What is the most likely cause of the excessive fluctuation?

A. A fuel injector with an intermittent electrical connection that causes it to fire erratically — when the injector fires unexpectedly, it momentarily drops the rail pressure; when it misses, the pressure rises from the un-consumed fuel; the random firing pattern creates the ±200 bar oscillation that the pressure regulator cannot compensate for quickly enough

B. The fuel rail pressure sensor has a noisy signal that makes the pressure appear unstable on the scan tool

C. The high-pressure fuel pump has a worn check valve that alternately seals and leaks with each pump stroke

D. The fuel return line has a partial restriction that creates a pressure oscillation from the alternating flow of returning fuel

17. A heavy-duty diesel engine has a condition where the engine oil pressure is adequate when the engine is first started (cold) but gradually drops over 30 minutes as the engine reaches operating temperature. At operating temperature, the pressure is 5 psi below the minimum idle specification. What is the most likely cause?

A. The oil pump relief valve spring has weakened from heat cycling and can no longer hold the valve closed against the system's pressure at operating temperature

B. The engine bearings have worn to the point where the oil leaks past the enlarged clearances faster at operating temperature (where the oil is thinner) than the pump can supply — the cold oil's higher viscosity partially compensates for the worn clearances at startup, but as the oil warms and thins, the leakage rate exceeds the pump's output at idle

C. The oil temperature sensor is reading higher than actual, causing the ECM to display a lower-than-actual pressure value

D. The oil cooler bypass thermostat is stuck open, routing oil through the cooler continuously and creating a pressure drop from the cooler's flow resistance

18. A diesel engine's DPF has reached its maximum ash loading limit according to the scan tool's ash accumulation counter. The DPF backpressure is within specification at idle but slightly elevated under load. What service is required?

A. A forced active regeneration at maximum temperature to burn the accumulated ash to a finer particle that passes through the DPF substrate

B. A chemical cleaning treatment added to the fuel tank that dissolves the ash deposits during the next regeneration cycle

C. Replacement of the DPF with a new unit because ash loading cannot be reversed by any cleaning method

D. Off-vehicle cleaning by a specialized DPF cleaning service — the DPF must be removed from the vehicle and cleaned using compressed air and vacuum (pneumatic cleaning) or a baking and blowing process that breaks the ash loose from the channels and removes it; this procedure is required periodically throughout the DPF's service life and is significantly less expensive than DPF replacement

19. A diesel engine equipped with an SCR aftertreatment system has a condition where the DEF consumption rate is approximately 50% higher than the expected rate for the engine's fuel consumption. The DEF quality sensor reads normal. What could cause the excessive DEF consumption?

A. The DEF dosing injector has worn and delivers more DEF per injection event than the ECM commands

B. The DEF return line has a restriction that creates backpressure on the dosing system, forcing more DEF through the injector

C. The SCR catalyst efficiency has degraded — the ECM monitors the NOx sensor downstream of the SCR and compares it to the target value; when the catalyst's conversion efficiency drops, the downstream NOx remains above the target, and the ECM increases the DEF dosing rate to compensate

for the reduced efficiency; the 50% increase in DEF consumption reflects the ECM's attempt to make up for the catalyst's declining performance

D. The engine's combustion produces higher-than-normal NOx levels from advanced injection timing that the SCR system must compensate for with increased DEF dosing

20. A heavy-duty diesel engine has a condition where the engine starts and runs normally but the exhaust gas temperature on cylinder 6 is consistently 120°C higher than the average of the other five cylinders during a loaded highway pull. What is the most likely cause?

A. The cylinder 6 injector is over-fueling — the injector delivers more fuel than the ECM commands, creating a richer combustion event that generates higher exhaust gas temperature; the excess fuel burns hotter and the elevated EGT can accelerate thermal wear on that cylinder's piston, rings, valves, and turbocharger components

B. The exhaust manifold runner for cylinder 6 has a restriction that traps hot exhaust gas near the temperature sensor

C. Cylinder 6 has higher compression than the other cylinders from a thicker head gasket fire ring

D. The EGR system draws exhaust gas from a port near cylinder 6, reducing the gas flow past the sensor and allowing the residual gas to heat further

21. A diesel engine's turbocharger has been in service for 400,000 km. The technician removes the turbocharger for inspection and finds the compressor wheel has visible erosion on the leading edges of several blades. What caused this erosion, and what is its effect?

A. The erosion is from normal airborne particulate impact — even filtered air contains microscopic particles that erode the compressor blades at high velocity over 400,000 km

B. The erosion is from moisture droplets in the intake air that impact the blades at high velocity during humid weather operation

C. The erosion has no measurable effect on the turbocharger's performance and the turbocharger can be returned to service

D. The eroded blade edges reduce the compressor wheel's aerodynamic efficiency — the worn leading edges cannot direct the airflow as precisely as the original profile, reducing the compressor's ability to

compress and accelerate the intake air; the turbocharger produces less boost for the same exhaust energy input, and the engine's power output decreases proportionally; the turbocharger should be rebuilt or replaced

22. A diesel engine has a condition where the engine's coolant temperature stabilizes at 75°C during highway driving. The specified operating temperature is 85-92°C. The thermostat has been replaced with the correct specification unit, but the temperature remains at 75°C. What else could prevent the engine from reaching operating temperature?

A. The radiator cap is venting at too low a pressure, allowing the coolant to boil at a lower temperature and reducing the system's effective operating temperature

B. The cooling fan is engaging at too low a temperature — the fan clutch, fan relay, or fan control circuit is commanding the fan on at a threshold below the thermostat's opening temperature, providing excessive cooling that prevents the engine from reaching its designed operating temperature even with a functioning thermostat

C. The oil cooler is rejecting excessive heat from the oil circuit, pulling the coolant temperature down below the thermostat's regulating range

D. The supplemental coolant additive concentration is too low, reducing the coolant's heat absorption capacity

23. A heavy-duty diesel engine equipped with a mechanical fuel injection pump has a condition where the engine runs well at idle and light load but produces excessive black smoke and loses power above 2,000 RPM. The governor spring tension has been verified as correct. What mechanical pump component could cause this high-RPM-only deficiency?

A. The fuel transfer pump inside the injection pump is unable to supply adequate fuel volume at high RPM — the transfer pump's worn gears or worn relief valve cannot maintain the internal fuel supply pressure needed for the injection pump's plungers at high delivery rates

B. The injection pump's timing is retarded and the late injection cannot burn completely at the higher RPM

C. The injection pump's delivery valves have worn seats that allow fuel to dribble back into the pump after injection, reducing the effective delivery at high RPM

D. The injection pump's governor linkage has excessive free play that prevents the governor from controlling fuel delivery accurately at high RPM

24. A diesel engine has a condition where a continuous stream of coolant weeps from the water pump weep hole. The weep hole is a small drain located between the pump's seal and the bearing. What does this continuous weep indicate?

A. The water pump shaft seal has failed — the weep hole is designed to drain any coolant that passes the shaft seal before it can reach and contaminate the bearing; a continuous weep confirms the seal has failed and coolant is leaking past it; the pump must be replaced because the seal cannot be serviced without removing and disassembling the pump, and the bearing may already be contaminated

B. The cooling system is overpressurized from a faulty radiator cap that is exceeding the pump seal's pressure rating

C. The pump housing has a porosity defect that allows coolant to seep through the casting to the weep hole

D. The engine block's water pump mounting surface has a gasket failure that allows coolant to reach the weep hole from the block's internal passages

25. A heavy-duty diesel engine has been diagnosed with a cracked cylinder head. The crack connects a coolant passage to an exhaust port. What symptom would this specific crack location produce?

A. Coolant contamination of the engine oil from the pressurized coolant entering the crankcase through the exhaust valve guide

B. Combustion gas entering the cooling system through the cracked exhaust port-to-coolant connection during the exhaust stroke

C. Coolant entering the combustion chamber through the exhaust port during the exhaust stroke when the exhaust valve opens

D. Coolant entering the exhaust gas stream — the pressurized coolant seeps through the crack into the exhaust port, where it is carried away by the exhaust gas; the coolant vaporizes in the hot exhaust and exits as white steam; the engine's power is unaffected because the crack is in the exhaust port (not the combustion chamber), and the oil remains clean because the coolant does not enter the crankcase through this path

26. A diesel engine's ECM has implemented a progressive power derate that has escalated from 5% to 25% over a 3-day period. The scan tool shows an active emission-related fault code for "NOx Sensor 2 — Rationality Error." What is the regulatory basis for this escalating derate?

A. The engine manufacturer imposes the derate voluntarily as a customer incentive to have emission system faults repaired promptly

B. Environmental regulations mandate that emission-related faults trigger an escalating derate schedule to compel timely repairs — the regulations specify that certain emission system faults must progressively reduce the engine's power output over a defined time period (typically engine-operating hours) to prevent indefinite operation with elevated emissions; the derate escalates from mild to severe to ensure the operator cannot ignore the fault

C. The ECM applies the escalating derate to protect the SCR catalyst from damage caused by the faulty NOx sensor's incorrect dosing commands

D. The derate is an ECM self-protection strategy that limits the engine's thermal load while the emission system is compromised

27. A diesel engine equipped with a common rail fuel system and a DPF has a condition where the engine oil level rises between oil changes. The engine uses post-injection for DPF regeneration. The oil viscosity is noticeably thinner than fresh oil. What is the most likely cause?

A. Post-injection fuel events during DPF regeneration are introducing raw fuel into the cylinders late in the combustion cycle — the late-injected fuel is intended to raise exhaust temperatures for DPF soot oxidation, but some of the fuel washes past the piston rings into the crankcase and dilutes the oil; frequent regeneration cycles, short trip operation that triggers more regenerations, or a regeneration strategy that uses excessive post-injection volume accelerate the dilution

B. The fuel return line has a pinhole leak inside the valve cover that drips fuel onto the cylinder head and into the crankcase

C. The oil has absorbed moisture from the crankcase ventilation system and the water volume is raising the oil level

D. The high-pressure fuel pump has a worn seal that allows fuel to leak from the pump housing into the engine's lubrication circuit

28. A heavy-duty diesel engine has a condition where the engine idles smoothly and runs well under most conditions, but produces a distinct misfire (stumble) at exactly 1,400 RPM under moderate load. Above and below 1,400 RPM, the engine runs normally. What type of diagnostic approach is needed for this RPM-specific symptom?

A. The 1,400 RPM stumble is likely caused by a resonance or interference condition rather than a general engine deficiency

B. The 1,400 RPM stumble is caused by a worn camshaft lobe that produces inadequate valve lift only at the specific valve timing that occurs at that RPM

C. The 1,400 RPM stumble is caused by a fuel system restriction that limits delivery at the specific fuel demand rate that occurs at that RPM under moderate load

D. The diagnostic approach must consider that an RPM-specific stumble is often caused by a torsional vibration, an intake or exhaust resonance, or an electronic control anomaly that occurs at a specific frequency — the engine's firing frequency at 1,400 RPM may coincide with a natural resonance in the intake manifold, exhaust system, or fuel rail; alternatively, the ECM's fuel map may have a calibration anomaly at that specific operating point

29. A diesel engine's coolant test shows the freeze point protection is adequate at −45°C, but the coolant's pH has dropped to 7.0. The manufacturer's minimum pH specification is 8.0. The coolant was last changed 2 years ago with an OAT-type extended-life coolant. What does the low pH indicate?

A. The OAT coolant's organic acid inhibitors are naturally acidic and a pH of 7.0 is within the expected range for a 2-year-old OAT coolant

B. The low pH is caused by exhaust gas contamination from an internal leak that is introducing acidic combustion products into the coolant, accelerating the inhibitor depletion and acidifying the fluid beyond normal aging — the pH test alone cannot distinguish between normal inhibitor depletion and combustion gas contamination, and a supplemental combustion gas test is needed to determine whether the low pH is from aging or from an internal leak

C. The coolant has been contaminated with a different coolant chemistry that reacted with the OAT inhibitors and lowered the pH

D. The OAT coolant's inhibitor package has depleted from normal service and the pH has dropped below the minimum — the inhibitors must be replenished with the manufacturer's recommended extender to restore the pH to the protective range; if the pH has dropped below 7.0, the coolant must be replaced entirely because the acid condition is now corroding internal engine surfaces

30. A heavy-duty truck's air compressor has been recently replaced. After installation, the new compressor builds pressure to cut-out normally but the air dryer purges every 30 seconds instead of the normal 3-5 minute interval. What is the most likely cause of the frequent purging?

A. The new compressor has a higher displacement than the original and builds to cut-out pressure faster, triggering more frequent governor cycling and purge events

B. The governor's cut-in pressure has been set too close to the cut-out pressure, creating a narrow operating band that the larger compressor traverses quickly

C. The new compressor is passing excessive oil that has saturated the air dryer desiccant, reducing its moisture-absorbing capacity and triggering premature purges — alternatively, a large air leak downstream of the dryer is depleting the system rapidly, causing the compressor to cycle from cut-in to cut-out every 30 seconds

D. The air dryer purge valve has been recalibrated to match the new compressor's higher output capacity

31. A tractor-trailer combination has a condition where the trailer brakes do not release after a brake application — the brakes remain applied even though the foot valve is fully released. The tractor brakes release normally. Disconnecting the service gladhand at the trailer releases the trailer brakes immediately. What does this test result indicate?

A. The foot valve's secondary circuit (which feeds the trailer service line) is not releasing its output pressure — the piston or seal in the secondary circuit is stuck in the applied position, maintaining signal pressure to the trailer's relay valve even after the pedal is released; disconnecting the service gladhand removes the trapped signal pressure and the trailer's relay valve exhausts the application air

B. The trailer relay valve exhaust has failed and cannot vent the application air from the trailer brake chambers

C. The trailer ABS modulator is holding residual pressure in the brake chambers after the application signal drops

D. The trailer's quick release valves have all failed simultaneously, preventing the brake chamber air from exhausting

32. A heavy-duty truck equipped with air disc brakes has a condition where the left front brake pad has worn to its minimum thickness while the right front pad still has 70% of its lining remaining. Both

calipers are the same type and the air pressure delivered to both chambers is equal. What is the most likely cause of the asymmetric wear?

A. The left front brake caliper has a smaller bore than the right front from a manufacturing variation

B. The left front rotor has a smaller diameter than the right, concentrating the braking force on a smaller pad area

C. The left front air disc brake caliper's automatic wear adjuster has over-compensated, holding the pad in light contact with the rotor at all times

D. The left front caliper's automatic wear adjuster has advanced beyond the correct position, holding the pad in continuous light contact with the rotor — the adjuster has over-compensated for normal wear and pushed the pad too close to (or in contact with) the rotor; the constant light friction generates continuous wear on the left pad while the correctly adjusted right pad wears only during intentional brake applications

33. A school bus equipped with air brakes has a condition where the driver reports a "spongy" brake pedal feel — the pedal requires more travel than normal to achieve adequate braking, and the feel is softer than the normally firm air brake pedal. What is the most likely cause?

A. The air system has a major leak that reduces the available pressure during each application

B. One or more brake chambers have ruptured diaphragms that allow the application air to escape into the spring cavity rather than pushing the pushrod — the ruptured diaphragm reduces the effective area pushing the pushrod, requiring more foot valve output (more pedal travel) to generate the same chamber force; the escaping air from the ruptured diaphragm does not push the pushrod, it simply fills the spring cavity, creating the spongy feel

C. The foot valve has a worn piston that bypasses internally, requiring more pedal travel to build adequate output pressure

D. The brake shoes have been replaced with a softer compound that compresses during application, absorbing pedal travel

34. A heavy-duty truck has a condition where the spring brakes partially apply during a hard service brake application — the driver feels the parking brakes engage momentarily during a hard stop. What is the most likely cause?

A. The spring brake relay valve has a fault that allows the hold-off air to vent partially during a hard service brake application

B. The dash-mounted parking brake valve has a loose plunger that shifts during the hard braking deceleration force

C. During a hard service brake application, the heavy air consumption from all brake chambers can momentarily drop the system pressure below the spring brake application threshold (approximately 60-65 psi) — the spring brakes begin to apply as the pressure drops, then release as the compressor rebuilds pressure; this indicates the system's reservoir capacity is insufficient for the number of hard applications between compressor cycles, or the system has leaks that reduce the available air volume

D. The spring brake chambers have weaker-than-specified power springs that begin to extend at a higher-than-normal pressure threshold

35. A transit bus equipped with air disc brakes on all axles has a condition where the brake dust on the front axle wheels is significantly heavier than the dust on the rear axle wheels. Both axle positions have the same pad specification. What does the heavier front-axle dust indicate?

A. The front brakes are performing a disproportionate share of the total braking work — the front axle receives more weight transfer during braking (the vehicle's weight shifts forward during deceleration), loading the front tires with more traction and allowing the front brakes to apply more force before lockup; the proportioning system may also deliver higher application pressure to the front axle; the heavier dust reflects the higher friction energy absorbed by the front pads

B. The front brake pads have a different compound than specified that produces more dust during the same amount of braking

C. The front rotors have a rougher surface finish that abrades the pads more aggressively than the smoother rear rotors

D. The front wheels are positioned in the aerodynamic airflow that dries the brake dust onto the wheel surface more visibly

36. A heavy-duty truck's air system has a condition where the air compressor produces adequate volume but the discharge air is excessively hot — the discharge line is too hot to touch comfortably (estimated 200°C+). The compressor is water-cooled. What is the most likely cause?

A. The compressor's internal valves are functioning normally but the compressor is running at a higher duty cycle than designed from a system leak

B. The compressor's head gasket has failed, allowing coolant to leak externally and reducing the cooling capacity

C. The compressor's water cooling circuit has inadequate flow — a restricted coolant supply line, a failed coolant return line, an air lock in the cooling circuit, or a thermostat in the coolant supply line that is stuck closed reduces the coolant flow through the compressor; without adequate cooling, the heat of compression raises the discharge temperature far above the normal range

D. The compressor's discharge line has a restriction that creates backpressure and heats the air from the compression work against the restriction

37. A tractor-trailer combination has a condition where the trailer brakes apply normally when the foot valve is pressed, but when the trailer hand valve (trolley valve) is used, the application is delayed by approximately 2 seconds before the trailer brakes begin to engage. What is the most likely cause of the hand valve delay?

A. The hand valve has worn internal components that allow air to bypass past the piston before building adequate output pressure

B. The air line between the hand valve and the trailer service gladhand has excessive length or volume — the hand valve must pressurize this entire line before the signal reaches the trailer's relay valve; a long routing path, an oversized line, or additional reservoir volume in the line's path delays the signal; the foot valve uses a different, shorter path to the same trailer relay valve, which is why it has no delay

C. The trailer's relay valve has a higher crack pressure for the hand valve signal than for the foot valve signal

D. The hand valve's air supply is restricted by a partially closed shut-off valve in the hand valve's supply line

38. A heavy-duty truck equipped with ABS has a condition where the ABS fault lamp illuminates and a fault code is stored for "Excessive Wheel Speed Difference — Left Rear vs Right Rear" during straight-line driving on dry pavement. There are no individual sensor fault codes. What could cause a speed difference between the left and right rear wheels during straight-line driving?

A. Mismatched tire diameters on the left and right rear drive positions — if one tire has a different rolling circumference (from a different size, brand, tread depth, or inflation pressure), it rotates at a different speed than its partner; the ABS module detects this constant speed difference during straight-line driving and sets the excessive wheel speed difference code

B. The differential lock has failed in the engaged position, forcing both wheels to the same speed and creating a paradoxical speed reading error

C. The ABS module's internal clock has drifted, causing it to calculate the left and right wheel speeds at different sample rates

D. The left rear axle shaft has twisted under load, creating a phase difference between the actual wheel speed and the sensor reading

39. A heavy-duty truck has a condition where the brake pedal vibrates rapidly during an ABS activation event. Is this pedal vibration normal during ABS operation?

A. The pedal vibration is abnormal and indicates a faulty ABS modulator valve that is creating pressure pulses in the brake circuit

B. The pedal vibration indicates the ABS system is applying and releasing the brakes too aggressively and the system sensitivity needs adjustment

C. The pedal vibration is normal during ABS activation — the ABS modulator valves rapidly cycle the brake application pressure (typically 10-15 times per second) to prevent wheel lockup; these rapid pressure cycles are transmitted through the air system plumbing back to the foot valve, and the driver feels the pulsation through the brake pedal; the vibration confirms the ABS is actively modulating

D. The pedal vibration is caused by the ABS modulator dumping exhaust air that backfires through the foot valve's exhaust port

40. A heavy-duty truck's air system has a condition where the governor cuts out at 125 psi (correct), but the air dryer does not purge — no audible purge blast occurs and the purge valve does not open. The desiccant cartridge was replaced 2 weeks ago. What is the most likely cause?

A. The new desiccant cartridge has a factory seal that was not removed during installation, blocking the purge valve's air path

B. The governor is not sending the unload signal to the air dryer — the governor unloads the compressor (confirmed by the correct cut-out) but may have a failed or disconnected signal port for the air dryer; the governor uses separate outputs for the compressor unloader and the air dryer purge valve, and the dryer's signal line may be disconnected, kinked, or plugged

C. The air dryer's purge valve has failed closed and cannot open regardless of the governor signal

D. The governor's signal line to the air dryer was connected to the wrong port on the dryer during the desiccant cartridge replacement, routing the signal to an inactive internal passage

41. A heavy-duty truck equipped with drum brakes has a condition where one brake drum is consistently 50°C hotter than the other drums after a highway drive. The brake adjustment on the hot drum is correct (pushrod stroke within specification). What should be investigated?

A. The brake chamber on the hot side for an internal spring that is applying residual force to the pushrod even when the brake is released

B. The brake anchor pin and S-cam bushing on the hot side — a seized anchor pin prevents the brake shoes from fully retracting from the drum when the S-cam returns to the released position; a worn S-cam bushing allows the cam to hang up in a partially rotated position, keeping the shoes in light contact; either condition creates a drag that generates the 50°C temperature elevation even though the pushrod stroke measurement appears correct

C. The brake return springs on the hot side for weakness or breakage that prevents the shoes from fully retracting

D. The automatic slack adjuster on the hot side for an internal fault that advances the adjustment beyond the correct setting

42. A tractor-trailer combination has a condition where the trailer's spring brakes apply during highway driving when the engine brake is activated at high retardation levels. The parking brake valve is in the released position. What is happening?

A. The engine brake's high retardation level creates a significant air demand from the air-operated engine brake actuators — this air consumption, combined with any existing system leaks, can drop the system pressure below the spring brake application threshold during sustained engine braking; the spring brakes apply because the tractor's air supply cannot maintain adequate pressure for both the engine brake actuators and the spring brake hold-off circuit simultaneously

B. The engine brake's vibration is causing the parking brake valve to shift momentarily to the applied position

C. The trailer's relay valve is misinterpreting the engine brake's exhaust backpressure signal as a brake application command

D. The engine brake controller is sending an erroneous signal through the CAN bus that the trailer ABS interprets as a spring brake command

43. A transit bus has a condition where one rear brake produces a grinding noise only when the bus is moving in reverse. The brakes are silent during forward driving and during forward brake applications. What is the most likely cause?

A. The brake shoes have been installed backward — the primary (leading) shoe and secondary (trailing) shoe have been swapped, and the reversed shoes contact the drum at an incorrect angle during reverse rotation

B. The brake drum has a scoring mark from a previous incident that the shoe contacts only during reverse rotation due to the shoe's asymmetric positioning on the backing plate

C. A piece of debris (stone, metal, or brake hardware) has lodged between the trailing shoe and the drum in a position that only contacts during reverse drum rotation — during forward rotation, the shoe's self-energizing action pulls it away from the debris; during reverse, the de-energizing action pushes the shoe toward the debris, causing the grinding

D. The ABS modulator activates briefly during reverse operation as part of a self-test routine that applies the brakes momentarily

44. A heavy-duty truck has a condition where the air system pressure builds to cut-out and the governor unloads the compressor, but the system pressure continues to rise by approximately 5 psi after the governor has cut out. What causes this continued pressure rise after the governor signals the compressor to stop?

A. The governor's cut-out pressure is set too low and the compressor's residual compression continues to add pressure after the unload signal

B. The air dryer's check valve is leaking in reverse, allowing compressed air from the supply tank to flow back toward the compressor and register as a pressure increase on the gauge

C. A small amount of residual compression in the compressor's cylinders continues after the unloader activates, and the air that was already compressed in the discharge line at the moment of unloading is still being pushed into the system

D. The compressor's unloader mechanism has a slight delay in fully unloading — the unloader does not instantaneously stop all pumping when the governor signals; the compressor continues to compress a few additional strokes worth of air through the partially opened unloader before the mechanism fully activates and the pumping stops completely

45. A heavy-duty truck equipped with ABS and electronic stability control has a condition where the ESC activates unexpectedly during moderate highway lane changes. The vehicle does not appear to be unstable during these maneuvers. Which sensors should be checked for calibration?

A. The wheel speed sensors, which if reading at slightly different rates could create a false wheel speed difference that the ESC interprets as instability

B. The yaw rate sensor, lateral accelerometer, and steering angle sensor — ESC compares the driver's steering intent (steering angle sensor) to the vehicle's actual behavior (yaw rate sensor and lateral accelerometer); if any of these sensors is miscalibrated, the ESC perceives a discrepancy between intended and actual behavior during normal lane changes and intervenes unnecessarily

C. The air pressure sensors in the brake circuits, which if reading different pressures could trigger an ESC response

D. The vehicle speed sensor, which if reading higher than actual would make the ESC perceive the lane change as being performed at an excessive speed

46. A heavy-duty truck has a condition where the foundation brake on one wheel position produces a metallic "clunk" at the beginning and end of each brake application — two clunks per application cycle. What is the most likely cause?

A. The S-cam bushing on the affected wheel is severely worn, allowing the S-cam shaft to shift in its bore — the first clunk occurs when the application force takes up the slack in the worn bushing (initial contact between the cam and the bushing wall), and the second clunk occurs when the release allows the cam to shift back to its resting position in the opposite direction

B. The brake drum has a crack that opens and closes during the thermal cycling of each brake application

C. The automatic slack adjuster has a broken internal worm gear that allows free play in both directions

D. The brake chamber diaphragm plate has come loose from the pushrod and shifts position during application and release

47. A heavy-duty truck has a condition where the engine starts normally but the alternator charge indicator lamp remains dimly illuminated with the engine running. The battery voltage reads 14.1V at the battery terminals (normal charging voltage). What does the dimly illuminated lamp indicate?

A. The lamp bulb has a partial internal short that allows a small current to flow through the filament even when the charging circuit is functioning correctly

B. The alternator has a marginal diode that is partially conducting in both directions — the small reverse leakage current flows through the indicator lamp circuit, providing just enough current to dimly illuminate the filament; the charging voltage appears normal because the remaining functional diodes compensate for the leaking diode, but the reverse leakage wastes energy and the failing diode will eventually cause a complete failure

C. The indicator lamp has the wrong resistance bulb installed, which draws current through the exciter circuit and produces a dim glow

D. The voltage regulator has a marginal connection that produces a small voltage fluctuation that illuminates the lamp dimly

48. A truck's scan tool retrieves an active fault code from the engine ECM: "Intake Manifold Pressure Sensor — Voltage Below Normal Operating Range." The sensor reads 0.2V. The specification for this sensor at atmospheric pressure (key on, engine off) is 1.0-1.5V. What is the most likely cause?

A. The intake manifold pressure sensor's signal wire is shorted to the sensor ground wire or to the vehicle chassis — the short circuit pulls the signal voltage down to near zero, which the ECM detects as below the normal operating range; the sensor itself may be functioning correctly, but the shorted signal wire prevents the ECM from reading the sensor's actual output

B. The sensor has an internal fault that produces a fixed 0.2V output regardless of the actual manifold pressure

C. The ECM's internal analog-to-digital converter on the MAP sensor input channel has a fault that reads the signal as 0.2V

D. The sensor's 5V reference supply wire has a high-resistance connection that reduces the reference voltage to the sensor

49. A heavy-duty truck has a condition where the batteries discharge overnight even though the parasitic draw test reads only 45 milliamps (within the 50-85 mA specification). The batteries are in good condition. What else should be investigated?

A. The battery cable connections for high resistance that may be preventing the alternator from fully charging the batteries during driving

B. The alternator's output capacity, which may be insufficient for the vehicle's total electrical demand during driving

C. The batteries' internal self-discharge rate, which if elevated from sulfation or age exceeds the rate of charge replacement during the daily driving cycle

D. The alternator for a reverse leakage (parasitic drain through the alternator) that occurs only when the engine is off — some alternator faults allow current to flow from the battery backward through the alternator's rectifier bridge to ground; this leakage may be too small to register on the parasitic draw test if the test is performed with the battery cable disconnected at the battery (which disconnects the alternator from the circuit); testing the draw at the alternator output terminal specifically may reveal the leakage

50. A truck equipped with LED tail lights has a condition where one LED tail light assembly appears to have a section (approximately 1/3) of its LED elements dark while the remaining 2/3 illuminate normally. What is the most likely cause?

A. The LED assembly's internal driver circuit has failed on one of its three output channels

B. A group of LED elements within the assembly has failed — LED assemblies contain multiple elements wired in series-parallel strings; if one string develops an open circuit (from a single failed LED element in that string), the entire string goes dark while the remaining strings continue to illuminate; the assembly produces reduced light output from the surviving strings

C. The power supply connector has a corroded pin that is limiting current to one section of the assembly

D. The LED assembly's lens has internal damage that blocks light from one section while allowing the other sections to transmit normally

51. A heavy-duty truck has a condition where the starter solenoid clicks once when the key is turned to start, but the engine does not crank. The batteries are fully charged. The technician measures the voltage at the solenoid's motor terminal (M terminal) during the click event and reads 0.3V. What does the 0.3V reading at the M terminal indicate?

A. The starter motor has a dead spot on the armature and the 0.3V represents the back-EMF from the motor sitting at an unfavorable position

B. The solenoid's pull-in winding has adequate force to move the plunger (producing the click) but the solenoid's heavy-duty contacts are not closing to connect the battery to the motor — 0.3V is the residual voltage from the pull-in winding's connection to the motor, not the full battery voltage that should appear when the contacts close; worn, pitted, or burned solenoid contacts are the cause

C. The starter motor has seized and the 0.3V represents the voltage dropped across the motor's locked-rotor resistance

D. The battery cables have extreme resistance that drops the voltage from 12.6V to 0.3V across the cable run

52. A truck's electronic instrument cluster has a condition where the engine oil pressure gauge suddenly drops to zero while the engine is running, then returns to normal after 5 seconds. This event occurs randomly, approximately once per hour. The engine oil pressure is verified as normal with a mechanical gauge. What is the most likely cause?

A. The oil pressure sender has an intermittent internal fault — the sender's variable resistance element has a worn spot or a corroded section that momentarily opens the circuit as the wiper crosses it; the open circuit produces a zero reading for the 5-second duration until the wiper moves past the defective section and contact is restored

B. The ECM momentarily drops the CAN bus oil pressure message during a periodic self-test routine

C. The instrument cluster's stepper motor for the oil pressure gauge has a mechanical fault that allows the needle to drop momentarily

D. The oil filter bypass valve opens periodically during operation, momentarily reducing the oil pressure at the sender location

53. A truck's CAN bus has a condition where one specific module goes offline intermittently. The technician has replaced the module, its power supply fuse, and cleaned its ground connection. The problem persists. What should be checked next?

A. The CAN bus backbone wiring between the module's CAN bus connector and the nearest bus junction point

B. The termination resistors, which may have shifted value and are affecting only the bus segment where the module connects

C. The module's firmware version, which may not be compatible with the other modules' firmware versions on the bus

D. The CAN bus connector at the module's location — the connector pins may be corroded, pushed back, or making intermittent contact; even though the module itself has been replaced and its power and ground are clean, a faulty CAN bus connector prevents the module from maintaining its connection to the communication bus; the connector must be inspected, cleaned, and repaired

54. A heavy-duty truck has a condition where the headlights produce a visible flicker at approximately 2 Hz when the engine is idling but the flicker disappears at higher engine RPM. What is the most likely cause?

A. The headlight circuit has a loose connection that resonates at the engine's idle vibration frequency

B. The alternator's output voltage is marginally low at idle RPM — the voltage regulator is cycling between charge and float modes at a frequency of approximately 2 Hz, creating a small voltage oscillation that is visible as a headlight flicker; at higher RPM, the alternator produces adequate voltage continuously and the regulator stabilizes

C. The engine's idle vibration is transmitted through the headlight's mounting bracket, causing the bulb filament to oscillate and produce the visible flicker

D. The battery has a high internal resistance that creates a voltage fluctuation at idle when the alternator's output cannot fully stabilize the battery's terminal voltage

55. A truck's scan tool shows that the engine ECM is broadcasting a vehicle speed of 0 km/h on the CAN bus, but the ABS module is broadcasting a vehicle speed of 85 km/h. The truck is actually traveling at 85 km/h. What does this conflicting data indicate?

A. The ECM receives its vehicle speed from a dedicated vehicle speed sensor (VSS) on the transmission output shaft, and this sensor has failed — the ECM broadcasts 0 km/h because it receives no speed signal from its dedicated sensor; the ABS module calculates vehicle speed from its wheel speed sensors, which are functioning correctly and broadcast the actual 85 km/h; the failed VSS must be diagnosed and repaired

B. The CAN bus has a data corruption fault that is altering the ECM's speed message before it reaches the scan tool

C. The ECM deliberately broadcasts 0 km/h during a diagnostic self-test that temporarily suspends the speed output

D. The ABS module has overwritten the ECM's speed data with its own calculation, and the ECM cannot broadcast while the ABS override is active

56. A heavy-duty truck has a condition where the right turn signal flashes at double the normal rate (hyper-flash). The left turn signal flashes at the normal rate. What is the most likely cause?

A. The right turn signal flasher module has an internal fault that doubles its output frequency for the right-side circuit

B. The right turn signal relay has welded contacts that supply continuous power to the right-side circuit instead of flashing

C. One or more bulbs on the right-side turn signal circuit have burned out, reducing the total current draw — the flasher module detects the reduced current and responds by flashing at an increased rate (hyper-flash) to alert the driver to the burned-out bulb; the left side has all bulbs functioning, producing the normal flash rate

D. The body controller module has a software fault that commands the right-side flasher at double the normal frequency

57. A truck equipped with a telematics system has a condition where the telematics unit occasionally reports "Engine Off" events while the driver is actively driving. The engine does not actually shut off during these events. What is the most likely cause?

A. The telematics unit's engine RPM detection circuit has a loose connection that momentarily loses the RPM signal

B. The telematics unit monitors engine status through a signal wire connected to an ignition-switched power source — if this wire has an intermittent connection (corroded splice, loose pin, or vibration-sensitive connector), the telematics unit loses the ignition signal momentarily and reports an "Engine Off" event even though the engine continues to run

C. The engine ECM momentarily suspends its CAN bus broadcasts during DPF regeneration events, and the telematics unit interprets the communication gap as an engine-off condition

D. The telematics unit's internal clock has a time-stamp error that duplicates engine-off events from the previous parking period

58. A heavy-duty truck has a condition where the electric cooling fan runs at full speed continuously from the moment the engine is started, regardless of the engine temperature. The engine is cold. No fault codes are present. The A/C system is off. What should the technician investigate?

A. The coolant temperature sensor, which if reading higher than actual would cause the ECM to command full fan speed from startup

B. The fan clutch engagement mechanism, which may have seized in the engaged position from age or contamination

C. The A/C high-pressure switch, which if stuck closed would command full fan speed through its dedicated fan activation circuit even with the A/C turned off

D. The ECM's fan control output and the fan controller's input signal — with no fault codes, the ECM believes its control is correct; the fan controller may have failed in the full-speed default state (ignoring the ECM's modulated signal), or the PWM signal wire between the ECM and the fan controller may be open or shorted, causing the controller to default to maximum speed as a protective measure

59. A truck's electronic throttle pedal has a condition where the pedal produces a normal idle-to-full-throttle voltage sweep (0.5V to 4.5V) on APP1, but APP2 reads a fixed 2.5V at all pedal positions. The ECM has set a correlation fault code and the engine is in idle-only mode. What is the most likely cause?

A. The APP2 sensor's internal element (potentiometer or Hall sensor) has failed and produces a fixed output regardless of pedal position

B. The APP2 sensor's mechanical connection to the pedal pivot has broken — the sensor is no longer physically linked to the pedal's movement and reads the voltage that corresponds to its disconnected rest position (2.5V at mid-range); APP1 is still physically connected and sweeps normally

C. The APP2 sensor's signal wire has a short to the 5V reference that holds the output at half the reference voltage

D. The ECM's APP2 input circuit has an internal pull-up resistor fault that fixes the reading at the voltage divider's mid-point

60. A heavy-duty truck has a condition where the battery disconnect switch produces a small spark when turned to the ON position, even though the ignition key is off and no accessories are activated. Is this spark normal?

A. A small spark when the battery disconnect switch is closed is normal — the vehicle's electronic modules, clock, telematics system, and other devices with keep-alive memory circuits draw a small standing current; when the disconnect switch closes, the initial in-rush current to charge the capacitors in these circuits produces the brief spark; this is the normal parasitic draw current establishing itself

B. The spark indicates a short circuit in the vehicle's wiring that must be diagnosed before the vehicle is operated

C. The spark is caused by a defective battery disconnect switch that has internal arcing from worn contacts

D. The spark indicates the alternator has a reverse-leakage diode that draws current from the battery through the charging circuit

61. A truck's ABS module stores a fault code for "Configuration Error — Tire Size Mismatch." The truck has had its steer axle tires replaced with a different brand that has a slightly different rolling circumference. What is the consequence of this configuration error?

A. The ABS system is completely disabled and will not provide anti-lock protection until the tire size is corrected

B. The ABS system is partially functional but the different rolling circumference of the steer tires produces a different rotational speed at the same vehicle speed — the ABS module compares the steer axle wheel speeds to the drive axle wheel speeds for plausibility, and the size mismatch creates a

constant speed difference that the module flags as a configuration error; the system may still provide ABS function but with reduced accuracy

C. The ABS system functions normally and the fault code is only an informational alert with no operational consequence

D. The ABS module interprets the different steer tire speed as a constant wheel slip condition and modulates the steer axle brakes continuously during driving

62. A truck's electronic gauge cluster has a condition where the tachometer reads 300 RPM higher than the actual engine speed at all operating conditions. The scan tool shows the correct engine RPM from the ECM. What is the most likely cause?

A. The crankshaft position sensor produces extra pulses that the ECM filters but the tachometer displays

B. The instrument cluster's tachometer display has an internal calibration error — the cluster receives the correct RPM data from the CAN bus (confirmed by the scan tool reading the correct value from the same data stream) but the cluster's internal processing applies an incorrect scaling factor to the tachometer stepper motor, displaying 300 RPM higher than the actual value

C. The engine ECM has a firmware bug that adds 300 RPM to the tachometer broadcast while displaying the correct value to the scan tool

D. The alternator's speed signal (which some clusters use as a secondary tachometer input) is producing a signal that adds to the ECM's RPM data

63. A heavy-duty truck has a condition where the starter motor disengages normally after the engine starts, but a grinding noise is heard from the starter area for approximately 1 second after disengagement. What is the most likely cause?

A. The starter motor armature has excessive inertia and continues spinning after the solenoid releases, causing the starter drive to scrape against the flywheel ring gear as the drive retracts

B. The flywheel ring gear has a damaged or worn section that the starter drive contacts as it retracts after disengagement

C. The starter drive mechanism's return spring is weak, causing the drive to retract slowly and grind against the ring gear during the 1-second delay between solenoid release and full drive retraction

D. The starter motor's one-way clutch (overrunning clutch) has failed and the engine's rotation is driving the starter motor backward for 1 second before the drive fully disengages — the engine turns the flywheel, the ring gear spins the starter drive, and the failed one-way clutch cannot prevent the engine from back-driving the starter; the grinding is the starter motor being forced to spin by the engine at a speed it was not designed for

64. A truck's windshield wiper motor has been replaced with a new unit. After installation, the wipers park at the top of the windshield instead of at the bottom. The wiper arms were not removed during the motor replacement. What is the most likely cause?

A. The new wiper motor's park switch is wired in the opposite configuration from the original motor, causing the park position to be at the top of the sweep instead of the bottom

B. The wiper linkage has been connected to the motor's crank arm at the wrong position — the crank arm has multiple connection points, and the technician connected the linkage to the 180-degree opposite hole from the correct position, reversing the park location

C. The motor rotates in the opposite direction from the original, sweeping the wipers in reverse

D. The new motor's internal park cam is oriented incorrectly from the factory, placing the park detent at the top of the sweep

65. A heavy-duty truck has a condition where the check engine lamp illuminates intermittently during driving. The scan tool retrieves a stored code for "Intake Air Temperature Sensor — Intermittent Signal." The lamp clears after a few minutes and may not return for hours. What diagnostic approach should be used for this intermittent fault?

A. Replace the intake air temperature sensor immediately since the fault code identifies it as the source

B. Perform a visual inspection of the sensor connector and wiring for signs of damage, corrosion, or chafing

C. Monitor the sensor's live data on the scan tool while manipulating the sensor's wiring harness and connector to recreate the intermittent condition

D. The technician should monitor the IAT sensor's live data stream on the scan tool while manipulating the sensor's connector, wiring harness, and the sensor itself — an intermittent signal fault is often caused by a broken wire that makes and breaks contact with vibration, a corroded connector pin that loses

contact intermittently, or a sensor with a cracked solder joint; physically disturbing the circuit while watching the live data can recreate the dropout and pinpoint the exact location of the intermittent connection

66. A truck's multiplexed lighting system has a condition where the BCM commands all the left-side marker lights on, and the BCM's feedback shows the correct total current draw for the left-side circuit. However, the driver reports that the second marker light from the front on the left side is dark. How is this possible?

A. The BCM's current measurement resolution is insufficient to detect the loss of one small LED marker light among several other lights on the same circuit

B. One marker light is dark but the BCM reads the correct total current because two conditions are occurring simultaneously — the dark lamp has an open circuit (drawing zero current), and another component on the same circuit has developed a current leak to ground that draws approximately the same current as the dead lamp; the BCM's total circuit current appears normal because the leakage replaces the dead lamp's current consumption

C. The BCM monitors only voltage, not current, and cannot detect a single burned-out lamp on a multi-lamp circuit

D. The dark marker light has an internal short that draws the same current as a functioning lamp but does not produce light

67. A heavy-duty truck has a condition where the cruise control will not engage. The engine runs normally, the vehicle speed signal is present on the scan tool, and the brake and clutch switches are verified as functional. The cruise control switches on the steering wheel show the correct inputs on the scan tool when pressed. What else could prevent engagement?

A. The cruise control system requires the engine coolant temperature to reach a minimum threshold before allowing engagement

B. The cruise control module or ECM has a software configuration that requires a minimum vehicle speed before engagement is permitted

C. The ECM has one or more active fault codes that disable the cruise control function as a protection strategy — many ECMs disable cruise control when any active engine fault code is present, including

codes for emission system faults, sensor rationality errors, or derate conditions; the cruise control inputs may all read correctly but the ECM refuses to engage the system while an engine fault is active

D. The cruise control resume function has been disabled by the fleet management software through the telematics system

68. A truck's battery system uses four 12V batteries — two pairs in parallel, with the pairs connected in series to provide 24V for the starting system. The 24V starting circuit works normally, but the 12V auxiliary circuit (which taps from the center of the series connection) has low voltage. What is the most likely cause?

A. The center-tap connection that provides the 12V auxiliary circuit has a high-resistance connection — corrosion, loose bolt, or a deteriorated cable at the junction between the two series-connected battery pairs reduces the voltage available to the 12V circuit; the 24V circuit is unaffected because it draws from the full series connection and the center-tap resistance does not affect the series path

B. One battery in the lower pair has a weak cell that reduces the 12V output from that pair

C. The 12V auxiliary circuit has a load that exceeds the capacity of the single pair it draws from

D. The voltage regulator provides separate charge profiles for the 24V and 12V circuits, and the 12V profile has drifted

69. A heavy-duty truck with a manual 13-speed transmission has a condition where the transmission pops out of high range (the range shift from low to high) during hard acceleration. The range cylinder air supply has been verified as adequate. What is the most likely cause?

A. The range synchronizer has worn teeth on the engagement dogs that allow the helical gear's thrust to push the range sleeve out of engagement under high torque

B. The range cylinder's air piston seal has developed a slow leak that cannot maintain the holding force required during the high-torque condition of hard acceleration — the range cylinder must hold the range sleeve in the engaged position against the gear's thrust force; a leaking seal gradually loses holding force, and the gear's thrust under hard acceleration overcomes the diminishing holding force, popping the transmission out of high range

C. The range shift air valve has a restriction that delays the full application of air to the range cylinder during hard acceleration

D. The transmission's countershaft bearings have excessive end play that allows the range gear to move axially under the acceleration thrust

70. A truck equipped with an Allison automatic transmission has a condition where the transmission produces a metallic rattle during the 2-3 upshift that is not present during any other shift. What is the most likely cause?

A. The 2-3 shift solenoid has a weak spring that causes it to vibrate during the shift event

B. The torque converter is going through a transient lockup-unlock cycle during the 2-3 shift

C. The 3rd gear planetary gear set has a worn thrust washer that allows the components to shift axially during the 2-3 shift engagement, producing a momentary metallic rattle as the clearance is taken up

D. A component within the 3rd gear clutch pack or the planetary gear set associated with the 2-3 shift has developed wear or clearance — a worn thrust washer, a damaged snap ring, or a loose clutch housing produces a brief metallic rattle during the transient loading of the 2-3 shift that is not reproduced during other shifts because the affected components are loaded differently

71. A heavy-duty truck's clutch has a condition where the clutch pedal effort has increased noticeably over the past month. The hydraulic fluid level in the master cylinder reservoir is correct. There are no external leaks. What is the most likely cause of the increasing pedal effort?

A. The clutch release bearing is wearing into the pressure plate's diaphragm spring contact surface, increasing the friction between the bearing face and the spring fingers — the additional friction adds resistance that the driver must overcome with more pedal effort; the hydraulic system is functioning correctly (level and no leaks), confirming the increased effort is mechanical rather than hydraulic

B. The clutch master cylinder's internal seal has hardened and creates more friction as the piston moves through the bore

C. The clutch disc is wearing thin, changing the diaphragm spring's operating position on its force curve to a higher-effort zone

D. The hydraulic fluid has absorbed moisture and the resulting internal corrosion in the master cylinder bore creates additional friction

72. A bus equipped with an automatic transmission has a condition where the transmission will not move the vehicle in any gear — Drive, Reverse, or manual gear selections produce no vehicle movement. The engine runs normally and revs freely in all gear positions. The transmission fluid level and condition are normal. What is the most likely cause?

A. The torque converter has failed internally — the impeller (driven by the engine) is spinning but the turbine (driving the transmission) is not receiving the fluid coupling's energy; alternatively, the torque converter's internal connection to the transmission's input shaft (spline engagement) has failed

B. The transmission's pump has failed and cannot generate the hydraulic pressure needed to apply any clutch pack

C. The transmission has a complete internal failure — the most likely cause when no gear produces movement is a loss of hydraulic pressure (from a pump failure, a catastrophic internal seal failure, or a blocked filter); without hydraulic pressure, no clutch packs apply and the engine revs freely because the input shaft is not connected to the output shaft

D. The transmission's output shaft has sheared at the parking pawl engagement point

73. A heavy-duty truck has a driveshaft that produces a vibration at exactly twice per revolution. The driveshaft has been dynamically balanced and the balance is correct. What produces a vibration at exactly the 2-per-revolution frequency?

A. A bent driveshaft tube that has been balanced around the bend rather than straightened

B. Incorrect U-joint phasing — when the driveshaft's yoke ears at one end are not aligned with the yoke ears at the other end (out of phase), the speed fluctuation produced by each U-joint does not cancel between the two joints; the result is a 2-per-revolution vibration because each U-joint produces one speed fluctuation per revolution, and the out-of-phase condition makes both fluctuations additive rather than canceling

C. A U-joint with one tight bearing cap that creates a bind at two points per revolution (each time the tight cap rotates through its loaded position)

D. The driveshaft slip yoke splines are worn and produce a vibration at twice per revolution from the two-lobed wear pattern

74. A truck equipped with a manual transmission has a condition where the transmission makes a growling noise in neutral with the engine running. The noise disappears when the clutch pedal is depressed. What does this behavior indicate?

A. The transmission's mainshaft bearing is worn and produces a load-dependent growl that quiets when the clutch disengages the input shaft

B. The countershaft bearings are worn and produce noise when loaded by the input shaft's drive

C. The transmission's input shaft pilot bearing is worn and growls during the speed difference between the input shaft and the mainshaft

D. The input shaft bearing or the cluster gear bearings are the noise source — in neutral with the engine running and the clutch engaged, the input shaft and cluster gears rotate (driven by the engine through the clutch); when the clutch is depressed, the input shaft stops rotating, the cluster gears stop, and the noise disappears; the noise source must be a component that rotates in neutral and stops when the clutch is disengaged

75. A heavy-duty truck's rear axle has a condition where the differential produces a clicking noise during parking lot maneuvers (tight turns at low speed). The inter-axle lock is not engaged. The noise does not occur during straight-line driving. What is the most likely cause?

A. The differential's spider gears and side gears have worn — during tight turns, the spider gears must rotate on their cross pin to accommodate the speed difference between the inner and outer wheels; worn gear teeth, worn cross pin bores, or a worn cross pin produce clicking as the gears engage and disengage through the worn clearances; during straight-line driving, the spider gears do not rotate and produce no noise

B. The axle shaft splines are worn and click during the torque reversal that occurs during tight turns

C. The ring gear has a damaged tooth that only contacts the pinion during the specific gear mesh angle of tight turns

D. The wheel bearings on the inner wheel develop play during tight turns from the increased lateral loading

76. A truck's torque converter has been replaced. After installation, the transmission shifts normally but the fuel consumption has increased by approximately 10%. The stall speed is correct. What could explain the increased fuel consumption after the converter replacement?

A. The replacement torque converter has a different stall speed than the original despite testing correctly during the stall test

B. The replacement torque converter's lockup clutch is not engaging during highway cruising — the converter is correctly matched for stall speed (confirmed), but the lockup clutch that eliminates the converter's slip during highway cruising is not engaging; the engine runs at a slightly higher RPM than it should during cruising because of the continuous converter slip, consuming approximately 10% more fuel

C. The replacement torque converter has a different turbine profile that produces less torque multiplication at highway speed

D. The transmission fluid was not refilled to the correct level after the converter replacement and the low fluid reduces the converter's efficiency

77. A heavy-duty truck equipped with a tandem drive axle has a condition where the front drive axle makes a whining noise during acceleration but the rear drive axle is quiet. The noise is present only during acceleration and disappears during coasting. What is the most likely cause?

A. The front drive axle has a worn wheel bearing that loads more heavily during acceleration from the torque reaction

B. The front drive axle's inter-axle differential has worn gears that produce the whine under the acceleration load

C. The rear drive axle's pinion gear mesh is too tight and the front axle compensates by carrying more load

D. The front drive axle's ring and pinion gear set has a wear pattern or contact adjustment issue on the drive (acceleration) side of the teeth — the whine is produced when the gears are loaded during acceleration; during coasting, the load shifts to the coast side where the contact pattern is different and no noise is produced; the rear axle's gear set is functioning normally

78. A truck's automatic transmission has a condition where the shift from 1st to 2nd is unusually firm (harsh) but all subsequent shifts (2-3, 3-4, etc.) are smooth. What is the most likely cause of the harsh 1-2 shift specifically?

A. The 1-2 shift solenoid has a faster response time than the other shift solenoids from an electrical fault

B. The accumulator piston for the 1-2 shift circuit has seized in its bore, eliminating the cushioning effect that normally softens the 1-2 clutch engagement — the accumulator absorbs the initial pressure spike when the clutch applies, providing a progressive engagement; the seized piston cannot move, and the clutch applies instantaneously at full line pressure

C. The 1-2 shift valve is sticking and releasing abruptly, sending a pressure spike to the clutch

D. The engine RPM is too high during the 1-2 shift because the shift point calibration has drifted

79. A heavy-duty truck has a condition where the clutch pedal gradually creeps to the floor when held at the friction point (partially engaged). The pedal returns to normal when fully released. What is the most likely cause?

A. The clutch master cylinder's primary piston seal is allowing fluid to bypass internally — when the pedal is held at a partial position, the seal must maintain hydraulic pressure; a worn seal leaks slowly under the sustained pressure, allowing the piston to advance as fluid bypasses, and the pedal creeps to the floor; releasing the pedal allows the piston to return to its home position where the seal re-seats

B. The slave cylinder has an external leak that is too small to see but allows enough fluid loss to cause the pedal creep

C. The clutch disc is dragging slightly on the input shaft splines and the continuous friction pulls the release bearing forward, causing the pedal to creep

D. The pressure plate's diaphragm spring is taking a set at the partially engaged position and losing its clamping force

80. A heavy-duty truck's driveshaft U-joint has been replaced. After the replacement, the technician notices that the U-joint produces a "clunk" when shifting from forward to reverse. The clunk was not present before the U-joint replacement. What is the most likely cause?

A. The replacement U-joint has loose needle bearings in its caps from a manufacturing defect

B. The replacement U-joint's bearing caps were not fully seated in the yoke bores during installation

C. The driveshaft was improperly phased during reinstallation after the U-joint replacement

D. The replacement U-joint's snap rings or retaining clips are not fully seated in their grooves — the clips must hold the bearing caps firmly in the yoke bores with zero clearance; if the clips are not fully seated, the caps can shift axially when the driveshaft's torque direction reverses (forward to reverse), producing the clunk as the clearance is taken up in the new torque direction

81. A bus equipped with an Allison automatic transmission has a condition where the transmission operates normally in Drive (forward gears) but will not move in Reverse. The selector lever shows Reverse is selected on the scan tool. What is the most likely cause?

A. The reverse shift solenoid has failed and cannot direct fluid to the reverse clutch circuit

B. The reverse inhibit solenoid has failed in the active (blocked) position, preventing reverse engagement

C. The reverse clutch pack has failed — the clutch plates are burned, glazed, or the apply piston seal has failed; the solenoid commands the shift, the valve directs fluid to the apply circuit, but the clutch cannot hold; all forward gears function because they use different clutch packs

D. The output shaft has a broken gear that prevents reverse rotation but allows forward rotation

82. A heavy-duty truck's drive axle oil has been changed and the technician accidentally fills the axle with engine oil instead of the specified gear oil. What is the consequence of operating with the wrong oil type?

A. Engine oil does not contain the extreme-pressure (EP) additives that gear oil contains — EP additives form a protective film on the gear teeth under the high contact pressures of the hypoid gear mesh; without EP protection, the gear teeth surfaces weld and tear at the contact points, producing accelerated wear, scoring, and potential catastrophic failure; the incorrect oil must be drained and replaced with the correct gear oil immediately

B. Engine oil has a lower viscosity than gear oil and will leak from the axle seals due to its thinner consistency

C. Engine oil foams excessively in the high-speed gear environment, reducing the effective lubrication of the bearings

D. Engine oil's detergent additives strip the protective oxide layer from the gear teeth surfaces, accelerating corrosion

83. A truck's transfer case makes a grinding noise when shifting from 2WD to 4WD while the vehicle is moving at 30 km/h. The transfer case is a part-time unit without a synchronizer. What is causing the grinding?

A. The transfer case's shift motor is not generating enough force to fully engage the 4WD gear set

B. The front axle disconnect mechanism has not fully engaged, and the front driveshaft is not spinning at the correct speed

C. The transfer case lubricant has degraded and cannot cushion the gear engagement during the shift

D. The front driveshaft and front axle are stationary (in 2WD, the front axle is disconnected and not spinning), and the transfer case must mesh the spinning rear output with the stationary front output — without a synchronizer, there is no mechanism to match the speeds; the grinding is the engagement teeth contacting at different speeds; the vehicle must be stopped (or the transfer case must be a full-time design with a synchronizer) for a clean engagement

84. A heavy-duty truck's clutch has been replaced with a new disc, pressure plate, and release bearing. After the installation, the technician adjusts the clutch brake and sets the free play. On the first test drive, the driver reports that the clutch engages very close to the floor — there is very little pedal travel between the floor and the engagement point. What is the most likely cause?

A. The new clutch disc is thicker than the worn disc it replaced, and the release bearing travel must be adjusted to account for the increased disc thickness — the thicker disc positions the pressure plate further from the flywheel, requiring more release bearing travel to disengage; the free play setting must be rechecked and adjusted to position the engagement point at the designed location in the pedal travel

B. The slave cylinder pushrod length is too long, positioning the release bearing too close to the pressure plate

C. The pressure plate has been installed backward on the flywheel, reversing the engagement geometry

D. The flywheel surface was not resurfaced before installing the new clutch components

85. A truck equipped with a two-speed rear axle has a condition where the axle shifts normally between low and high range, but fuel economy has decreased by 5% since the shift mechanism was recently serviced. The axle operates in high range during highway driving. What should be verified?

A. The axle ratio in the high range position — the service may have altered the axle's shift mechanism in a way that the axle appears to be in high range (indicator light shows high) but is actually operating in low range; the engine runs at higher RPM than expected for the vehicle speed, consuming more fuel

B. The shift mechanism's air supply pressure, which if too high could create continuous drag on the shift collar

C. The axle ratio is correctly in high range — verify by comparing the engine RPM to the vehicle speed at highway cruise; if the ratio matches the high-range specification, the 5% fuel economy decrease has a different cause

D. The shift mechanism's lubrication, which if incorrect could create internal drag that consumes engine power

86. A heavy-duty truck has a condition where the power steering makes a buzzing noise during full-lock turns at low speed. The noise comes from the power steering pump area. The fluid level is correct and the fluid is clean. What is the most likely cause?

A. The power steering pump reaches maximum pressure during full-lock turns and the pressure relief valve opens — the high-pressure fluid flowing through the relief creates the buzzing noise; sustained full-lock operation overheats the fluid and accelerates pump wear; the driver should avoid holding full-lock for extended periods

B. The pump's mounting bolts have loosened and the pump vibrates against the bracket during maximum pressure operation

C. The power steering lines contact the engine block during full-lock turns and the pressurized fluid vibrating in the lines creates the buzz

D. The steering gear's internal rotary valve has a worn seal that vibrates under maximum pressure

87. A heavy-duty truck has a condition where the steering wheel is off-center to the left during straight-line driving. The alignment has been checked and the toe is within specification. What is the most likely cause?

A. The pitman arm has been installed on the sector shaft at the wrong spline position

B. The left and right tie rod adjustments are unequal — the total toe is within specification, but one tie rod is shorter than the other; this asymmetry offsets the steering wheel position without affecting the total toe measurement

C. The drag link length is incorrect — the drag link's adjustable length determines the angular relationship between the steering gear's center position and the wheels' straight-ahead position; if the drag link is too long or too short, the steering wheel is off-center when the wheels are pointing straight; adjusting the drag link length centers the steering wheel without affecting the toe setting

D. The steering column U-joint is installed 180 degrees out of phase, reversing the center position

88. A heavy-duty truck equipped with leaf spring suspension has a condition where one front leaf spring produces a metallic clunking noise over bumps. The spring U-bolts are tight and the spring's center bolt is intact. What should be inspected?

A. The spring shackle pins and bushings for wear that allows the spring to shift in its hangers over bumps

B. The spring clips (rebound clips) that hold the individual leaves together — if a clip has broken or loosened, the individual leaves can separate and clunk together during suspension travel; the center bolt holds the leaf pack to the axle but the spring clips maintain alignment between the leaves during compression and rebound

C. The spring's main leaf for a crack that allows the two halves to shift relative to each other over bumps

D. The spring perch (the pad on the axle where the spring seats) for wear or looseness that allows the spring pack to shift on the axle

89. A truck equipped with air ride suspension on the drive axle has a condition where the suspension bottoms out (the axle contacts the frame bump stops) when the truck hits a moderate bump at highway speed. The ride height is correct and the air springs are properly inflated. What should be checked?

A. The air spring pressure, which may be at the correct static ride height but below the pressure needed to absorb dynamic loads

B. The height control valve for a response that is too slow to add air during the rapid compression event

C. The frame bump stops for excessive wear that allows more suspension travel than designed before contact occurs

D. The shock absorbers — the air springs provide the load-carrying function and are correctly inflated (ride height confirmed), but the shock absorbers control the rate of compression; worn shock absorbers cannot resist the rapid compression from a highway-speed bump impact, and the suspension compresses past the air spring's dynamic travel to contact the bump stops

90. A heavy-duty truck has a condition where the steer tires show a scalloped wear pattern (alternating high and low spots around the circumference). The alignment is within specification and the tire pressures are correct. What is the most likely cause?

A. Worn shock absorbers on the steer axle — the shocks cannot control the tire's bounce after each road irregularity, causing the tire to alternate between heavy and light road contact; the heavy-contact patches wear faster (creating the low spots) while the light-contact patches wear slower (creating the high spots); the scalloped pattern is characteristic of damping-related irregular wear

B. The steer axle king pin bushings are worn, allowing the wheel to shimmy at the resonant frequency of the tire

C. The brake drum on the steer axle is out of round, causing once-per-revolution variations in braking force that scallop the tire

D. The tire itself has a manufacturing defect that causes uneven tread stiffness around the circumference

91. A transit bus equipped with independent front suspension has a condition where one front wheel camber changes significantly between the loaded and unloaded condition — the camber moves from +0.5° (unloaded) to −1.5° (loaded). What does this excessive camber change indicate?

A. The ball joints on the affected side have normal wear that is accentuated by the suspension's geometry change under load

B. The upper control arm mounting points on the frame have shifted from collision damage or fatigue cracking

C. The upper or lower control arm bushings on the affected side have excessive wear or separation — the bushings allow the control arm to change position under load, and the excessive bushing compliance changes the wheel's camber as the load pushes the suspension through its travel; new bushings maintain the precise arm geometry and limit the camber change to the designed specification

D. The coil spring on the affected side has sagged, changing the suspension's operating position and the associated camber angle

92. A heavy-duty truck's fifth wheel has a condition where the fifth wheel produces a loud popping noise when the tractor makes tight turns in a yard. The noise occurs once during each tight turn. What is the most likely cause?

A. The fifth wheel's lock jaw mechanism has excessive play that allows the king pin to shift during the turn

B. The fifth wheel top plate is dry — the lack of lubrication between the upper coupler plate and the fifth wheel top plate creates a stick-slip condition during tight turns; the trailer's nose weight presses the two surfaces together, and the dry metal-to-metal contact binds until the turning force overcomes the friction; the sudden release produces the pop; applying grease to the fifth wheel top plate eliminates the condition

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

D. The trailer's upper coupler plate has a worn section that catches on the fifth wheel's locking mechanism during articulation

93. A trailer equipped with a tandem axle has a condition where both tires on the right side of the rear axle show feathered wear on the inner ribs, while all other tire positions show normal wear. What alignment condition would produce feathering on only one side of one axle?

A. The total toe on the rear axle is within specification but the individual wheel angles are asymmetric

B. The rear axle has been pushed laterally (shifted to the right) from its correct position relative to the frame, likely from an impact event

C. The drive axle (forward tandem) has a thrust angle error that forces the rear axle tires to compensate

D. The rear axle on the affected side has shifted — one end of the axle has moved forward or backward relative to the other end (axle skew), angling the right-side wheels and causing them to scrub during straight-line driving; the feathering appears on the inner ribs of the right-side tires because the skewed axle points the right wheels slightly outward (toe-out), scrubbing the inside edges

94. A heavy-duty truck has a condition where the steering requires noticeably more effort during right turns than left turns. The power steering pump output is normal. What should be inspected?

A. The steering gear's internal spool valve and its centering mechanism — the spool valve directs hydraulic pressure to the appropriate side of the power piston during turns; if the valve is not centering correctly (from a worn centering spring, contamination in the valve bore, or a damaged spool), it may not open as fully for right turns as for left turns, reducing the hydraulic assist in one direction

B. The pitman arm for a crack that flexes under the increased load of right turns

C. The right-side tie rod end for tightness that resists the steering force more in the right direction

D. The right steer tire for lower inflation pressure that increases the steering effort for right turns

95. A truck equipped with hub-piloted wheels has had one wheel studs break repeatedly at the same position. The stud breaks within 10,000 km of each replacement. What should be investigated?

A. The wheel nut torque procedure — if the nut on that position is consistently over-torqued, the stud is pre-loaded beyond its fatigue limit and breaks from cyclic loading during normal driving

B. The stud material specification, which may be incorrect for the application's load requirements

C. The wheel bolt hole and the hub stud hole alignment at that specific position — if the wheel's bolt hole is slightly elongated, misaligned, or damaged, the stud at that position bears a disproportionate share of the clamping load and the cyclical driving forces; the stud is loaded beyond its fatigue limit and breaks repeatedly regardless of correct torque on the other positions

D. The impact wrench calibration, which may be producing inconsistent torque at that specific position from the operator's technique

96. A heavy-duty truck has a condition where the front suspension produces a creaking noise from the left side when the steering is turned slowly at low speed. The noise sounds like a rusty hinge. What is the most likely cause?

A. The steering gear's input shaft seal is dry and produces the creaking as the shaft rotates

B. The left-side ball joint has inadequate lubrication and the metal-to-metal contact between the ball and the socket produces the creaking during the slow, high-load turning maneuver

C. The left-side tie rod end threads are dry and the adjusting sleeve creaks as it flexes during the turn

D. The left-side king pin bushings are dry — the king pin rotates inside the bushings during steering, and without lubrication, the dry metal-to-metal contact between the pin and the bushing produces the characteristic creaking noise; the noise is most audible at low speed because road noise masks it at highway speed

97. A trailer has a condition where the tires on the tag axle (the rearmost non-driving axle) show severe inside-edge wear on both sides. The inflation pressure is correct. What alignment parameter should be checked?

A. The tag axle's tracking alignment relative to the trailer's centerline

B. The tag axle's camber — excessive negative camber (top of the wheel tilted inward) on both sides loads the inside edge of each tire more heavily; both sides showing the same wear pattern confirms the camber is the issue rather than toe, which would produce feathering rather than smooth inside-edge wear

C. The tag axle's self-steering mechanism, which if binding could force the tires into a constant scrubbing angle

D. The tag axle's mounting height, which if too low would change the effective camber under loaded conditions

98. A truck's frame inspection reveals that the right frame rail has a twist — the front flange is rotated approximately 3 degrees relative to the rear flange when measured with a frame gauge. What could cause this twist, and what is the consequence?

A. A frame twist of 3 degrees was caused by an asymmetric load, a collision, or a jack-up event that stressed the frame beyond its yield point — the twist affects wheel alignment (both steer and drive axles reference the frame for their alignment), creates body stress (cab, box, or trailer mounting points are distorted), and may affect the vehicle's handling characteristics; the frame must be evaluated for straightening or replacement

B. A 3-degree twist is within the normal manufacturing tolerance for heavy-duty truck frames and does not require correction

C. The twist was caused by the torsional loads of normal driving and will continue to progress until the frame fails

D. The twist only affects the cab mounting and does not influence the vehicle's axle alignment or handling

99. A heavy-duty truck equipped with disc brakes on all positions has a condition where the brake rotors on the steer axle develop a visible pulsation (thickness variation) after only 20,000 km. The rotors were new at the last brake service. What could cause this premature thickness variation?

A. The replacement rotors are a lower quality aftermarket product that does not meet the OEM's metallurgical specification for the application

B. The rotors were not properly torqued during installation — uneven or excessive wheel nut torque creates stress points that distort the rotor; the hot-and-cold cycling of braking operation amplifies the initial distortion into measurable thickness variation within 20,000 km

C. The brake pads are a compound that is too aggressive for the rotor material, wearing the rotor unevenly

D. The caliper guide pins are binding, causing uneven pad wear that transfers to the rotor as thickness variation

100. A heavy-duty truck has a condition where the steering wanders at highway speed — the driver must constantly make small corrections to maintain a straight path. The alignment has been checked and is within specification. Tire pressures are correct and the tires are in good condition. What should be inspected?

A. The engine mounts, which if broken could allow the engine to shift under acceleration and deceleration, affecting the steering through the frame

B. The cab mounting bushings, which if worn could transmit misleading steering feedback to the driver

C. The shock absorbers, which if worn would allow the suspension to respond sluggishly to road inputs and create a wandering sensation

D. All steering linkage joints and connections for play — the steering linkage includes the pitman arm, drag link, tie rod ends, and steering arm connections; even small amounts of play in multiple joints accumulate and create a loose, wandering feel at the steering wheel; the total accumulated play in the system may exceed the acceptable limit even though each individual joint may still be within its own specification

101. A heavy-duty truck's left front wheel bearing has been recently serviced and the preload adjusted. After the service, the driver reports that the steering pulls to the left during braking only. The pull is not present during normal driving. What could the bearing service have caused?

A. The bearing preload on the left side was set too tight, creating a constant friction that acts as a brake drag on the left side during braking deceleration

B. The bearing preload adjustment procedure displaced the ABS wheel speed sensor's air gap, causing the ABS to modulate the left front brake differently during stops

C. The left front wheel bearing was assembled with the bearing races reversed (inner race on the outer position), creating a camber change under braking load that pulls the vehicle left

D. The bearing adjustment has changed the effective brake rotor position relative to the caliper — a hub bearing preload that is too loose allows the hub (and rotor) to shift laterally under braking load, moving the rotor into contact with one pad before the other and creating an asymmetric braking force that pulls the vehicle to the left

102. A heavy-duty truck equipped with a walking beam suspension has a condition where one drive axle sits higher than the other when the vehicle is on level ground. Both sides are at the same height. The air springs are not used on this suspension. What is the most likely cause?

A. The equalizer beam pivot bushing on the affected side has worn, changing the pivot geometry and raising one axle relative to the other

B. The leaf springs on the high-side axle have taken a permanent set from an overloading event and have increased arch

C. The torque arms on the higher axle have bent from a road hazard impact, shortening their effective length and raising that axle

D. The equalizer beam has cracked or worn at one of its ends, changing the load distribution between the two axles and raising the axle on the worn side

103. A heavy-duty truck has a condition where both steer tires show cupping wear that is concentrated on the outside shoulder of both tires. The alignment shows correct toe and camber. What should be checked?

A. The tire pressure, which if excessively high concentrates the contact patch at the center of the tread and lifts the shoulders, causing the shoulders to bounce and cup

B. The steering damper and the shock absorbers — cupping on the outside shoulders of both steer tires with correct alignment indicates a damping problem; the outside shoulders are the first tread area to contact the road during any steering input, and worn dampers allow the tires to bounce during steering corrections and road inputs, creating the cupping pattern at the point of initial contact

C. The caster angle, which if excessively positive causes the outside shoulder to scuff during straight-line driving

D. The steer axle's track width, which if wider than specification increases the scrub radius and concentrates wear on the outside shoulders

104. A heavy-duty truck's cab has a condition where the driver hears wind noise that appears to come from the passenger-side A-pillar area at highway speed. The windshield seal, door seal, and mirror mount have all been inspected and appear intact. What less obvious source should be checked?

A. The windshield washer nozzle on the passenger side, which may have shifted from its original position and is catching the airflow at highway speed

B. The mirror mounting bracket's aerodynamic profile, which creates turbulence at the A-pillar regardless of the mirror's condition

C. The cab's exterior trim or body panel gap at the A-pillar, which may have opened from a shifted panel, a missing clip, or a deteriorated seam sealer

D. The A-pillar's exterior trim strip, a missing body clip, or a gap in the seam sealer between the cab panels — at highway speed, even a small gap catches the high-velocity airflow and creates a whistle or roar that appears to come from the A-pillar area; the gap may not be visible during a static inspection because the panels are pressed together by their own weight; the technician must inspect with the vehicle at speed or use a smoke test to identify the exact air path

105. A transit bus has a condition where the passenger stop-request chime sounds continuously without any stop-request buttons being pressed. What is the most likely cause?

A. The stop-request system's electronic controller has failed and is sending a continuous chime signal

B. A stop-request switch at one of the passenger positions has stuck in the closed (activated) position — the system monitors a circuit that connects all stop-request switches in parallel; a single stuck switch continuously completes the circuit; the specific stuck switch must be located and replaced

C. The stop-request system's wiring harness has a short to ground that mimics a pressed stop-request button

D. The chime module has an internal fault that causes it to sound continuously regardless of the input signals

106. A heavy-duty truck's cab tilt mechanism has a condition where the cab creaks loudly when tilted to the service position and when returned to the latched position. The tilt mechanism has been lubricated according to the maintenance schedule. What is the most likely cause?

A. The cab tilt hinge pins and bushings are worn, allowing metal-to-metal contact between the hinge components during the tilting motion — the worn bushings cannot maintain the designed clearance, and the hinge pins scrape against the worn bushing surfaces; lubrication temporarily silences the noise but the underlying wear produces a recurring creak

B. The cab tilt cylinder's internal seals are worn and produce a creaking noise from the hydraulic fluid passing the seals

C. The cab tilt latch mechanism's striker plate has worn and the engagement produces a creak during the latching motion

D. The cab's structural mounting points have fatigued and the cab panels flex during the tilting operation

107. A heavy-duty truck has a condition where the heated seat on the driver's side produces heat on one side of the seat cushion but not the other. The seat heater switch shows the correct indicator light. What is the most likely cause?

A. The seat heater switch has a faulty second output that fails to power the other heating element zone

B. The seat cover's internal insulation has separated on the warm side, allowing heat to radiate through the cover while the other side's insulation prevents heat transfer

C. The seat's heating pad has an internal dual-zone design with a break in one zone's resistance wire

D. The seat cushion's heating element has a partial break in its circuit — the heating element is a continuous resistance wire or a carbon-fiber mat that spans the entire cushion; a break in one section disconnects the portion of the element downstream of the break; the remaining connected section produces heat while the disconnected section remains cold

108. A heavy-duty truck's driver-side window produces a grinding noise during operation and moves more slowly than the passenger-side window. Both windows are the same design. What is the most likely cause?

A. The driver-side window motor is failing from the more frequent use that the driver's window receives compared to the passenger window

B. The driver-side window regulator's mechanical components (gears, cables, or slider mechanism) are worn from the higher usage — the grinding noise comes from worn gear teeth or a frayed cable that catches during window travel; the increased mechanical friction slows the window speed compared to the less-used passenger side

C. The driver-side window switch has a corroded contact that reduces the voltage to the motor, slowing it and causing the grinding

D. The driver-side window glass has shifted in its mounting clips and is scraping against the door frame during travel

109. A reefer trailer has a condition where the TRU's diesel engine starts and runs but the refrigeration system does not cool. The compressor clutch does not engage. The TRU's controller shows a fault code for "High-Pressure Switch — Open Circuit." What does this code indicate?

A. The high-pressure refrigerant switch has tripped from excessive discharge pressure and must be manually reset

B. The high-pressure switch's electrical circuit is open — the switch itself has failed, the wiring to the switch is broken, or the connector has lost contact; the TRU's controller sees the open circuit and interprets it as a high-pressure condition, preventing the compressor clutch from engaging as a safety measure

C. The refrigeration system has a massive refrigerant leak that has reduced the high-side pressure to zero

D. The TRU controller needs to be rebooted to clear the historical fault code that is blocking the compressor from engaging

110. A trailer's structural inspection reveals that several crossmembers have visible corrosion pitting on their lower flanges. The pitting depth is approximately 2 mm on crossmembers that are originally 6 mm thick (33% material loss). What is the structural consequence?

A. The crossmembers have lost load-carrying capacity proportional to the material loss — the crossmembers support the floor and distribute the cargo weight to the main beams; a 33% reduction in flange thickness significantly reduces each crossmember's bending strength and shear capacity; the affected crossmembers must be evaluated for replacement or the trailer's rated payload must be reduced

B. The crossmember corrosion is cosmetic and does not affect the trailer's structural capacity because the floor distributes the load across multiple crossmembers

C. The crossmembers only support the floor boards and do not contribute to the trailer's overall structural capacity

D. The corrosion pitting can be repaired by welding filler material into the pits to restore the original thickness

111. A flatbed trailer equipped with coil package racks has a condition where the coil cradles have shifted from their original positions on the deck. What is the safety concern?

A. The shifted coil cradles change the load distribution on the trailer — steel coils are extremely heavy (often 10,000+ kg each) and the cradles must position the coils at specific locations on the trailer to maintain the correct axle weight distribution and the overall center of gravity; shifted cradles can overload individual axle positions, exceed the trailer's structural capacity at specific points, and create a top-heavy condition that increases rollover risk

B. The shifted cradles will damage the deck boards from the concentrated coil weight on unsupported sections

C. The shifted cradles will interfere with the trailer's ABS wheel speed sensor wiring that runs beneath the deck

D. The shifted cradles will reduce the trailer's aerodynamic efficiency by changing the load profile

112. A trailer's air ride suspension has a condition where one air spring has collapsed completely — it appears flat with no air pressure. The other three air springs are correctly inflated. The ride height on the collapsed corner is significantly lower than the other corners. What is the most likely cause?

A. The height control valve for that corner has failed in the exhaust position, continuously venting the air from the spring

B. The air supply line to the collapsed spring has a complete break or disconnection that prevents air from reaching the spring

C. The air spring itself has failed — a ruptured bellows, a failed piston seal, or a separated bead allows all air to escape; alternatively, the air supply line to that spring has been severed, kinked completely, or disconnected; in either case, the spring cannot hold pressure and collapses

D. The check valve in the supply line to that spring has failed in the closed position, blocking the air supply

113. A trailer equipped with ABS has a condition where the ABS lamp illuminates briefly during every trailer connection to the tractor, then extinguishes after approximately 5 seconds. Is this behavior normal?

A. This indicates a marginal ABS fault that clears itself after the system stabilizes

B. This indicates the ABS module is losing its stored fault codes during disconnection and must relearn them during each connection

C. This indicates the trailer's ABS power supply has a voltage dip during initial connection that the module interprets as a power failure

D. This is the normal ABS power-up self-test — when the trailer is connected and receives power, the ABS module performs an initial self-diagnostic check of its sensors, modulators, and internal circuits; the lamp illuminates during the test (typically 3-7 seconds) and extinguishes if no faults are detected; if the lamp remains on continuously, a fault has been detected

114. A trailer's landing gear has a condition where the gear cranks smoothly when raising the trailer but produces a loud grinding noise and requires significantly more effort when lowering the trailer. What is the most likely cause?

A. The landing gear gearbox has adequate lubrication for raising but the reversed load direction during lowering exposes a worn gear face that produces the grinding

B. The landing gear's internal gearbox has worn or damaged gears — the gear teeth mesh differently during the raising and lowering directions; during lowering, the trailer's nose weight loads the gears in the opposite direction, and worn teeth that function adequately during raising (where the crank handle provides the force) grind and bind during lowering (where the trailer's weight drives the gears backward)

C. The landing gear legs are bent from a previous impact and the interference causes binding during the lowering direction

D. The lowering direction engages a different gear set than the raising direction and this gear set has worn teeth

115. A trailer has a condition where the license plate light is burned out. The driver is pulled over during a roadside inspection and receives a violation. Is a burned-out license plate light a citable offense?

A. A burned-out license plate light is a citable lighting violation — the license plate must be illuminated during nighttime operation to allow law enforcement to read the plate; a burned-out light prevents identification and constitutes a lighting equipment violation under the Highway Traffic Act and CMVSS regulations; the violation may also trigger a full roadside inspection of the trailer

B. A license plate light is an auxiliary light and its failure is noted on the inspection report but is not a citable offense

C. The license plate light is only required on the tractor, not the trailer, so the trailer violation is issued in error

D. The violation can only be issued if the light has been burned out for more than 24 hours

116. A trailer's conspicuity tape has been partially covered by mud and road grime, reducing its reflective area by approximately 50%. Is this a compliance issue?

A. The reduced reflective area does not constitute a violation because conspicuity tape is not required to be clean

B. Mud and grime are a naturally occurring road condition and the driver is not responsible for maintaining tape visibility during a trip

C. The reduced visibility from the covered tape is a compliance issue — conspicuity tape must be maintained in a visible, reflective condition to fulfill its safety function; if a significant portion of the tape is obscured, the trailer's nighttime visibility is reduced and the driver can receive a violation during a roadside inspection; the tape must be cleaned as part of the pre-trip or en-route inspection

D. The tape only needs to meet the reflectivity standard when tested with laboratory equipment, not during visual roadside inspection

117. A truck's A/C system has been diagnosed with a compressor that makes a knocking noise only during the first 30 seconds after the clutch engages. The noise disappears after 30 seconds and does not return. What is the most likely cause?

A. The compressor's oil level is low — during the off cycle, the oil drains from the compressor's internal components (bearings, pistons, reed valves) to the sump; when the compressor starts, the components operate briefly without adequate lubrication until the oil circulates back to all internal surfaces; the knocking is from the temporarily unlubricated components impacting each other

B. The compressor's reed valves have carbon buildup that prevents them from sealing properly until the refrigerant flow clears the debris

C. The compressor's electromagnetic clutch has excessive air gap that causes a brief period of clutch slippage

D. Liquid refrigerant has migrated to the compressor during the off cycle and the compressor slugs the liquid during the first few revolutions until it is pumped through

118. A truck's HVAC system has a condition where the A/C system produces adequate cold air from the dashboard vents, but the floor vents blow warm air when the "A/C and floor" combination mode is selected. What is the most likely cause?

A. The evaporator core has a blockage in its lower section that prevents cold air from reaching the floor duct

B. The mode door routing in the HVAC housing directs the cold air from the evaporator to the dashboard vent pathway and directs air that has not passed through the evaporator (or has passed through the heater core section) to the floor duct — the housing's internal design routes different air paths to different outlets, and the combination mode may not provide equally cooled air to all outlets

C. The blower motor's air distribution is uneven, sending more volume to the dashboard vents and less to the floor vents

D. The floor duct runs through a warm section of the cab structure and the duct's heat gain raises the air temperature before it exits the floor vent

119. A truck's A/C system has a condition where the system produces adequate cooling but the evaporator produces a rhythmic thumping noise at approximately 1-second intervals. What is the most likely cause?

A. The expansion valve is hunting — the valve opens too far (flooding the evaporator), the evaporator superheat drops to zero, the valve's sensing bulb detects the cold liquid and closes the valve, the evaporator warms from the reduced flow, the bulb warms and opens the valve again, and the cycle repeats at approximately 1-second intervals; the thumping is the sound of the expansion valve alternately flooding and starving the evaporator

B. The compressor has a worn internal component that produces a thump once per revolution

C. The blower motor's fan wheel has a broken blade that thumps against the housing once per revolution

D. The condenser fan blade has a balance weight that has shifted and produces a vibration that is transmitted through the refrigerant lines to the evaporator

120. A bus's HVAC system has a condition where the A/C system works adequately in the morning but loses cooling performance in the afternoon when the ambient temperature exceeds 35°C. The system pressures are within specification for the morning conditions. What is the most likely cause of the afternoon performance loss?

A. The system was designed for the morning conditions and is undersized for the higher heat load of the afternoon

B. The condenser's capacity is at its limit during the morning and cannot handle the additional heat rejection demand of the 35°C afternoon temperature

C. The system's refrigerant charge is marginal — at the lower morning temperatures, the system's capacity is adequate because the heat load is lower; as the ambient temperature rises in the afternoon, the heat load increases, the high-side pressure rises, and the marginal charge cannot maintain adequate cooling; a full charge would provide the reserve capacity needed for the higher ambient temperature

D. The compressor clutch relay overheats in the afternoon sun and starts to cycle erratically

121. A truck's heated mirror has a condition where the mirror glass cracks when the heater is activated in extremely cold weather (−30°C). This has happened on two consecutive mirror replacements. What is the cause, and how can it be prevented?

A. The heating element generates too much heat too quickly — the rapid temperature change creates thermal stress that exceeds the glass's thermal shock resistance; the temperature differential between the heated center and the cold edges of the glass creates expansion forces that crack the glass; the mirror's heater circuit may need a thermal management modification (a soft-start relay or a resistance that limits the initial current) to reduce the thermal shock

B. The replacement mirror glass is a lower quality aftermarket product that cannot withstand the heating element's designed temperature

C. The mirror's heating element has a hot spot from a defective resistance wire that concentrates all the heat in one area

D. The heating element produces excessive current at −30°C because the element's resistance drops at cold temperatures, generating more heat than designed

122. A truck's A/C system has been recharged but the technician did not evacuate the system before recharging — the refrigerant was simply added to the existing charge. What is the consequence of not evacuating?

A. The compressor oil charge will be excessive because the new refrigerant introduces additional oil that was not needed

B. The existing air and moisture in the system were not removed — air is a non-condensable gas that raises the high-side pressure (reducing system efficiency and increasing compressor load), and moisture reacts with the refrigerant to form hydrochloric and hydrofluoric acids that corrode internal components and clog the expansion valve's orifice; proper evacuation removes both air and moisture before the new charge is introduced

C. The refrigerant charge weight will be incorrect because the existing charge volume was not measured before the additional refrigerant was added

D. The system will operate normally initially but the excess charge will cause premature compressor failure within 6 months

123. A truck's cab heater has a condition where the heater only produces warm air (not hot) during idle but produces hot air at highway RPM. The engine temperature gauge shows the engine is at full operating temperature at both conditions. What is the most likely cause?

A. The heater core has a partial internal restriction that limits coolant flow at idle's lower water pump output — the restriction reduces the volume of hot coolant passing through the core during the low pump speed of idle operation; at highway RPM, the increased pump speed forces adequate coolant through the restricted core; the engine temperature is unaffected because the restriction is in the heater circuit, not the main cooling circuit

B. The HVAC blend door actuator responds to the engine RPM signal and partially closes the blend door at idle

C. The coolant level is slightly low and the heater core is the highest point in the system, making it susceptible to air pockets at idle's low flow rate

D. The thermostat opens wider at highway RPM and sends more hot coolant to the heater core circuit

124. A hydraulic system on a refuse truck has a condition where the hopper arm extends and retracts normally but the clamping function (which holds the refuse container) has gradually weakened over the past 3 months. The clamping cylinder reaches full extension but cannot grip the container firmly enough to lift it. What is the most likely cause?

A. The clamping cylinder's mechanical linkage has worn, reducing the effective grip force at the container contact points

B. The hydraulic pump has worn and cannot produce adequate pressure for the clamping function, which requires the highest force in the system

C. The clamping circuit's relief valve has gradually shifted to a lower setting from vibration or internal spring fatigue, limiting the maximum pressure available to the clamping cylinder — the cylinder extends fully (low-pressure function) but cannot develop the high clamping force needed to grip the container because the relief valve diverts the flow before the pressure reaches the required level

D. The clamping cylinder's piston seal has developed a gradual bypass that reduces the effective force — the seal held adequately 3 months ago but has progressively worn or degraded from the high-pressure, high-frequency cycling of the clamping function

125. A hydraulic crane has a condition where the operator cannot feather the boom swing function — the swing either moves at full speed or does not move at all. All other functions feather (modulate speed) normally. What is the most likely cause?

A. The swing motor has a worn internal component that produces a non-linear speed response to flow changes

B. The swing circuit's proportional valve has a contaminated spool that sticks in the bore, preventing smooth modulation between closed and open positions

C. The swing circuit's counterbalance valve is set too high, creating a threshold effect where the valve does not open until full system pressure is applied

D. The swing circuit's proportional control valve spool is contaminated or scored — the spool must slide smoothly through the entire range from closed to open for proportional speed control; contamination or scoring causes the spool to stick in the closed position until enough pilot force overcomes the friction,

then it jumps to the fully open position; the hopper arm and other functions use different valve spools that are not contaminated

126. A hydraulic system has a condition where the pump produces adequate flow and pressure but the hydraulic fluid turns dark brown within 2 weeks of an oil change. The system was flushed before the oil change. What could cause the rapid fluid discoloration?

A. The new hydraulic oil is reacting with residual flushing solvent that was not completely removed from the system

B. The system has an ongoing oxidation problem — the fluid is overheating from an internal bypass (relief valve set too low, pump wear, or a restriction), a malfunctioning cooler, or the reservoir is not providing adequate dwell time for heat dissipation; the elevated temperature accelerates the oil's oxidation, turning it dark brown rapidly; the heat source must be identified and corrected

C. The hydraulic fluid brand is incompatible with the system's seal material and the seal degradation products are discoloring the fluid

D. The reservoir's breather cap is allowing excessive atmospheric contamination into the fluid during the breathing cycle

127. A hydraulic system uses a pressure-compensated variable-displacement piston pump. The pump maintains system pressure at the compensator setting (3,000 psi) in standby, but when a function is commanded, the pressure drops to 2,000 psi and the function operates slowly. What is the most likely cause?

A. The pump's compensator is set correctly for standby but the pump cannot maintain 3,000 psi under flow demand because the pump's internal components (pistons, swash plate actuator, or displacement mechanism) have worn — the worn pump depresses to a reduced displacement under load, delivering less flow than the function demands; the pressure drops because the pump cannot simultaneously maintain pressure and deliver adequate flow

B. The directional valve has an internal restriction that limits the flow to 2,000 psi worth of delivery

C. The relief valve is set to 2,000 psi and is diverting flow when the function demands exceed the pump's compensator setting

D. The pump's compensator spring has weakened and cannot maintain the pump at full displacement when flow is demanded

128. A hydraulic crane has a condition where the outrigger cylinders extend and retract normally, but one outrigger slowly retracts (bleeds down) when supporting the crane's full weight. The control valve is in the neutral (hold) position. What is the most critical safety concern?

A. The slow bleed-down will gradually lower the crane on one corner, changing the crane's level position and the boom's operating angles — an unlevel crane operating at or near its rated capacity can become unstable as the geometry changes; the crane may tip toward the sinking outrigger without warning if the operator does not continuously monitor the crane's level

B. The bleed-down indicates the system pressure is gradually decreasing throughout the entire hydraulic circuit

C. The slow retraction wastes hydraulic energy and increases the system's heat generation

D. The bleed-down will eventually cause the outrigger to fully retract, requiring the operator to restart the outrigger extension cycle

129. A hydraulic system's reservoir has a condition where the fluid level rises significantly when the system is at operating temperature compared to when it is cold. The level increase is approximately 3 inches above the cold level. Is this level change normal?

A. The level change is abnormal and indicates an external fluid source is entering the reservoir during operation

B. The level change is abnormal and indicates the system has trapped air that compresses during operation and allows the fluid to rise

C. The level change is excessive — while some thermal expansion is normal, a 3-inch rise indicates the system may have trapped air that compresses under pressure during operation, releasing its volume when functions are de-activated and the pressure drops; alternatively, the reservoir may be receiving return fluid from cylinders that were extended during the cold measurement

D. A level change from thermal expansion is normal — hydraulic fluid expands as it heats (typically 0.04% per degree Celsius), and the difference between cold ambient temperature and operating temperature (60-80°C) can produce a measurable level increase; the reservoir's sight glass should be

marked for both cold and hot levels; however, 3 inches is at the upper range and the system should be verified for the correct fill level and checked for air entrainment

130. A hydraulic hose on a utility truck's aerial lift has developed a small external weep at a hose fitting. The weep is a slow drip of hydraulic fluid. The operator wants to continue using the aerial lift because the production schedule is urgent. What is the correct response?

A. The aerial lift can be used temporarily if the hydraulic reservoir is monitored and topped up to compensate for the slow leak

B. The aerial lift must be taken out of service immediately — a hydraulic hose weep on an aerial lift is a safety-critical fault; the weep may progress to a full hose failure at any time, and a sudden loss of hydraulic pressure while the boom is extended with a worker in the bucket can cause the boom to drop, the platform to tilt, or the outriggers to retract; the hose must be replaced before the aerial lift is returned to service

C. The weeping hose can be temporarily repaired with a hose clamp until the replacement hose is available

D. The operator can continue if the working height is limited to below 10 metres to reduce the hydraulic pressure demand

131. A hydraulic system on a dump truck has a condition where the dump body raises at the correct speed but the body oscillates (bounces up and down approximately 20 mm) when held at the fully raised position. What is the most likely cause?

A. The hydraulic system's accumulator (if equipped) has lost its nitrogen pre-charge and cannot stabilize the pressure fluctuations at the fully raised position

B. The dump cylinder has reached its full stroke and the pump continues to deliver flow against the fully extended cylinder — the system pressure rises to the relief valve setting and the relief valve opens; the pump's continuous delivery against the cycling relief valve creates pressure oscillations that bounce the body; the directional valve should be returned to neutral at full extension to stop the pump's delivery

C. The directional valve has a leaking spool that alternately pressurizes and depressurizes the cylinder at the fully raised position

D. The dump body's mechanical supports (prop rod or body rest) are not engaged and the body rests entirely on hydraulic pressure that fluctuates

132. A battery electric transit bus has a condition where the regenerative braking produces a noticeable vibration through the brake pedal during deceleration. The friction brakes are not engaged during the regenerative braking event (confirmed by the scan tool). What is the most likely cause of the vibration?

A. The regenerative braking force is unevenly distributed between the left and right drive wheels from a differential speed sensor fault

B. The traction motor has a worn bearing that produces vibration during generator mode operation

C. The traction motor's rotor has developed an imbalance — during regenerative braking, the motor switches to generator mode and the rotor's rotational speed decreases; any rotor imbalance produces a vibration that is proportional to the speed, and this vibration is transmitted through the drivetrain to the chassis and felt through the brake pedal

D. The inverter's power electronics have a faulty phase that produces an uneven torque output during regenerative braking, creating the vibration through the drivetrain

133. A hybrid electric truck has a condition where the 12V auxiliary battery consistently discharges overnight even though the main high-voltage battery is at 80% SOC. The 12V DC-DC converter should maintain the 12V battery charge from the high-voltage system. What is the most likely cause?

A. The main high-voltage battery has a cell imbalance that prevents the BMS from authorizing the DC-DC converter to operate

B. The 12V auxiliary system has a parasitic draw that exceeds the DC-DC converter's output capacity

C. The high-voltage system's main contactors open when the vehicle is parked, disconnecting the DC-DC converter from the high-voltage battery — without the high-voltage supply, the DC-DC converter cannot charge the 12V battery; the 12V battery must sustain all key-off loads (telematics, security, BMS monitoring) from its own capacity until the vehicle is restarted

D. The DC-DC converter has failed or its control circuit has a fault that prevents it from operating during the key-off period — the converter should maintain the 12V battery from the high-voltage supply during parking periods; if the converter is not operating, the 12V battery discharges from the normal key-off parasitic loads (telematics, security systems, BMS monitoring) overnight

134. A technician is performing maintenance on a battery electric truck and must disconnect the high-voltage system before working near the battery pack. What is the correct de-energization procedure?

A. Turn the ignition key off and wait 5 minutes for the high-voltage capacitors to discharge naturally

B. Follow the manufacturer's specific high-voltage de-energization procedure — this typically includes turning the vehicle off, removing the service disconnect plug (which breaks the high-voltage circuit), verifying the high-voltage warning lights are off, waiting the specified time for the capacitor discharge (typically 5-10 minutes), then using a CAT III rated voltmeter to verify zero voltage at the high-voltage terminals before beginning work; the procedure must be followed exactly because high-voltage capacitors can retain lethal energy even after the main circuit is opened

C. Disconnect the 12V auxiliary battery to remove all power from the vehicle's control systems

D. Engage the emergency shutdown switch and verify the high-voltage indicator on the dashboard is off

135. A battery electric delivery truck has a condition where the vehicle's maximum regenerative braking force has decreased significantly. The battery SOC is at 50% (not near full charge), and the battery SOH is at 85%. The scan tool shows the regenerative braking torque command from the VCU is at the correct level but the actual motor torque during regeneration is lower than commanded. What is the most likely cause?

A. The traction motor or its inverter has a fault that limits the motor's generator output — the VCU commands the correct regenerative torque, but the motor or inverter cannot deliver it; possible causes include a degraded motor winding, a failing inverter power module, or a thermal limitation that has reduced the motor's current capacity; the motor produces less regenerative torque than commanded, reducing the braking force

B. The brake pedal position sensor has drifted, reducing the regenerative braking command

C. The battery's internal resistance has increased enough to limit the maximum charging current during regeneration

D. The drive axle's gear ratio has changed from wear, reducing the effective motor speed during regeneration

Practice Exam 13: Answer Key and Explanations

1. C — An oily inner wheel mounting surface dramatically reduces friction between the wheel and the hub pilot. When the technician pulls the heavy wheel (50+ kg) from the hub, it can slide unexpectedly and drop, crushing hands or feet. Proper lifting technique, a helper, or a wheel dolly must be used to control the heavy, slippery wheel during removal.

2. A — Used diesel fuel filters contain petroleum residue, combustion soot, and potentially heavy metals from the fuel system's metallic components. They must be drained of free-flowing fuel into the waste fuel container, then placed in a designated hazardous waste container. A licensed hazardous waste hauler collects and processes the filters according to provincial environmental regulations.

3. D — A floor jack and wood blocks are not an engineered lifting solution for a 150 kg fifth wheel — the component's weight, irregular shape, and overhead mounting position make it difficult to balance safely on a floor jack. The overhead crane with proper rigging provides controlled, secure lifting. Improvised methods risk the heavy component falling and causing serious injury.

4. B — A fire extinguisher with the gauge needle in the recharge zone cannot be relied upon during a fire emergency. The welding area is a high-fire-risk location that requires a fully charged, properly rated extinguisher immediately accessible at all times. The depleted unit must be removed immediately and replaced with a fully charged unit — waiting for the annual service date is unacceptable.

5. C — Even a mild electrical shock can cause internal injuries that may not be immediately apparent — cardiac arrhythmia, muscle damage, nerve injury, or internal burns. The incident must be reported to the supervisor immediately, documented per the shop's incident procedures, and the technician should be evaluated by a medical professional. The electrical hazard must also be corrected before further work.

6. A — Before driving any vehicle onto a lift, the technician must verify the lift's rated capacity exceeds the vehicle's gross weight and the runway surfaces are clean and free of oil or debris. Exceeding the capacity risks catastrophic structural failure. An oily runway surface can cause the vehicle to slide during positioning or raising, potentially rolling off the lift.

7. D — Exhaust system components retain dangerous heat (300°C+ on the turbine housing) for an extended period after engine shutdown. The technician must verify the surface temperature with a non-contact thermometer or by cautious proximity testing before starting work. If the components are hot, the technician must either wait for cooling or wear appropriate heat-resistant PPE.

8. B — Human perception of tightness varies with fatigue, hand strength, wrench length, bolt lubrication, and the fastener's friction characteristics. A calibrated torque wrench applies a measured, repeatable clamping force that ensures the manufacturer's specification is met. Under-torqued fasteners loosen and fail; over-torqued fasteners stretch, yield, and break. No amount of experience replicates the consistency of a calibrated instrument.

9. A — At idle, the electronic unit injector delivers fuel at the minimum injection pressure. A worn nozzle with enlarged clearances cannot maintain an effective spray pattern at these low pressures — the fuel dribbles rather than atomizing. At 1,200 RPM and higher, the injection pressure increases significantly, and the higher pressure forces the fuel through the worn clearances in a more effective spray pattern.

10. C — UV-fluorescent dye added to the coolant circulates through the entire cooling system during normal driving. The dye concentrates at any leak point, even microscopic ones, and fluoresces brightly under UV illumination. This method detects leaks too small for visual inspection or static pressure testing by allowing the leak to develop naturally over several driving cycles.

11. D — Black smoke only at full load with correct boost and fuel system pressure indicates the fuel is not atomizing properly at maximum delivery. One or more injectors with degraded spray patterns (dribbling tips, worn spray holes, carbon-restricted orifices) produce coarse fuel droplets that do not burn completely at maximum delivery volume. At partial loads, the reduced fuel quantity masks the injector's deficiency.

12. B — One or more fuel injectors are leaking fuel into the cylinders — either during the engine-off period (dripping fuel onto the piston tops that washes past the rings into the crankcase) or during operation (a degraded spray pattern directing fuel onto the cylinder wall). The sudden jump from 1% to 8% fuel dilution confirms a significant leak that is actively diluting the oil. The diluted oil loses its viscosity and film strength.

13. A — VGT vanes accumulate carbon and soot deposits from diesel exhaust. When the ECM commands the vanes to close for maximum boost during rapid throttle application, the contaminated vanes resist movement. The 3-second delay represents the actuator pushing the vanes through the carbon deposits to the commanded position. Once positioned, the turbocharger produces adequate boost at the new operating point.

14. C — The three indicators collectively confirm progressive ring-to-liner wear. Increased oil consumption (oil passing worn rings), rising crankcase pressure (combustion gases leaking past worn

rings), and increasing iron (liner material) and chromium (piston ring plating) in the oil analysis all point to the piston ring and cylinder liner interface. The accelerating trend indicates the engine is approaching overhaul.

15. D — A large air pocket trapped during the coolant refill prevents the water pump from circulating coolant. The pump cannot pump air effectively, so the coolant in the engine block absorbs heat without being circulated to the radiator. The upper radiator hose is cold because no coolant flow reaches the radiator. The system must be properly bled using the manufacturer's bleeding procedure to remove all trapped air.

16. A — An injector with an intermittent electrical connection fires erratically. When the injector fires unexpectedly, it consumes fuel from the rail and the pressure drops. When it misses, the unconsumed fuel raises the rail pressure. The random firing creates a ±200 bar oscillation that the fuel pressure regulator cannot compensate for quickly enough, producing the unstable pressure reading.

17. B — At cold startup, the oil's high viscosity partially seals the worn bearing clearances, maintaining adequate pressure despite the wear. As the oil warms and thins to operating viscosity, it flows through the enlarged clearances faster than the pump can supply it at idle speed. The pressure drops below the minimum specification because the leakage rate through the worn bearings exceeds the pump's idle output capacity.

18. D — DPF ash is non-combustible metallic residue from engine oil additives that cannot be burned at any achievable temperature. Off-vehicle cleaning by a specialized service removes the ash using pneumatic methods (compressed air and vacuum) or a baking-and-blowing process. This periodic cleaning is significantly less expensive than DPF replacement and restores the filter's flow capacity.

19. C — The ECM monitors the downstream NOx sensor and adjusts DEF dosing to maintain the target NOx level. When the SCR catalyst's conversion efficiency drops from aging or contamination, the downstream NOx reading remains above target. The ECM increases DEF dosing to compensate. The 50% increase represents the ECM's attempt to overcome the catalyst's declining efficiency with additional DEF volume.

20. A — A single cylinder's EGT reading 120°C above the average indicates that cylinder is burning hotter than the others. The most likely cause is over-fueling — the injector delivers more fuel than commanded, creating a richer combustion event that produces higher temperatures. The excess fuel generates more heat per combustion cycle, and the sustained elevated temperature can damage the piston, rings, valves, and downstream components.

21. D — Compressor blade erosion from airborne particulate impact over 400,000 km changes the blade's aerodynamic profile. The worn leading edges cannot direct the airflow as precisely as the original design, reducing the compressor's ability to compress and accelerate the intake air. The turbocharger produces less boost for the same exhaust energy input. The turbocharger should be rebuilt or replaced to restore its efficiency.

22. B — A new, correct thermostat opens at the designed temperature but the engine still runs cold. The cooling fan is engaging at a temperature below the thermostat's opening point, providing excessive cooling that prevents the engine from reaching operating temperature. The fan clutch, relay, or control circuit must be checked for a faulty temperature threshold that commands the fan on prematurely.

23. A — The fuel transfer pump inside the mechanical injection pump supplies fuel to the injection pump's high-pressure plungers. At high RPM, the plungers demand more fuel per unit time. A transfer pump with worn gears or a worn relief valve cannot maintain the internal fuel supply pressure at the elevated demand rate. The starved plungers cannot deliver adequate fuel at high RPM, causing the power loss and black smoke.

24. A — The water pump weep hole is positioned between the shaft seal and the bearing. Its purpose is to drain any coolant that leaks past the shaft seal before it can reach and contaminate the bearing. A continuous weep confirms the seal has failed. The pump must be replaced because the seal cannot be serviced in place, and continued leaking will eventually contaminate the bearing.

25. D — A crack connecting a coolant passage to an exhaust port allows pressurized coolant to seep into the exhaust stream. The coolant vaporizes in the hot exhaust and exits as white steam. The engine's power is unaffected because the crack is in the exhaust port, not the combustion chamber. The oil remains clean because the coolant enters the exhaust path, not the crankcase.

26. B — Environmental regulations mandate escalating derate schedules for emission-related faults to compel timely repairs. The regulations specify that certain emission system faults must progressively reduce engine power over a defined time period (measured in engine-operating hours) to prevent indefinite operation with elevated emissions. The escalating severity ensures the operator cannot ignore the fault.

27. A — Post-injection events during DPF regeneration inject fuel late in the combustion cycle. This late-injected fuel is intended to raise exhaust temperatures but some washes past the piston rings into the crankcase. The fuel dilutes the oil, reducing its viscosity and raising its level. Frequent regeneration cycles and short-trip operation that triggers more regenerations accelerate the dilution rate.

28. D — An RPM-specific stumble that occurs at exactly 1,400 RPM under moderate load requires consideration of resonance and frequency-dependent phenomena. The engine's firing frequency at 1,400 RPM may coincide with a natural resonance in the intake manifold, exhaust system, or fuel rail. Alternatively, the ECM's fuel calibration map may have an anomaly at that specific operating point.

29. B — A pH drop from the specified minimum (8.0) to 7.0 in a 2-year-old OAT coolant can result from either normal inhibitor depletion or from combustion gas contamination. Combustion gases (CO_2) dissolve in the coolant and form carbonic acid, accelerating the pH drop beyond normal aging. A supplemental combustion gas test is needed to determine whether the low pH is from normal aging or from an internal engine leak.

30. C — The compressor builds to cut-out normally but purges every 30 seconds instead of every 3-5 minutes. Either the new compressor is passing excessive oil (saturating the desiccant and reducing its capacity), or a large air leak downstream of the dryer is depleting the system rapidly, forcing the compressor to cycle every 30 seconds. Both conditions cause the same symptom of frequent governor cycling and purge events.

31. A — Disconnecting the service gladhand releases the trailer brakes immediately, confirming the signal pressure was being maintained in the service line even with the foot valve released. The foot valve's secondary circuit piston or seal is stuck in the applied position, maintaining signal pressure to the trailer. The tractor brakes release normally because the primary circuit functions independently.

32. D — Equal air pressure to both chambers with correct caliper type rules out the pneumatic system. The left front caliper's automatic wear adjuster has advanced beyond the correct setting, holding the pad in continuous contact with the rotor. The constant friction wears the left pad rapidly while the correctly adjusted right caliper's pad wears only during intentional brake applications.

33. B — One or more brake chambers have ruptured diaphragms. When the application air enters the chamber, it passes through the rupture into the spring cavity instead of pushing the pushrod with full force. The reduced effective diaphragm area requires more air volume (more pedal travel) to develop adequate pushrod force, creating the spongy feel and increased pedal travel.

34. C — During a hard service brake application, all brake chambers consume a large volume of air simultaneously. If the system's reservoir capacity is marginal or leaks exist, the heavy air consumption can momentarily drop the system pressure below the approximately 60-65 psi spring brake application threshold. The spring brakes begin to apply, then release as the compressor rebuilds pressure.

35. A — Weight transfer during braking shifts the vehicle's mass forward, loading the front tires with more traction. The proportioning system delivers higher application pressure to the front axle to utilize this additional traction. The front brakes absorb more friction energy per stop, generating more brake dust. The heavier dust accumulation directly reflects the front axle's greater braking contribution.

36. A — The air compressor is water-cooled, and its cooling circuit must receive adequate coolant flow to remove the heat of compression. A restricted supply line, failed return line, air lock, or stuck thermostat reduces the coolant flow. Without adequate cooling, the compression heat raises the discharge air temperature far above the normal range, potentially damaging the air dryer desiccant and system components.

37. B — The hand valve must pressurize the entire air line between its output port and the trailer's service gladhand before the signal reaches the trailer's relay valve. A long routing path, oversized line, or additional volume in the line's path creates a delay. The foot valve uses a different, shorter path to the same trailer relay valve, which is why the foot valve application has no delay.

38. A — Mismatched tire diameters (from different sizes, brands, tread depths, or inflation pressures) on the left and right rear drive positions cause the tires to rotate at different speeds during straight-line driving. The ABS module compares the wheel speeds and detects the constant speed difference. The excessive wheel speed difference code is set because the module cannot distinguish between a tire size mismatch and a genuine wheel speed anomaly.

39. C — Brake pedal pulsation during ABS activation is normal. The ABS modulator valves rapidly cycle the application pressure (typically 10-15 times per second) to prevent wheel lockup while maintaining maximum braking force. These rapid pressure cycles transmit through the air system plumbing to the foot valve, and the driver feels the pulsation through the pedal. The vibration confirms the ABS is actively modulating.

40. D — The governor unloads the compressor correctly (confirmed by the correct cut-out pressure), but the air dryer does not purge. The governor uses separate outputs for the compressor unloader and the air dryer purge valve. The signal line to the dryer may be disconnected, kinked, plugged, or connected to the wrong port during the desiccant cartridge replacement. The purge valve never receives the signal to open.

41. B — One drum running 50°C hotter than the others with correct pushrod stroke indicates a drag condition. The anchor pin and S-cam bushing are the most likely sources — a seized anchor pin prevents the shoes from fully retracting, and a worn S-cam bushing allows the cam to hang up in a partially

rotated position. Either condition keeps the shoes in light contact with the drum, generating continuous friction heat.

42. A — The engine brake's air-operated actuators consume significant air volume during high-retardation operation. This consumption, combined with any existing system leaks, can drop the system pressure below the spring brake application threshold. The spring brakes apply because the tractor's air supply cannot maintain pressure for both the engine brake actuators and the spring brake hold-off circuit simultaneously.

43. C — A piece of debris lodged between the trailing shoe and the drum contacts the drum only during reverse rotation. During forward rotation, the shoe's self-energizing action pulls it away from the debris. During reverse, the de-energizing action changes the shoe's contact geometry, pushing it toward the debris and producing the grinding noise. The grinding only occurs in reverse because the shoe's loading direction changes with drum rotation.

44. D — The compressor's unloader mechanism does not instantaneously stop all pumping when the governor signals. The unloader requires a brief mechanical or pneumatic response time to fully activate. During this fraction-of-a-second delay, the compressor completes a few additional compression strokes, pushing the residual compressed air into the system. The 5 psi rise represents this residual compression after the governor's cut-out signal.

45. B — ESC compares the driver's steering intent (steering angle sensor) to the vehicle's actual behavior (yaw rate sensor and lateral accelerometer). If any of these three sensors has a calibration error, the ESC perceives a discrepancy between intended and actual behavior during normal lane changes. The system intervenes unnecessarily because it believes the vehicle is not responding as the driver intends.

46. A — A severely worn S-cam bushing allows the S-cam shaft to shift laterally in its bore. The first clunk occurs at the beginning of the application when the cam's rotational force takes up the slack in the worn bushing (the cam contacts one side of the bushing wall). The second clunk occurs during release when the return spring pulls the cam back through the clearance to its resting position on the opposite side.

47. C — A dimly illuminated charge indicator lamp with correct charging voltage indicates a small reverse current flowing through the lamp circuit. A marginal alternator diode partially conducting in both directions allows this reverse leakage. The charging voltage appears normal because the remaining functional diodes compensate, but the leaking diode wastes energy and will eventually fail completely.

48. A — The MAP sensor reads 0.2V with the engine off (atmospheric pressure should produce 1.0-1.5V). The signal wire is shorted to the sensor ground or to the vehicle chassis, pulling the signal voltage down to near zero. The ECM detects the below-range voltage. The sensor itself may be functional, but the shorted wire prevents the ECM from reading the sensor's actual output.

49. D — The parasitic draw test at the battery cable reads 45 mA (within specification), but the batteries still discharge. Some alternator faults allow reverse current flow through the rectifier bridge that may not register on a standard parasitic draw test performed at the battery cable. Testing specifically at the alternator's output terminal with the engine off can reveal reverse leakage current flowing from the battery through the alternator to ground.

50. B — LED assemblies contain multiple elements wired in series-parallel strings. When one LED element in a string fails open, the entire string goes dark because the series circuit is broken. The remaining strings continue to illuminate normally because they have independent parallel paths. The 1/3 dark section corresponds to one failed string while the other two strings produce the remaining 2/3 light output.

51. C — The solenoid clicks (confirming the pull-in winding has enough force to move the plunger), but only 0.3V appears at the motor terminal instead of the full battery voltage. The solenoid's heavy-duty contacts should close when the plunger is pulled in, connecting the battery directly to the motor. The 0.3V residual is from the pull-in winding, not the main contacts. Worn, pitted, or burned contacts are not making connection.

52. A — The oil pressure sender has a variable resistance element (wire-wound or thick-film) that the wiper slides across. A worn spot or corroded section in the element creates a momentary open circuit as the wiper crosses it. The open circuit produces a zero reading for the few seconds the wiper is on the damaged section. Once the wiper moves past the defect, contact is restored and the reading returns to normal.

53. D — The module has been replaced, the power supply fuse is new, and the ground is clean — yet the intermittent dropout persists. The CAN bus connector at the module's location is the remaining interface between the module and the communication bus. Corroded pins, pushed-back terminals, or intermittent contact at the connector prevents the module from maintaining its CAN bus connection despite having clean power and ground.

54. B — The alternator's output voltage is marginally low at idle RPM. The voltage regulator cycles between charge and float modes at approximately 2 Hz, creating a voltage oscillation visible as a

headlight flicker. At higher RPM, the alternator produces adequate voltage continuously, the regulator stabilizes, and the flicker disappears. The alternator's output capacity at idle should be evaluated.

55. A — The ECM receives vehicle speed from a dedicated sensor on the transmission output shaft. This sensor has failed, so the ECM broadcasts 0 km/h. The ABS module calculates vehicle speed independently from its wheel speed sensors, which are functioning correctly, and broadcasts the actual 85 km/h. The two modules use independent speed sources, and the dedicated VSS failure affects only the ECM's broadcast.

56. C — Hyper-flash (double-rate flashing) is the turn signal system's built-in alert for a burned-out bulb. The flasher module monitors the current draw on each turn signal circuit. When one or more bulbs burn out, the reduced current changes the flasher's timing characteristics, increasing the flash rate. The left side has all bulbs functioning and flashes at the normal rate.

57. B — The telematics unit monitors engine status through a signal wire connected to a switched power source. An intermittent connection on this wire (corroded splice, loose pin, vibration-sensitive connector) causes the telematics unit to momentarily lose the ignition signal. The unit interprets the brief power loss as an engine-off event and logs it, even though the engine continues to run normally.

58. D — No fault codes are present, meaning the ECM believes its fan control output is correct. The fan controller may have failed in the full-speed default state, ignoring the ECM's modulated PWM signal. Alternatively, the PWM signal wire between the ECM and the fan controller is open or shorted, causing the controller to default to maximum speed as a protective cooling measure.

59. C — APP2 reads a fixed 2.5V regardless of pedal position while APP1 sweeps normally. The APP2 sensor is still physically connected to the pedal (or it would read the supply voltage or ground, not mid-range). A sensor failure at mid-range output with normal mechanical connection indicates the APP2 sensor's internal element has failed. The ECM detects the correlation error between the two sensors and enters idle-only mode for safety.

60. A — A small spark when the battery disconnect switch closes is normal. Electronic modules with keep-alive memory, clocks, telematics systems, and security systems draw a standing parasitic current. When the disconnect closes, the initial in-rush current to charge the capacitors in these circuits produces the brief spark. This is the normal parasitic draw establishing itself and does not indicate a fault.

61. D — The ABS module continuously compares the steer axle wheel speeds to the drive axle wheel speeds for plausibility. The different rolling circumference of the replacement steer tires produces a constant speed difference at the same vehicle speed. The module flags this as a configuration error because the speeds do not match the expected ratio. The ABS may still function but with reduced accuracy.

62. B — The scan tool reads the correct RPM from the same CAN bus data stream, confirming the ECM broadcasts accurate data. The instrument cluster receives this correct data but displays it 300 RPM high. The cluster's internal processing applies an incorrect scaling factor to the tachometer stepper motor, producing the 300 RPM offset at all operating conditions.

63. C — After the solenoid releases, the starter drive must retract from the flywheel ring gear via its return spring. A weak return spring allows the drive to retract slowly, and the still-spinning drive gear scrapes against the ring gear during the delay. The 1-second grinding represents the time between solenoid release and full drive retraction while the starter drive remains in partial mesh with the ring gear.

64. A — The new wiper motor's park switch is wired differently from the original, causing the internal park circuit to energize at the opposite end of the wiper sweep. The park switch determines at which point in the sweep the motor receives its park signal to stop. The reversed configuration places the park detent at the top instead of the bottom.

65. D — An intermittent signal fault requires dynamic diagnosis. The technician should monitor the IAT sensor's live data on the scan tool while physically manipulating the sensor connector, wiring harness, and the sensor itself. An intermittent connection (broken wire, corroded pin, cracked solder joint) will produce a momentary signal dropout on the live data when the defective section is disturbed, pinpointing the exact fault location.

66. B — One lamp is dark (zero current) but the BCM reads the correct total circuit current. This paradox occurs when a leakage to ground elsewhere on the circuit draws approximately the same current as the dead lamp. The BCM's total current measurement appears normal because the leakage replaces the dead lamp's current. The net effect masks the individual lamp failure.

67. C — Many ECMs disable cruise control when any active engine fault code is present, including emission system faults, sensor errors, or derate conditions. All cruise control inputs read correctly, but the ECM refuses to engage the system while a fault is active. Clearing the active fault code (after repairing the root cause) restores cruise control functionality.

68. A — The center-tap connection provides the 12V auxiliary circuit from the junction between the two series-connected battery pairs. A high-resistance connection at this junction (corrosion, loose bolt, deteriorated cable) reduces the voltage available to the 12V circuit. The 24V circuit is unaffected because it draws from the full series connection and the center-tap resistance does not impact the series path.

69. B — The range cylinder's air piston seal must hold the range sleeve in the engaged position against the gear's thrust force during acceleration. A leaking seal gradually loses holding pressure. Under hard acceleration, the gear's thrust force increases, and the diminishing cylinder pressure cannot maintain the engagement. The range sleeve pops out as the thrust overcomes the failing seal's holding force.

70. D — A metallic rattle during the 2-3 shift only indicates a wear or clearance issue in the 3rd gear assembly. A worn thrust washer, damaged snap ring, or loose component within the 3rd gear clutch pack or planetary set produces the rattle during the transient loading of the 2-3 shift engagement. Other shifts load different components and do not produce the noise.

71. A — The release bearing is wearing into the pressure plate's diaphragm spring contact surface. The progressive wear increases friction between the bearing face and the spring fingers, requiring more pedal force to overcome the friction. The hydraulic system functions correctly (confirmed by correct level and no leaks), confirming the increased effort is from mechanical resistance, not hydraulic loss.

72. C — No gear produces movement despite a running engine and normal fluid. The most likely cause is a complete loss of internal hydraulic pressure — from a failed pump, catastrophic internal seal failure, or a blocked filter. Without hydraulic pressure, no clutch packs can apply, the input shaft spins freely with no connection to the output shaft, and the engine revs without resistance in any gear selection.

73. B — Incorrect U-joint phasing means the yoke ears at one end of the driveshaft are not aligned with the ears at the other end. The speed fluctuation produced by each U-joint does not cancel between the two joints. Each joint produces one fluctuation per revolution, and the out-of-phase condition makes both fluctuations additive, creating a 2-per-revolution vibration pattern.

74. D — In neutral with the engine running and clutch engaged, the input shaft and cluster gears rotate (driven by the engine). When the clutch is depressed, the input shaft stops, the cluster gears stop, and the noise disappears. The noise source must be a component that rotates in neutral and stops when the clutch is disengaged — the input shaft bearing or cluster gear bearings.

75. A — During tight turns, the spider gears must rotate on their cross pin to accommodate the speed difference between the inner and outer wheels. Worn spider gear teeth, worn cross pin bores, or a worn cross pin produce clicking as the gears mesh through the worn clearances. During straight-line driving, the spider gears do not rotate and produce no noise.

76. A — The replacement torque converter's lockup clutch is not engaging during highway cruising. The stall speed is correct (confirming the converter's torque multiplication is matched), but the lockup clutch that eliminates the converter's slip during cruising is not functioning. The continuous converter slip forces the engine to run at a higher RPM than designed for highway cruise, consuming approximately 10% more fuel.

77. D — The front drive axle whines during acceleration and is silent during coasting. The noise is load-dependent and direction-specific — present only on the drive (acceleration) side of the ring and pinion gear teeth. The wear pattern or contact adjustment on the drive side produces the whine under acceleration load. The rear axle's gear set is functioning normally.

78. B — The 1-2 shift accumulator piston has seized in its bore. The accumulator normally absorbs the initial pressure spike when the 1-2 clutch applies, providing a progressive, cushioned engagement. The seized piston cannot move, so the clutch applies instantaneously at full line pressure, producing the harsh shift. Subsequent shifts use different accumulators that function normally.

79. A — The clutch pedal creeps to the floor when held at a partial position because the master cylinder's primary piston seal is leaking internally. The worn seal cannot maintain hydraulic pressure under sustained load — fluid slowly bypasses past the seal, the piston advances, and the pedal moves toward the floor. Releasing the pedal allows the piston to return to its home position where the seal re-seats.

80. D — The replacement U-joint's snap rings or retaining clips are not fully seated in their grooves. The clips must hold the bearing caps in the yoke bores with zero clearance. Partially seated clips allow the caps to shift axially when the driveshaft's torque direction reverses (forward to reverse), producing the clunk as the clearance is taken up in the new direction.

81. C — The transmission operates normally in forward gears (confirming the pump, fluid, and forward clutch packs function). The reverse clutch pack has failed — burned, glazed, or the apply piston seal has failed. The solenoid commands the shift and the valve directs fluid, but the clutch cannot hold. Each forward gear uses a different clutch pack that is unaffected.

82. A — Engine oil lacks the extreme-pressure (EP) additives that gear oil contains. These EP additives form a protective film on the gear teeth under the extreme contact pressures of the hypoid gear mesh. Without EP protection, the gear teeth experience metal-to-metal contact, micro-welding, and tearing at the contact points. The incorrect oil must be drained immediately and replaced with the specified gear oil.

83. D — In 2WD, the front driveshaft and front axle are disconnected and stationary. The transfer case must mesh the spinning rear output with the stationary front output. Without a synchronizer, there is no mechanism to match the speeds. The grinding is the engagement teeth contacting at different speeds. The vehicle must be stopped for a clean engagement on a part-time transfer case.

84. A — The new clutch disc is thicker than the worn disc it replaced. The thicker disc positions the pressure plate further from the flywheel, requiring more release bearing travel to disengage. The engagement point is very close to the floor because the increased disc thickness has consumed most of the pedal travel before the release bearing reaches the disengagement point. The free play must be readjusted.

85. C — The indicator light shows high range, but the actual gear ratio should be verified by comparing engine RPM to vehicle speed at highway cruise. If the RPM-to-speed ratio matches the high-range specification, the axle is truly in high range and the 5% fuel economy decrease has a different cause. If the ratio matches the low-range specification, the axle is operating in low range despite the indicator showing high.

86. A — The power steering pump reaches its maximum operating pressure during full-lock turns. The internal pressure relief valve opens to prevent overpressure, and the high-velocity fluid flowing through the relief creates the buzzing noise. Sustained full-lock operation forces the pump to work at maximum pressure with zero flow output, generating excessive heat that degrades the fluid and accelerates pump wear.

87. C — The drag link's adjustable length determines the angular relationship between the steering gear's center position and the wheels' straight-ahead position. If the drag link is too long or too short, the steering wheel is off-center when the wheels point straight. Adjusting the drag link length centers the steering wheel without changing the toe setting because the tie rod geometry is unaffected.

88. B — The spring clips (rebound clips) hold the individual leaves aligned as a pack during compression and rebound. A broken or loosened clip allows individual leaves to separate and shift during suspension travel. The metal-to-metal contact between the loose leaves produces the clunk over

bumps. The center bolt holds the pack to the axle, but the spring clips maintain inter-leaf alignment during deflection.

89. D — The air springs are correctly inflated (ride height confirmed), and the springs provide the load-carrying function. But the shock absorbers control the rate of compression. Worn shocks cannot resist the rapid compression from a highway-speed bump impact. The suspension compresses past the air spring's normal dynamic travel and contacts the bump stops because the shocks fail to slow the compression rate.

90. A — Scalloped (cupped) wear with correct alignment and inflation is characteristic of inadequate damping. Worn shock absorbers cannot control the tire's bounce after each road irregularity. The tire alternates between heavy contact (creating low spots) and light contact (creating high spots) at the tire's natural bounce frequency. The scalloped pattern develops progressively around the tire's circumference.

91. C — A 2-degree camber change between loaded and unloaded conditions indicates excessive compliance in the suspension's locating components. Worn upper or lower control arm bushings allow the arm to change position under load, altering the wheel's camber. New bushings maintain precise arm geometry and limit the camber change to the designed specification throughout the suspension's travel range.

92. B — A loud pop during tight yard turns indicates a stick-slip condition. The dry fifth wheel top plate creates high static friction between the upper coupler plate and the fifth wheel surface. During tight turns, the turning force builds until it overcomes the friction, and the surfaces release suddenly with a pop. Applying grease to the fifth wheel top plate eliminates the stick-slip condition.

93. D — Feathered inner-rib wear on both right-side tires of one axle indicates that axle has shifted (skewed). One end of the axle has moved forward or backward relative to the other, angling the right-side wheels outward (toe-out). The skewed angle scrubs the inside ribs during straight-line driving. All other positions are unaffected because their axles are correctly aligned.

94. A — The steering gear's internal spool valve directs hydraulic pressure to the appropriate side of the power piston during turns. A worn centering spring, contamination, or damaged spool can prevent the valve from opening fully for one direction. If the valve provides less hydraulic assist during right turns than left turns, the driver must apply more manual effort to turn right.

95. C — Repeated stud failure at the same position despite correct torque on all positions indicates a localized stress concentration. An elongated, misaligned, or damaged wheel bolt hole at that position forces the stud to bear a disproportionate share of the clamping and cyclic driving forces. The stud is cyclically overloaded beyond its fatigue limit and breaks within 10,000 km each time.

96. D — The left-side king pin rotates inside its bushings during steering. Without adequate lubrication, the dry metal-to-metal contact between the pin and the bushing produces the characteristic creaking noise during slow, high-load turns. The noise is most audible at low speed because road noise and wind noise mask it at highway speed. Regular king pin greasing prevents the dry contact.

97. B — Severe inside-edge wear on both sides of the tag axle with correct inflation indicates a camber problem. Excessive negative camber (top of wheel tilted inward) loads the inside edge of each tire more heavily. Both sides showing the same wear pattern confirms the camber setting is the cause. The tag axle's camber must be measured and corrected.

98. A — A 3-degree frame twist was caused by an asymmetric force event — a side impact, collision, or improper jacking event that stressed the frame beyond its yield point. The twist affects wheel alignment (both axles reference the frame), distorts body and cab mounting points, and may affect handling. The frame must be evaluated by a qualified frame repair facility for straightening feasibility.

99. A — Rotor thickness variation (pulsation) developing within 20,000 km on new rotors suggests the replacement rotors are a lower quality aftermarket product. The rotor's metallurgical specification may not match the OEM's requirements for the application's operating temperatures and pressures. The inferior material develops hot spots, hard spots, and uneven wear faster than the OEM specification.

100. D — Steering wander with correct alignment, tire pressure, and tire condition indicates accumulated free play in the steering linkage. The pitman arm, drag link, tie rod ends, and steering arm connections all contain joints that can develop small amounts of play. Even within individual specifications, the total accumulated play across all joints produces a loose, wandering feel at the steering wheel.

101. B — The pull to the left during braking only (not during normal driving) appeared after a wheel bearing service. The bearing preload adjustment has displaced the ABS wheel speed sensor's air gap, causing the ABS module to detect a different wheel speed on the left front during braking. The ABS modulates the left front brake differently, creating an asymmetric braking force that pulls the vehicle left.

102. C — On a walking beam suspension without air springs, the axle height is determined by the torque arms and the equalizer beam geometry. If the torque arms on the higher axle have bent (from a road hazard impact or overloading event), their shortened effective length raises that axle relative to the other. The equalizer beam distributes load between the axles but the torque arms determine the axle position.

103. B — Cupping on the outside shoulders of both steer tires with correct alignment indicates a damping problem at the steering and suspension interface. The outside shoulders are the first tread contact area during steering corrections. Worn steering dampers and shock absorbers allow the tires to bounce during inputs, creating the cupping pattern at the initial contact point. Replacing the dampers and shocks restores controlled tire contact.

104. D — The A-pillar's exterior trim strip, a missing body clip, or a gap in the seam sealer between cab panels can catch high-velocity airflow at highway speed. Even a small gap creates a whistle or roar that appears to come from the A-pillar area. The gap may not be visible during a static inspection because the panels are pressed together by gravity. A smoke test or a speed-dependent inspection identifies the air path.

105. B — The stop-request system connects all switches in parallel on a single circuit. A single stuck switch continuously completes the circuit, activating the chime regardless of whether any passenger has pressed a button. The specific stuck switch must be located (often by systematically disconnecting switches or sections of the circuit) and replaced.

106. A — The cab tilt hinge pins and bushings are the primary wear components in the tilt mechanism. Worn bushings allow metal-to-metal contact between the hinge pins and the bushing bores during the tilting motion. Lubrication temporarily silences the noise, but the underlying wear creates a recurring creak as the lubricant is squeezed from the worn surfaces during each tilt cycle.

107. D — The seat cushion's heating element is a continuous resistance wire or carbon-fiber mat spanning the entire cushion. A break in one section disconnects the portion downstream of the break. The connected section upstream of the break receives current and produces heat. The disconnected section receives no current and remains cold, creating the one-side-warm, one-side-cold condition.

108. C — The driver-side window regulator's mechanical components have worn from higher usage than the passenger side. Worn gear teeth or a frayed cable produces the grinding noise during window travel. The increased mechanical friction from the worn components slows the motor's ability to drive the window mechanism, resulting in slower operation compared to the less-used passenger side.

109. D — The high-pressure switch's electrical circuit is open — the switch has failed internally, the wiring is broken, or the connector has lost contact. The TRU controller sees the open circuit and interprets it as a high-pressure safety condition, preventing the compressor clutch from engaging. The controller uses the open circuit as a default-safe condition to prevent compressor operation when it cannot verify the discharge pressure is safe.

110. B — A 33% reduction in crossmember flange thickness from corrosion significantly reduces each crossmember's bending strength and shear capacity. The crossmembers support the floor and distribute the cargo weight to the main beams. The reduced structural capacity means the trailer's rated payload must be reassessed, and the corroded crossmembers should be evaluated for replacement.

111. A — Shifted coil cradles change the load distribution on the trailer. Steel coils weighing 10,000+ kg each must be positioned at specific locations to maintain correct axle weight distribution and center of gravity. Shifted cradles can overload individual axle positions, exceed the trailer's structural limits at specific points, and raise the center of gravity, increasing rollover risk.

112. C — A completely collapsed air spring has either a ruptured bellows, a failed piston seal, a separated bead, or a severed/disconnected air supply line. The spring cannot hold any pressure, and the corner drops to the bump stops. The specific failure (spring or supply line) must be identified by inspecting the spring for obvious damage and checking the supply line for continuity.

113. D — The brief ABS lamp illumination during every trailer connection is the normal power-up self-test. When the trailer receives power, the ABS module performs an initial diagnostic check of all sensors, modulators, and internal circuits. The lamp illuminates during the test (3-7 seconds) and extinguishes if no faults are found. A lamp that stays on continuously indicates a detected fault.

114. B — The landing gear's internal gearbox meshes differently during raising and lowering. During lowering, the trailer's nose weight drives the gears backward through the mechanism, and worn or damaged teeth that function adequately during raising (crank-driven) grind and bind when loaded in the opposite direction by the trailer's weight. The worn gears must be inspected and the gearbox rebuilt or replaced.

115. A — A burned-out license plate light is a citable lighting violation. The license plate must be illuminated during nighttime operation to allow law enforcement to read the plate number for identification purposes. The violation can trigger additional inspection scrutiny that may reveal other deficiencies on the trailer.

116. C — Conspicuity tape must be maintained in a visible, reflective condition to fulfill its nighttime safety function. Tape obscured by mud and grime cannot retroreflect headlight beams from following vehicles. The reduced visibility increases the risk of rear-end collisions. The driver is responsible for maintaining tape visibility as part of the pre-trip or en-route inspection procedures.

117. D — During the compressor's off cycle, liquid refrigerant migrates to the compressor housing (the coldest point in the system). When the compressor starts, the pistons attempt to compress the incompressible liquid. The impact produces the knocking noise for the first 30 seconds until the liquid has been pumped through to the condenser and the compressor handles only compressible vapor.

118. B — The HVAC housing's internal design routes different air paths to different outlets. In the combination mode, the air destined for the floor follows a direct path from the heater core. The air destined for the dashboard and defrost vents may pass through or near the A/C evaporator section, which retains residual cold from previous operation. The different air paths produce different outlet temperatures.

119. A — The expansion valve is hunting between overshoot and undershoot. The valve opens too far, flooding the evaporator with liquid. The sensing bulb detects the cold liquid, the valve closes. The evaporator warms from the reduced flow, the bulb warms, the valve opens again. The 1-second cycle repeats as the valve cannot find a stable operating point. The thumping is the valve's rapid opening and closing.

120. C — The system has a marginal refrigerant charge that provides adequate cooling during the lower morning heat load. As the afternoon ambient temperature rises, the increased heat load demands more from the system. The marginal charge cannot maintain adequate cooling capacity at the higher heat load. A full charge provides the reserve capacity needed for the higher ambient temperatures.

121. D — At −30°C, the heating element's resistance drops (most resistance materials have lower resistance at lower temperatures). The reduced resistance at extreme cold draws more current than designed, generating more heat more rapidly. The rapid temperature rise creates a thermal shock that exceeds the glass's thermal stress limit. The temperature differential between the heated center and the −30°C edges cracks the glass.

122. B — Not evacuating before recharging leaves existing air and moisture in the system. Air is a non-condensable gas that raises high-side pressure, reducing efficiency and increasing compressor load. Moisture reacts with refrigerant to form hydrochloric and hydrofluoric acids that corrode internal

components and form ice crystals that clog the expansion valve's orifice. Proper evacuation removes both contaminants.

123. A — The heater core has a partial internal restriction that limits coolant flow. At idle, the water pump's low output cannot force adequate coolant through the restriction. At highway RPM, the increased pump speed forces sufficient coolant through the restricted core. The engine temperature is unaffected because the restriction is in the heater circuit, not the main cooling circuit.

124. C — The clamping circuit's relief valve has gradually shifted to a lower setting from vibration or internal spring fatigue. The cylinder extends fully (a low-pressure function) but the relief valve diverts flow before the pressure reaches the level needed for adequate clamping force. The 3-month gradual weakening matches the progressive relaxation of the relief valve's spring.

125. D — The swing circuit's proportional valve spool is contaminated or scored. The spool must slide smoothly through its entire range for proportional speed control. Contamination causes the spool to stick closed until enough pilot force overcomes the friction, then it jumps to fully open. The result is all-or-nothing speed control with no intermediate positions. Other functions use different, uncontaminated spools.

126. B — Rapid fluid discoloration within 2 weeks indicates an active oxidation problem. The fluid is overheating from an internal bypass, a malfunctioning cooler, or inadequate reservoir dwell time. Elevated temperatures accelerate the oil's oxidation, turning it dark brown rapidly. The system was flushed, so residual contamination is ruled out. The heat source must be identified and corrected.

127. A — The pump's compensator maintains 3,000 psi in standby (no flow demand). Under flow demand, the pump should maintain 3,000 psi while delivering flow. The 1,000 psi drop to 2,000 psi under demand indicates the pump's internal components have worn — the pump depresses to reduced displacement under load, delivering less flow than demanded. The worn pump cannot simultaneously maintain pressure and deliver adequate flow.

128. A — An outrigger that slowly retracts under load while the crane operates creates a critical stability hazard. The crane's level position gradually changes as the sinking outrigger loses height. An unlevel crane operating at or near rated capacity can tip toward the sinking corner without warning. The operator must continuously monitor the crane's level, and the leak must be repaired before continued lifting operations.

129. D — Hydraulic fluid expands as it heats (approximately 0.04% per degree Celsius). The temperature difference between cold ambient and 80°C operating temperature produces a measurable level rise. The reservoir should have markings for both cold and hot levels. A 3-inch rise is at the upper range of normal expansion and the system should be verified for correct fill level and checked for air entrainment.

130. B — A hydraulic hose weep on an aerial lift is a safety-critical fault. The weep may progress to complete hose failure at any time. A sudden loss of hydraulic pressure while the boom is extended with a worker in the bucket can cause the boom to drop, the platform to tilt, or the outriggers to retract. The aerial lift must be taken out of service immediately and the hose replaced before returning to operation.

131. A — At full cylinder extension, the pump continues to deliver flow against the fully extended, dead-headed cylinder. The system pressure rises to the relief valve setting, the relief opens, the pressure drops momentarily, the relief closes, and the cycle repeats. The rapid pressure cycling between the relief setting and the pump's output creates oscillations that bounce the body. Returning the directional valve to neutral stops the pump's delivery.

132. C — The traction motor's rotor has developed an imbalance. During regenerative braking, the motor operates as a generator and any rotor imbalance produces a speed-proportional vibration. The vibration transmits through the drivetrain to the chassis and is felt through the brake pedal. The friction brakes are confirmed disengaged, isolating the vibration source to the motor/generator system.

133. D — The DC-DC converter should maintain the 12V battery charge from the high-voltage system during parking. If the converter has failed or its control circuit prevents operation during key-off, the 12V battery must sustain all parasitic loads (telematics, security, BMS monitoring) from its own capacity. The battery discharges overnight because it receives no replenishment from the high-voltage system.

134. B — The manufacturer's specific de-energization procedure must be followed exactly. This includes turning the vehicle off, removing the service disconnect plug, verifying warning lights are off, waiting the specified capacitor discharge time (5-10 minutes), then using a CAT III rated voltmeter to verify zero voltage at the high-voltage terminals. High-voltage capacitors retain lethal energy even after the main circuit is opened.

135. A — The VCU commands the correct regenerative torque, but the motor or inverter delivers less than commanded. The discrepancy between commanded and actual torque indicates a fault in the motor's generating capability or the inverter's power conversion. Possible causes include a degraded

motor winding, a failing inverter power module, or a thermal limitation. The motor produces less regenerative force than the VCU expects.