PRACTICE EXAM 14: RED SEAL 310T SIMULATION (135 QUESTIONS)

1. A technician is performing a road test on a heavy-duty truck after a steering gear replacement. During the road test, the technician discovers the steering has excessive free play — approximately 90 mm of play at the steering wheel rim before the wheels begin to turn. The specification is a maximum of 50 mm. What should the technician do?

A. Complete the road test at reduced speed and adjust the steering gear in the shop after returning

B. Return the truck to the shop immediately using the most direct, lowest-traffic route — the excessive free play creates a steering response hazard that increases the risk of losing directional control, particularly during emergency maneuvers or highway speeds; the truck should not be driven further than necessary to return it safely for correction

C. Continue the road test to evaluate whether the free play changes with speed or temperature before making corrections

D. Pull over and call for the truck to be towed back to the shop because any amount of free play exceeding specification makes the vehicle unsafe to drive at any speed

2. A technician is draining the coolant from a heavy-duty diesel engine into a drain pan. The coolant is a standard ethylene glycol mixture. During the draining process, the technician notices a cat drinking from a puddle of coolant that has spilled on the shop floor. Why is this a critical concern?

A. The coolant contains supplemental coolant additives that are corrosive and will cause chemical burns to the cat's mouth and throat

B. The coolant's dye will permanently stain the cat's fur and the shop owner will be liable for veterinary cleaning costs

C. The coolant is too cold for the cat to drink safely and could cause hypothermia in the animal's digestive system

D. Ethylene glycol is extremely toxic to animals — it has a sweet taste that attracts animals, but even a small quantity (as little as one tablespoon for a cat) causes kidney failure and death within hours if untreated; the spill must be cleaned up immediately and the animal removed from the area

3. A shop has a centralized compressed air system that supplies air to all workstations. A technician discovers that the air line at their workstation has a fitting that is leaking air audibly. The technician wraps the fitting with duct tape and continues working. What is wrong with this repair?

A. Duct tape is an acceptable temporary repair for compressed air fittings as long as the leak rate is minimal

B. The duct tape should be replaced with Teflon tape on the fitting threads to create a proper seal

C. A leaking compressed air fitting must be repaired properly — duct tape can fail suddenly under air pressure, releasing the fitting and creating a whipping hose hazard; the compressed air can also penetrate the skin through the tape's edges if the technician holds the tape during pressurization; the fitting must be tightened or replaced with the correct thread sealant, not temporarily wrapped

D. The duct tape repair is acceptable as long as the fitting pressure does not exceed 80 psi

4. A technician is using a portable parts washer with mineral spirits solvent. The technician notices that the parts washer's cover has been propped open for the entire shift. What hazard does the open cover create?

A. The open cover allows the mineral spirits to evaporate continuously, releasing flammable vapors into the shop air — the accumulated vapors can reach flammable concentrations near the parts washer, creating an explosion and fire hazard from any ignition source; additionally, the chronic inhalation of solvent vapors is a health hazard to all shop personnel; the cover must be kept closed when the washer is not actively in use

B. The open cover allows debris and contaminants from the shop air to fall into the solvent and reduce its cleaning effectiveness

C. The evaporating solvent will cause the parts washer's pump to cavitate and fail prematurely

D. The open cover allows insects to enter the solvent tank and contaminate the recycling process

5. A technician needs to clean brake dust from a set of drum brake assemblies during a brake inspection. The technician reaches for the shop air nozzle to blow the dust out of the drums. A coworker stops them. Why should compressed air not be used to clean brake assemblies?

A. Compressed air can damage the brake shoe lining material and weaken the bond between the lining and the shoe table

B. Brake dust from older vehicles may contain asbestos fibers — blowing with compressed air disperses the microscopic fibers into the shop air where they can be inhaled by anyone in the area; asbestos inhalation causes mesothelioma and asbestosis; even non-asbestos brake dust contains metallic particles and friction material compounds that are harmful when inhaled; wet cleaning or HEPA-filtered vacuum systems must be used

C. Compressed air can push brake dust into the wheel bearings and contaminate the bearing grease

D. The high-pressure air can dislodge the brake return springs and the springs can project from the assembly

6. A new technician is assigned to work on a truck equipped with a diesel exhaust fluid (DEF) system. The technician has not received training on DEF handling. What is the primary handling concern with DEF?

A. DEF is a highly flammable liquid that must be stored away from heat sources and ignition points

B. DEF is a corrosive acid that requires full-face protection and chemical-resistant gloves during handling

C. DEF is under high pressure in the vehicle's system and can spray uncontrollably when lines are disconnected

D. DEF (32.5% urea solution) is corrosive to certain metals (aluminum, copper, carbon steel) and will damage painted surfaces, electrical connectors, and flooring if spilled — it must be stored in approved containers (polyethylene or stainless steel), cleaned up immediately if spilled, and kept separate from other automotive fluids to prevent cross-contamination

7. A technician is installing a rebuilt transmission into a heavy-duty truck using an overhead crane. During the lift, the transmission begins to rotate slowly on the chain sling. The technician reaches out to grab the transmission to stop the rotation. What is the danger of this action?

A. The technician's hands could be contaminated with transmission fluid that has leaked from the rebuild

B. The transmission's weight could pull the technician off balance and cause a fall from the elevated work position

C. A rotating suspended load can trap and crush fingers, hands, or arms between the load and any adjacent structure — the transmission's mass creates enough momentum during rotation that a technician cannot stop it safely by hand; if the technician's hand is caught between the rotating transmission and the frame rail, engine, or another component, the crushing force can cause severe injury; a tag line should be used to control the load's rotation

D. The sudden stop of the rotation can cause the chain sling to shift and change the load's center of gravity

8. A shop technician discovers that the portable eye wash station near the battery charging area is empty. The technician reports this to the supervisor, who says a replacement supply will arrive next week. What is the correct response?

A. The battery charging area must be shut down immediately until the eye wash station is functional — battery charging produces hydrogen gas and the batteries contain sulfuric acid; a splash of acid to the eyes requires immediate flushing within seconds to prevent permanent vision loss; the eye wash station is a regulatory-required safety device that must be accessible and functional at all times when acid-containing batteries are being serviced

B. The charging area can remain operational as long as the technicians wear safety glasses during battery work

C. A bucket of clean water can be placed near the charging area as a temporary substitute for the eye wash station

D. The charging area can continue operations because the main shop eye wash station in the restroom area provides adequate coverage

9. A heavy-duty diesel engine equipped with a common rail injection system has a condition where the engine starts normally but develops a progressive misfire over 30 minutes of idle operation. The misfire is not present at startup but worsens gradually. No fault codes are set during the 30-minute period. What is the most likely cause?

A. The fuel filter is gradually restricting as contaminants settle during idle operation and block the filter media

B. The engine's glow plugs are cycling off after the initial startup period and the combustion temperatures drop below the autoignition threshold at idle

C. The fuel cooler is overcooling the fuel at idle, reducing its combustibility below the ignition threshold

D. One or more fuel injectors have a slow internal leak that worsens as the injector heats during operation — at startup, the cold injector's internal clearances are tight and the injector seals adequately; as the injector heats from the engine's operating temperature, the clearances open from thermal expansion and fuel leaks past the internal seals; the progressive leak reduces that cylinder's fuel delivery incrementally over 30 minutes

10. A diesel engine has been running with a coolant leak from the EGR cooler for an extended period. The driver reports that the engine has gradually lost power over the past month. Aside from the direct effects of coolant loss, what damage could the leaking EGR cooler have caused to contribute to the power loss?

A. The coolant leaking through the EGR cooler into the intake system has deposited mineral and additive residue on the intake manifold runners, intake ports, and intake valve surfaces — these deposits progressively restrict the airflow to the cylinders, reducing the engine's volumetric efficiency; the power loss correlates with the increasing restriction as the deposits accumulate over the month of operation with the leaking cooler

B. The coolant has contaminated the turbocharger's compressor wheel, reducing its aerodynamic efficiency

C. The coolant has entered the combustion chambers and washed the protective oil film from the cylinder walls, increasing ring-to-liner friction

D. The coolant has contaminated the crankcase oil and reduced the oil's film strength, causing accelerated bearing wear

11. A heavy-duty diesel engine has a condition where the exhaust manifold on one bank (a V-configuration engine) glows cherry red during a loaded pull, while the other bank shows no visible glow. Both banks have the same number of cylinders and the same exhaust gas temperature readings on the scan tool (within 30°C of each other). What could cause one manifold to glow while the other does not?

A. The glowing manifold has thinner wall sections from casting variations or internal erosion that allow the heat to radiate more visibly

B. The turbocharger's turbine housing is closer to the glowing manifold and is radiating additional heat that makes the manifold appear to glow

C. The glowing manifold is running significantly hotter than the EGT sensors indicate — the manifold has a restriction or a crack that traps hot exhaust gas in a section not monitored by the EGT sensor, creating a localized hot spot that causes the visible glow while the sensor downstream reads the average temperature of the combined gas flow

D. The opposite bank's manifold has a heat-resistant coating that prevents visible glow at the same temperature

12. A diesel engine's SCR system has a condition where the downstream NOx sensor reads higher than the upstream NOx sensor during certain operating conditions. Under normal operation, the downstream sensor should always read lower than the upstream sensor (because the SCR converts NOx). What does this reversed reading indicate?

A. The downstream NOx sensor has drifted and is reading higher than the actual NOx level

B. The SCR catalyst is producing NOx instead of converting it — when excess ammonia (from over-dosing DEF) passes through the SCR catalyst and encounters the oxidation catalyst downstream, the ammonia is converted to NOx; this ammonia-to-NOx conversion produces a higher downstream reading than upstream; the DEF dosing rate must be reduced or the ammonia slip catalyst's capacity has been exceeded

C. The upstream NOx sensor is reading lower than actual because it is contaminated with soot from the DPF

D. The exhaust gas is bypassing the SCR catalyst through a crack in the catalyst housing and mixing with the downstream sensor's sample

13. A heavy-duty diesel engine equipped with a wastegate turbocharger has a fault code for "Wastegate Position — Actuator Overcurrent." The engine is in a power derate. What does "overcurrent" on the wastegate actuator indicate?

A. The wastegate actuator motor is drawing more current than specified to move the wastegate mechanism against excessive resistance

B. The ECM's driver circuit for the wastegate actuator has a fault that sends too much current to the motor

C. The wastegate position sensor has failed and the ECM is commanding maximum current in an attempt to find the wastegate position

D. The wastegate linkage or the wastegate valve is seized, jammed, or mechanically obstructed — the electronic actuator motor draws excessive current because it is working against a mechanical resistance that it cannot overcome; the ECM detects the overcurrent (which exceeds the motor's normal operating range) and sets the fault code; the derate protects the actuator and engine from damage

14. A diesel engine's turbocharger has been replaced. During the first startup after the replacement, the technician notices the turbocharger produces a high-pitched shriek that was not present before the replacement. The shriek varies with engine speed. What is the most likely cause?

A. The replacement turbocharger has an air leak at the compressor outlet connection — the boosted air escaping through the leak produces a high-pitched shriek that varies with engine speed because the boost pressure and airflow velocity increase with RPM; the leak may be at the compressor housing-to-pipe gasket, a loose V-band clamp, or a misaligned pipe connection

B. The replacement turbocharger's compressor wheel is rubbing against the compressor housing from an incorrect clearance specification

C. The replacement turbocharger has a defective bearing that produces the shriek under the high-speed rotation

D. The replacement turbocharger's wastegate is vibrating at its natural frequency from the exhaust pulses

15. A diesel engine has a condition where the engine produces a loud knocking noise under heavy load that disappears at idle and light load. A cylinder cut-out test at heavy load reveals that disabling cylinder 5's injector eliminates the knock. What does the load-dependent knock on cylinder 5 indicate?

A. Cylinder 5's connecting rod bearing has excessive clearance that does not produce noise at idle but hammers under the combustion load of heavy operation

B. Cylinder 5's injector is producing a misfire under heavy load that creates a delayed combustion event (detonation knock)

C. Cylinder 5 has a mechanical fault that produces a knock proportional to the combustion load — under heavy load, the higher cylinder pressures amplify the knock from a worn connecting rod bearing, a worn piston pin, or a cracked piston; at idle and light load, the reduced combustion pressure is insufficient to drive the worn component hard enough to produce an audible knock; the injector cut-out eliminates the combustion force on cylinder 5, confirming the source

D. Cylinder 5's exhaust valve is sticking partially open under heavy load, allowing combustion pressure to escape and create the knocking noise

16. A heavy-duty diesel engine has a condition where the engine oil analysis shows a sudden appearance of aluminum (35 ppm, previously 5 ppm) and silicon (45 ppm, previously 10 ppm). All other metals remain stable. What do aluminum and silicon together indicate?

A. The oil has been contaminated with silicone gasket sealant from a recent repair that introduced aluminum particles from the cleaned surface

B. Dirt ingestion has occurred (silicon from soil) and the abrasive dirt is now wearing aluminum components (pistons, bearings, or other aluminum-alloy engine parts) — the two metals appearing together confirm the dirt entered the engine and is actively eroding aluminum surfaces; the air intake system must be inspected for the breach

C. The coolant has leaked into the oil, introducing silicon from the coolant additive package and aluminum from corrosion of the engine's aluminum components

D. The oil additive package has depleted and the silicon is from the anti-foam agent breaking down while the aluminum is from accelerated piston wear due to the lost additive protection

17. A diesel engine equipped with a DOC and DPF aftertreatment system has a condition where the DPF regeneration attempts fail repeatedly — the soot loading continues to increase after each attempted regeneration. The exhaust temperature reaches the regeneration threshold (600°C) during each attempt. What could prevent the soot from burning despite reaching the correct temperature?

A. The DPF substrate has been contaminated with a substance that raises the soot's ignition temperature above the achievable 600°C

B. The oxygen concentration in the exhaust is too low for the soot to oxidize at 600°C — the EGR system may be introducing too much exhaust gas into the intake, or the engine's air-fuel ratio may be too

rich, reducing the available oxygen in the exhaust stream below the minimum needed for soot combustion

C. The DPF's platinum catalyst coating has degraded and can no longer catalyze the soot oxidation reaction at 600°C

D. The DPF substrate has cracked internally and the exhaust bypasses the soot-laden channels through the crack, reaching temperature at the sensor but not heating the actual soot deposits; alternatively, the soot has been contaminated with coolant (from an EGR cooler leak or a head gasket seep) that forms calcium sulfate deposits that cannot be oxidized at achievable exhaust temperatures

18. A diesel engine's cooling system has been flushed and the coolant replaced. After the service, the technician notices that the coolant temperature fluctuates rapidly between 78°C and 95°C during highway driving. The temperature should stabilize at 85-88°C. What is the most likely cause?

A. The replacement thermostat has been installed backward — some thermostats are directional (the sensing element must face the engine and the bleed hole must be oriented correctly); a backward thermostat senses the cooled radiator temperature instead of the engine temperature, causing it to cycle rapidly between open and closed as it alternately senses hot engine coolant and cold radiator coolant

B. The coolant mixture ratio is incorrect (too much water, not enough antifreeze) and the lower boiling point causes temperature instability

C. The water pump impeller has corroded from the flush chemicals and cannot maintain consistent flow

D. The radiator cap has been installed with the wrong pressure rating, causing the system to cycle between pressurized and vented states

19. A heavy-duty diesel engine has a condition where the engine's idle roughness increases gradually over a 6-month period without any fault codes appearing. The technician performs a relative compression test using the scan tool's cranking RPM analysis feature. The test shows that cylinder 2 has 12% lower cranking RPM contribution than the other cylinders. What does the lower cranking RPM indicate?

A. Cylinder 2's injector has a weak solenoid that cannot open quickly enough during the cranking cycle

B. The starter motor has a weak section on its commutator that coincides with cylinder 2's compression stroke position

C. Cylinder 2 has lower compression than the other cylinders — during cranking, each cylinder creates a resistance that slows the crankshaft as the piston compresses the air; a cylinder with reduced compression (from worn rings, a leaking valve, or a head gasket breach) creates less resistance and the crankshaft decelerates less during that cylinder's compression stroke, producing the lower contribution value

D. Cylinder 2's crankshaft journal has more bearing clearance than the others, creating less rotational resistance during cranking

20. A diesel engine equipped with a variable geometry turbocharger has a condition where the VGT actuator produces a chattering noise during specific engine operating conditions. The noise sounds like rapid clicking from the VGT actuator area. The engine runs normally during the chattering. What is the most likely cause?

A. The ECM's VGT control algorithm is oscillating between two commanded positions that are very close together

B. The VGT actuator is hunting — the actuator motor is receiving a PWM signal from the ECM that commands a specific vane position, but the actuator cannot achieve the exact commanded position due to internal friction, linkage play, or a calibration error; the actuator oscillates rapidly around the target position, producing the chattering noise as it alternately overshoots and undershoots the commanded angle

C. The exhaust gas pressure pulsations from the engine's firing order are vibrating the VGT vanes at their natural frequency

D. The VGT actuator motor has worn brushes that produce a clicking noise during specific PWM duty cycle ranges

21. A heavy-duty diesel engine has a condition where the engine's fuel consumption has increased by 15% over a 6-month period. The engine produces full power and has no fault codes. All maintenance is current. The driver's operating pattern has not changed. What should be investigated?

A. The tire pressures on all axle positions — underinflated tires increase rolling resistance proportionally to the pressure deficit

B. The engine's parasitic loads — an air compressor that is loading more frequently (from air leaks), a cooling fan that is engaging at a lower temperature than designed, or an alternator with higher-than-

normal field current draw can all increase fuel consumption without affecting engine power or triggering fault codes

C. The fuel injectors for drift in their calibration that causes over-fueling without triggering an ECM fault

D. The fuel consumption measurement methodology to verify the 15% increase is real and not a measurement or record-keeping error

22. A diesel engine's oil pressure gauge fluctuates between 35 and 45 psi at a steady 1,500 RPM. The pressure should be stable at approximately 40 psi at this RPM. The fluctuation has a frequency of approximately 2 Hz. What is the most likely cause?

A. The oil pressure relief valve is cycling (opening and closing) at 2 Hz — the valve opens at 45 psi (its set point), the pressure drops to 35 psi, the valve closes, the pressure builds to 45 psi again, and the cycle repeats; a worn valve seat, a contaminated seat, or an incorrect relief spring causes the valve to chatter rather than modulate smoothly

B. The oil pump has worn gears that produce pressure pulsations at the gear mesh frequency

C. The crankshaft's main bearing clearances are uneven, creating a cyclic load variation that modulates the oil pressure at crankshaft frequency

D. The oil pressure sender has an electrical fault that produces an oscillating signal

23. A heavy-duty diesel engine equipped with an exhaust gas recirculation system has a condition where the EGR cooler efficiency has dropped from 90% (when new) to 60% (current). The cooler is not leaking coolant. What does reduced cooler efficiency mean, and what is the consequence?

A. Reduced efficiency means the cooler cannot reject heat as effectively as when new

B. Reduced efficiency means the cooler is passing more exhaust gas than designed, overwhelming the cooling capacity

C. Reduced efficiency means the EGR cooler is not cooling the recirculated exhaust gas as effectively — the hot exhaust gas enters the intake manifold at a higher temperature than designed, reducing the EGR's effectiveness at suppressing NOx formation; additionally, the hotter gas reduces the intake charge

density, and the ECM must increase the EGR flow rate to achieve the same NOx reduction, further reducing the available fresh air and potentially increasing soot production

D. Reduced efficiency means the coolant flowing through the EGR cooler is absorbing too much heat and raising the engine's coolant temperature

24. A diesel engine has a condition where the engine starts normally but produces a continuous, loud exhaust leak noise. The noise originates from the junction between two exhaust system sections downstream of the DPF. The technician discovers that the V-band clamp at this junction has broken. What caused the V-band clamp to fail?

A. The V-band clamp was over-torqued during installation, pre-loading the clamp material beyond its fatigue limit

B. The V-band clamp has failed from thermal fatigue — the exhaust system undergoes significant thermal expansion and contraction during each heating and cooling cycle; the V-band clamp must accommodate this movement while maintaining clamping force; repeated thermal cycling work-hardens and embrittles the clamp material until it cracks; this is a common failure mode for exhaust system clamps, particularly those downstream of the DPF where regeneration temperatures are highest

C. The exhaust system's vibration from the engine's firing frequency has resonated the V-band clamp at its natural frequency

D. The DPF's exhaust backpressure exceeded the clamp's rated holding force and blew the joint open

25. A diesel engine's DEF quality sensor reports a DEF concentration of 28% instead of the correct 32.5%. No fault code has been set yet, but the ECM is showing a DEF quality warning. What is the consequence of operating with this low-concentration DEF?

A. The lower DEF concentration (28% versus 32.5%) provides less urea per unit of DEF injected — the SCR catalyst receives less ammonia than the ECM's dosing calculation expects, resulting in reduced NOx conversion efficiency; the ECM will progressively increase the dosing rate to compensate, but if the NOx target cannot be met, the ECM will eventually set a fault code and initiate a derate timer to compel correction

B. The 28% concentration will freeze at a higher temperature than the correct 32.5% concentration, potentially damaging the DEF tank in winter

C. The lower concentration will damage the SCR catalyst by depositing excessive urea crystals on the catalyst surface

D. The 28% concentration produces less ammonia than needed and the excess water from the diluted solution will corrode the exhaust system components

26. A heavy-duty diesel engine has a condition where the engine produces a rhythmic pulsation in the exhaust that can be felt at the tailpipe — the exhaust pressure alternates between strong and weak pulses. The pulsation frequency corresponds to the engine's firing order. What does this indicate?

A. The exhaust manifold has a leak on one runner that reduces the exhaust pulse from that cylinder

B. The turbocharger's wastegate is partially open, allowing some exhaust pulses to bypass the turbine while others pass through

C. The exhaust system has a resonance condition that amplifies certain exhaust pulses and dampens others

D. One or more cylinders are producing weaker exhaust pulses than the others — the pulsation indicates an imbalance in the engine's cylinder-to-cylinder exhaust output; the weak pulses come from cylinders that are producing less combustion pressure (from low compression, weak injection, or late timing), and the strong pulses come from the normally functioning cylinders; the difference is felt as an alternating pattern at the tailpipe

27. A diesel engine's turbocharger oil drain line has been identified as restricted. The turbocharger appears to function normally and the boost pressure meets specification. What is the consequence of a restricted oil drain?

A. The restricted drain has no operational consequence because the turbocharger's bearings receive adequate oil pressure regardless of the drain condition

B. The restricted drain line prevents oil from flowing freely from the turbocharger's center housing back to the crankcase — the oil backs up inside the center housing, increasing the oil pressure around the shaft seals; the elevated pressure pushes oil past the compressor-side seal (into the intake, causing oil consumption and blue smoke) and past the turbine-side seal (into the exhaust, causing blue smoke and carbon buildup); the turbocharger functions normally because the bearing receives adequate oil supply pressure, but the seals are being overwhelmed by the drain-side backpressure

C. The restricted drain causes the turbocharger to overheat from inadequate oil flow through the bearing

D. The restricted drain causes cavitation in the oil supply to the turbocharger bearing from the backpressure

28. A diesel engine's cooling system has a condition where the upper radiator hose collapses during highway driving. The hose inflates normally when the engine is first started. What is the most likely cause?

A. The upper radiator hose has a weak inner liner that cannot withstand the suction created by the water pump at highway RPM

B. The engine's thermostat is creating a pressure differential that exceeds the hose's collapse resistance

C. The radiator cap's vacuum valve has failed — when the engine is shut off or the thermostat closes, the coolant cools and contracts, creating a vacuum in the system; the cap's vacuum valve should open to allow air in and prevent vacuum buildup; if this valve is stuck closed, the vacuum increases during highway driving (when the coolant flow dynamics create suction) and the upper hose collapses because the atmospheric pressure outside exceeds the reduced internal pressure

D. The coolant level is slightly low and the air pocket in the system expands during highway driving, creating the vacuum that collapses the hose

29. A heavy-duty diesel engine has a condition where the engine produces a steady ticking noise from the front of the engine that does not change with engine temperature or load. The ticking corresponds to crankshaft speed (one tick per revolution). What is the most likely cause?

A. A cracked flexplate or flywheel that produces a tick once per revolution as the crack opens and closes under the crankshaft's torsional load — the tick at crankshaft frequency is consistent because the crack passes the same point each revolution; the noise does not change with temperature or load because the crack is structural, not thermal or load-dependent

B. The crankshaft front seal has a hardened lip that ticks against the crankshaft's harmonic balancer once per revolution

C. The timing gear train has a damaged tooth that produces a tick once per revolution of the crankshaft gear

D. The vibration damper has separated internally, and the outer ring shifts position once per revolution relative to the hub

30. A heavy-duty truck's air brake system has a condition where the driver reports that the service brakes feel normal during the first stop after driving at highway speed, but the braking effectiveness decreases noticeably during the second and third stops within a 1-minute period. The air pressure remains above 100 psi throughout. What is the most likely cause?

A. The brake shoes are glazing rapidly from the highway-speed stops and losing friction coefficient with each subsequent application

B. The air system's reservoir volume is marginal for the number of brake chambers in the system

C. The brake drums are expanding from the heat of the first stop, increasing the shoe-to-drum clearance for subsequent stops

D. The brake drums are heat-expanding — the first hard stop generates significant friction heat that thermally expands the drums; the expanded drums move the friction surface away from the shoes, increasing the running clearance; subsequent stops have reduced effectiveness because the shoes must travel further to contact the expanded drums; the automatic slack adjusters cannot compensate for thermal expansion during the brief 1-minute interval between stops

31. A tractor-trailer combination has a condition where the trailer ABS lamp illuminates after the trailer has been sitting unused in a yard for 3 months. The tractor ABS functions normally. After driving the combination for 30 minutes, the trailer ABS lamp extinguishes and the trailer ABS functions correctly. What caused the temporary fault?

A. The trailer's ABS ECU battery backup has depleted during the 3-month storage period and the module required driving time to recalibrate

B. Corrosion has developed on one or more trailer ABS wheel speed sensor connections during the 3-month outdoor storage — the initial power-up self-test detected the high-resistance connection and set the fault; driving the combination for 30 minutes generated enough heat (from brake proximity) and vibration to temporarily improve the corroded connection, allowing the ABS to pass the continuous monitoring checks and clear the lamp

C. The trailer's ABS modulator valves have seized from inactivity during the 3-month storage period and the driving freed the stuck components

D. The trailer tires developed flat spots during the 3-month storage that created false wheel speed signals during the initial self-test

32. A heavy-duty truck equipped with drum brakes has a condition where one brake shoe on the right rear wheel has worn to metal-on-metal (the lining is completely gone), but the other shoe on the same wheel has 50% of its lining remaining. What would cause this severely uneven wear between the two shoes on the same wheel?

A. The leading shoe was installed with a thinner lining than the trailing shoe during the last brake service

B. The anchor pin on the worn shoe's side is seized, preventing the shoe from returning away from the drum and causing continuous contact

C. The self-energizing effect causes the leading shoe to generate more friction force than the trailing shoe during forward braking — the leading shoe is pushed into the drum by the drum's rotational force (self-energizing), while the trailing shoe is pushed away from the drum (de-energizing); the leading shoe performs approximately 70% of the braking work and wears correspondingly faster; this differential wear rate is normal for a duo-servo drum brake system, but a 100%-to-50% difference is excessive and suggests the brakes were not serviced when the leading shoe reached its minimum

C. The automatic slack adjuster has over-adjusted on the worn shoe's side, keeping it in contact with the drum

D. The brake return spring on the worn shoe has broken, preventing that shoe from retracting away from the drum

33. A heavy-duty truck has a condition where the air governor cuts out at the correct pressure (125 psi), but the air dryer purge valve does not open during the cut-out event. The compressor unloads correctly. What is the most likely cause?

A. The governor's signal line to the air dryer purge valve is disconnected, kinked, or plugged — the governor sends separate signals to the compressor unloader and the air dryer purge valve; the compressor unloads correctly because its signal is intact, but the purge valve does not receive the separate signal; the signal line between the governor and the dryer must be inspected for integrity

B. The air dryer's desiccant cartridge has collapsed internally and is blocking the purge valve's air path

C. The purge valve has failed in the closed position and cannot open regardless of the signal pressure

D. The air dryer's check valve downstream of the purge valve is stuck open, equalizing the pressure and preventing the purge valve from sensing the differential needed to open

34. A transit bus equipped with air disc brakes has a condition where the brake pads on both front wheels have worn to the minimum thickness indicator in only 25,000 km. The previous pad set lasted 80,000 km. The same pad brand and compound were used for both sets. What should be investigated?

A. The brake rotors for excessive runout that would cause the pads to scrub against the rotor during every wheel revolution

B. The pad backing plates for correct fitment in the caliper carrier — an incorrect pad profile can cause the pad to contact the rotor at a different angle

C. The bus's operating route and driving conditions, which may have changed to include more hills or more frequent stops

D. The caliper slide mechanism and the caliper piston retraction — if the caliper guide pins are seized, corroded, or binding, or the caliper piston seals have swollen (from fluid contamination) and cannot retract the pistons after each application, the pads remain in continuous contact with the rotors; the continuous drag wears the pads at 3-4 times the normal rate

35. A heavy-duty truck's air system has a condition where the wet tank drain valve releases a significant amount of oil along with the normal water condensate during the daily drain. Where is the oil most likely originating?

A. The oil is from the engine's lubrication system — the air compressor draws lubricating oil from the engine's oil supply, and the compressor's piston rings seal the oil from the compressed air; worn compressor piston rings allow oil to pass into the compressed air stream

B. The air compressor's piston rings are worn, allowing engine oil to pass into the compressed air stream — the compressor is lubricated by engine oil, and worn rings cannot prevent the oil from being carried into the air system; the oil passes through the discharge line, through the air dryer (which may not fully capture it), and into the wet tank where it accumulates and is drained with the condensate

C. The air dryer's desiccant has absorbed engine oil vapors from the crankcase ventilation system and is releasing them during the purge cycle

D. The governor has a leaking diaphragm that allows engine oil to enter the air system through the governor's vent port

36. A school bus equipped with air brakes has a condition where the service brakes produce adequate stopping force on the first 3-4 stops but the stopping distance increases progressively with each subsequent stop during a brake fade test. The air pressure remains constant. What is the cause of this progressive fade?

A. The air system's relay valves are overheating from the rapid cycling and losing their delivery efficiency

B. The brake fluid (on air-over-hydraulic systems) is boiling from the accumulated heat of repeated stops

C. The brake drums are absorbing more heat than they can dissipate — each hard stop adds heat to the drums; as the drum temperature rises, the friction material's coefficient of friction decreases (thermal fade), and the drums expand thermally (moving the friction surface away from the shoes); both effects combine to progressively increase the stopping distance with each subsequent application

D. The automatic slack adjusters are over-adjusting during the heated expansion and creating excessive shoe-to-drum clearance as the drums cool between stops

37. A heavy-duty truck has a condition where the low air pressure warning buzzer sounds intermittently during normal driving even though the system pressure reads 110 psi on both gauges. What is the most likely cause?

A. The low-pressure warning switch has a marginal calibration — the switch should activate at approximately 60 psi, but a faulty switch with a drifted activation point may respond to the normal pressure fluctuations during brake applications at a threshold much higher than 60 psi; the switch activates during each application-induced pressure dip and resets when the pressure recovers

B. The air lines to the pressure gauges have a restriction that delays the gauge reading during pressure drops

C. The warning buzzer has a loose electrical connection that completes the circuit intermittently from vibration

D. The governor is cycling too frequently, creating pressure oscillations that trigger the warning switch during the low points

38. A heavy-duty truck equipped with S-cam drum brakes has had all brake shoes replaced. After the brake job, the driver reports that the brakes grab sharply during the first few stops. What is the most likely cause of the grabbing?

A. The new brake shoes have not yet conformed to the drum surface — the shoes contact the drum at isolated high spots during the initial bedding period, creating concentrated friction points that produce sharp, uneven braking; as the shoes bed into the drum surface over the first 100-200 km, the contact area increases and evens out, producing smooth, progressive braking

B. The brake return springs are the wrong specification (too strong) for the replacement shoes

C. The new shoes have a higher friction coefficient than the previous set and the relay valve delivery pressure needs to be reduced to compensate

D. The automatic slack adjusters have over-compensated during the bedding process, holding the shoes too tightly against the drums

39. A tractor-trailer combination has a condition where the tractor protection valve closes (exhausting the trailer supply) during hard brake applications. The system pressure does not drop below 80 psi during the hard stop. The tractor protection valve's specification requires it to close at approximately 45 psi. Why is the valve closing at 80 psi?

A. The tractor protection valve has a manufacturing defect that sets the closing threshold at 80 psi instead of 45 psi

B. The tractor protection valve's spring has weakened from fatigue and can no longer hold the valve open against the pressure differential created during a hard brake application — the pressure drop across the valve during the high-flow demand of a hard application creates a momentary pressure differential that the weakened spring cannot resist, causing the valve to close momentarily; when the application ends and the pressure stabilizes, the valve reopens

C. The trailer has a large air leak that creates a continuous flow demand through the tractor protection valve, and the hard brake application adds enough additional demand to trigger the valve

D. The tractor protection valve is responding to the pressure drop at the valve's sensing port — the sensing port may be connected to a location in the system where the local pressure drops below 45 psi during the hard application even though the main reservoir is at 80 psi

40. A heavy-duty truck has a condition where one brake chamber (Type 30) consistently measures a pushrod stroke of 55 mm. The maximum specification for a Type 30 chamber is 57 mm (for manual adjusters) or 51 mm (for automatic adjusters). This truck has automatic slack adjusters. What is the assessment?

A. The pushrod stroke is within the manual adjuster specification of 57 mm and is therefore acceptable

B. The automatic slack adjuster is functioning correctly because the stroke is below the absolute maximum limit

C. The pushrod stroke of 55 mm exceeds the 51 mm maximum for automatic slack adjuster-equipped vehicles — the vehicle fails the inspection; the brake on this position is out of adjustment despite having an automatic slack adjuster, which indicates the ASA has failed to maintain the correct adjustment; the ASA must be evaluated for its ability to adjust, and the root cause (worn drums, worn linings, seized anchor pin, or defective ASA) must be identified and corrected

D. The stroke measurement is invalid because automatic slack adjusters self-adjust during operation and a static measurement does not reflect the dynamic adjustment

41. A heavy-duty truck's air dryer has a condition where the desiccant cartridge is saturating (passing moisture) within 2 weeks of replacement. The compressor duty cycle is normal (20-25%). What is the most likely cause of the rapid desiccant saturation?

A. The air compressor is passing excessive oil that coats the desiccant beads and blocks their moisture-absorbing surfaces — oil-contaminated desiccant cannot absorb moisture effectively because the oil film prevents the water vapor from contacting the desiccant material; the desiccant saturates rapidly because it has significantly reduced capacity; the compressor must be evaluated for oil pass-by

B. The replacement desiccant cartridge is the wrong specification for the air dryer and has less capacity than the correct part

C. The ambient humidity is exceptionally high, overwhelming the desiccant's designed capacity within the 2-week period

D. The air dryer's purge cycle is too short, not adequately regenerating the desiccant during each cycle

42. A trailer equipped with ABS has a condition where the ABS modulator valve on the left rear axle makes a rapid buzzing noise during every brake application, not just during ABS activation events. What is the most likely cause?

A. The ABS module is continuously commanding the modulator to cycle based on a faulty wheel speed sensor signal

B. The modulator valve has a stuck solenoid that vibrates at the system's electrical frequency during each application

C. The ABS wheel speed sensor for the left rear has a contaminated or damaged reluctor ring that produces an erratic signal the ABS module interprets as wheel lockup during every application

D. The ABS module is receiving an erratic wheel speed signal from the left rear sensor — the signal characteristics mimic an impending wheel lockup condition (rapidly decelerating wheel speed), causing the ABS module to modulate the brake on that position during every application; the faulty signal could come from a damaged reluctor ring (missing teeth, accumulated debris), an incorrect sensor air gap, or a deteriorating sensor element

43. A heavy-duty truck has a condition where the front steer axle brakes produce significantly less braking force than the rear drive axle brakes. The pushrod strokes are within specification on all positions. The air pressure delivered to all chambers is equal. What is the most likely cause of the front-to-rear imbalance?

A. The front brake chambers are a smaller Type designation than the rear chambers, producing proportionally less force at the same air pressure

B. The front brake chambers are a smaller Type than the rear — on many heavy-duty trucks, the steer axle uses Type 20 or Type 24 chambers while the drive axles use Type 30 or Type 36 chambers; the smaller effective diaphragm area of the front chambers produces proportionally less pushrod force at the same application pressure; this is by design to match the front-to-rear weight distribution, but if the proportioning is incorrect, the imbalance produces inadequate front braking

C. The front brake linings have a lower friction coefficient than the rear linings from a mixed lining installation

D. The front brake drums are cold and have not reached their optimal friction temperature for the lining compound

44. A heavy-duty truck's parking brake valve has a condition where the valve handle is difficult to pull — it requires significantly more force than normal to move the handle from the released position to the applied position. What is the most likely cause?

A. The parking brake valve's internal springs have corroded from moisture exposure and create excessive friction against the valve body

B. The air line connected to the parking brake valve has a kink that creates backpressure against the valve's exhaust function

C. The parking brake valve's internal piston or plunger mechanism is corroded, contaminated, or has a damaged O-ring that creates friction within the valve body — the increased resistance makes the handle difficult to move; the valve should be replaced because a stiff valve may not apply the parking brakes fully in an emergency when rapid application is needed

D. The valve handle's pivot mechanism has seized from moisture contamination and lack of lubrication

45. A transit bus has a condition where the foundation brakes on the rear axle produce a pulsation felt through the brake pedal during every stop. The pulsation frequency corresponds to wheel speed (it slows as the bus decelerates). What is the most likely cause?

A. The brake drums on the rear axle are out of round — the drum's inner surface has developed a non-circular shape (either from localized heating, improper machining, or a manufacturing defect); the out-of-round drum contacts the brake shoes at varying intensity during each revolution, creating a once-per-revolution pulsation that is felt through the pedal and that slows as the wheel speed decreases during deceleration

B. The ABS modulator on the rear axle is partially activating during normal braking from a calibration error

C. The rear brake return springs have weakened and allow the shoes to chatter against the drum surface during application

D. The brake shoe anchor pins on the rear axle are worn and allow the shoes to oscillate on the backing plate during application

46. A heavy-duty truck has a condition where the compressor builds air pressure from 0 to the governor cut-out in 3 minutes. The specification for build-up time from 50 to 90 psi is a maximum of 3 minutes. The overall build-up from 0 to cut-out seems fast, but the technician measures the 50-90 psi segment specifically and it takes 3 minutes and 15 seconds. Does the truck pass?

A. The truck passes because the overall build-up time is fast and the 50-90 psi segment is close to the specification

B. The truck passes because the build-up time specification applies only to the overall 0-to-cut-out time

C. The 50-90 psi segment is the only measurement that matters for regulatory compliance and the overall time is irrelevant

D. The truck fails — the regulatory specification for air pressure build-up is measured specifically from 50 to 90 psi (or from 85 to 100 psi depending on the jurisdiction) with the engine at governed RPM; the 3-minute-15-second measurement exceeds the 3-minute maximum for this specific segment; the fast overall build-up is misleading because the 0-50 psi range builds quickly (little system resistance), but the 50-90 psi range reveals the compressor's true capacity against the system's demand

47. A heavy-duty truck has a condition where the engine starts and runs normally, but the scan tool cannot communicate with any module. The scan tool works correctly on other vehicles. What should the technician check first on this truck?

A. The CAN bus termination resistance, which if open on both terminators would prevent all communication

B. The diagnostic connector (DLC) — the scan tool connects to the vehicle's OBD port, and if the connector has no power (blown fuse for the DLC power supply), no ground (corroded ground pin), or damaged CAN bus pins, the scan tool cannot communicate with any module; the DLC fuse, ground, and pin integrity should be checked before investigating the bus itself

C. The ECM's main power relay, which if de-energized would prevent all modules from communicating

D. The vehicle's battery voltage, which if below 9V would prevent the CAN bus from operating

48. A truck's alternator has been tested with a load tester and produces 14.2V at 80% of its rated output. At 100% of its rated output, the voltage drops to 13.1V. What does this voltage drop at full load indicate?

A. The alternator is functioning normally because it maintains voltage above the battery's resting voltage at all load levels

B. The voltage regulator is intentionally reducing the output voltage at full load to prevent overheating the alternator

C. The alternator has reached its maximum current capacity — the voltage drop from 14.2V to 13.1V at full load indicates the alternator cannot maintain its regulated voltage at the maximum demand; a healthy alternator should maintain its regulated voltage (within 0.5V) up to its rated capacity; the drop to 13.1V confirms the alternator's output is limited by a weak stator winding, worn brushes, or a failed rectifier diode

D. The test leads have excessive resistance that creates a voltage drop at the higher current of the full-load test

49. A heavy-duty truck has a condition where the marker lights on both sides of the vehicle flash at the same rate as the right turn signal when the right turn is activated. This does not occur when the left turn signal is activated. What is the most likely cause?

A. The right turn signal circuit has a ground fault that backfeeds through the marker light circuit — the right turn signal's power is finding ground through the marker light filaments instead of through its designed ground path; the current flows backward through the marker lights, making them flash in sync with the turn signal; the left turn signal uses a separate circuit with a functional ground and does not exhibit the backfeed

B. The right turn signal flasher has a higher-than-normal output that couples into the marker light circuit through shared wiring

C. The body controller module has a software fault that links the right turn signal output to the marker light output

D. The turn signal switch has an internal short between the right turn signal contact and the marker light contact

50. A truck equipped with LED clearance lights has a condition where the lights produce a visible flicker at engine idle that is not present at higher engine RPM. The voltage at the light connector reads a steady 13.8V on a standard multimeter. What could cause the flicker if the voltage reads steady?

A. The LED driver circuit inside the lamp assembly has a fault that responds to a frequency component in the power supply that the multimeter cannot detect

B. The alternator produces a small AC ripple component superimposed on the DC output that the incandescent bulbs' thermal inertia masks but the LED's instant response displays as a visible flicker

C. The LED assembly has a defective current limiter that oscillates at idle frequency

D. The alternator's AC ripple is visible in the LED response — a standard multimeter reads the average DC voltage and cannot detect the AC component superimposed on it; at idle, the alternator's output has more AC ripple (from the lower rotational speed), and LEDs respond instantly to voltage changes (unlike incandescent bulbs that have thermal inertia); the LEDs flicker with the AC ripple; at higher RPM, the ripple decreases and the flicker disappears

51. A heavy-duty truck has a condition where the engine oil pressure warning lamp illuminates for 2 seconds when the driver makes a hard right turn at low speed. The lamp extinguishes immediately when the truck straightens. The oil level is at the full mark. What is the most likely cause?

A. The oil pump pickup tube has a marginal positioning that allows the tube to momentarily surface above the oil level during a hard turn

B. The oil level may be at the full mark when the truck is level, but during a hard right turn, the oil shifts to the left side of the oil pan — the oil pickup tube is located near the center or right side of the pan, and the centrifugal force of the turn moves the oil away from the pickup; the tube momentarily draws air instead of oil, the pressure drops, and the warning lamp illuminates; when the truck straightens, the oil covers the pickup and the pressure returns

C. The oil pressure sender is located on the right side of the engine and the G-force from the right turn compresses the sender's diaphragm, triggering a false low-pressure reading

D. The engine's main bearings have worn on the right side and the centrifugal force of the turn increases the clearance momentarily

52. A truck's CAN bus system has a condition where the engine ECM and transmission ECM communicate normally, but the instrument cluster periodically displays incorrect data — showing the transmission in 3rd gear when the scan tool confirms it is in 6th gear. What is the most likely cause?

A. The CAN bus has a data rate mismatch between the transmission ECM and the instrument cluster

B. The instrument cluster's CAN bus receive buffer has a fault that intermittently corrupts incoming messages

C. The CAN bus has intermittent data corruption between the transmission ECM and the instrument cluster — electrical noise from a nearby source (alternator ripple, PWM-controlled device, or a chafing wire near the CAN bus cable), a marginal connector, or a damaged section of the CAN bus wiring intermittently corrupts the transmission's gear position message; the corrupted data produces the incorrect gear display

D. The transmission ECM has a firmware bug that occasionally broadcasts the wrong gear position to the cluster

53. A heavy-duty truck has a condition where the batteries test at 12.6V (fully charged) with the engine off, and the charging system produces 14.2V with the engine running. Despite these normal readings, the driver reports that the truck is difficult to start on the first attempt every morning. What additional test should be performed?

A. A battery load test (or conductance test) must be performed — voltage alone does not confirm the battery's ability to deliver high current; the batteries may have 12.6V from surface charge but their internal plates may be sulfated, cracked, or degraded, reducing their current delivery capacity below the starter motor's demand; a load test or conductance test measures the battery's actual ability to deliver the cranking amps needed for starting

B. An alternator ripple test to check for AC component in the charging output that may be degrading the batteries

C. A parasitic draw test to verify no excessive drain is partially discharging the batteries overnight

D. A starter motor current draw test to verify the starter is not drawing more current than the batteries can supply

54. A truck's electronic throttle pedal has two independent position sensors (APP1 and APP2). The ECM monitors both sensors simultaneously. If both sensors are functioning correctly, they should track together with a fixed voltage offset. The scan tool shows APP1 increasing from 0.5V to 4.5V during a full pedal sweep, while APP2 increases from 0.25V to 2.25V during the same sweep. Is this normal?

A. This is abnormal — APP2 should have the same voltage range as APP1, and the lower range indicates a sensor fault

B. This is abnormal — APP2 should decrease as APP1 increases, providing a mirror signal for comparison

C. This is abnormal — APP2's voltage range should be exactly half of APP1's range at every position, and 2.25V at full throttle is too low

D. This is normal — dual APP sensors are designed with different voltage ranges and/or different slopes; the ECM monitors the mathematical relationship between the two signals (ratio, offset, or slope) to verify they are tracking together; if the relationship deviates from the expected correlation, the ECM sets a fault code; the specific voltage ranges are manufacturer-dependent

55. A truck's windshield wiper system has a condition where the wipers operate normally on all speeds but do not park at the bottom of the windshield when turned off — they stop at whatever position they are in when the switch is moved to "off." What is the most likely cause?

A. The wiper motor's speed control module has failed and cannot control the park function

B. The wiper switch has an internal fault that disconnects the motor before the park circuit can engage

C. The wiper motor's park circuit has failed — the motor has a separate internal park circuit (a park switch and associated wiring) that keeps the motor running after the main switch is turned off until the wipers reach the park position; if the park switch or its circuit has failed, the motor stops immediately when the main switch is opened instead of running to the park position

D. The wiper motor's park switch is designed to open at the park position — the motor runs until the park switch opens, stopping the motor at the park position; if the park switch has failed in the open position, the motor stops immediately when the main switch opens

56. A heavy-duty truck has a condition where the alternator produces a whining noise that varies with engine RPM. The noise is separate from the serpentine belt noise and is confirmed to originate from inside the alternator housing. What is the most likely cause?

A. The alternator's internal rectifier has a failed diode that creates an electrical imbalance in the stator windings, producing a vibration felt as a whine

B. The alternator's internal bearings have worn, allowing the rotor to vibrate within the enlarged clearance — the worn bearings produce a speed-proportional whine as the rotor oscillates at high RPM;

the alternator may continue to produce adequate voltage and current temporarily, but the bearing wear will progress to failure

C. The alternator's voltage regulator is cycling at an audible frequency that produces the whining noise

D. The alternator's cooling fan blades are imbalanced from a broken blade or accumulated debris

57. A truck's scan tool retrieves an active fault code: "Vehicle Speed Signal — Implausible." The speedometer shows 85 km/h, which matches the vehicle's actual speed. The ABS module also broadcasts 85 km/h. What makes the speed signal "implausible"?

A. The speed signal is implausible because the ECM is comparing two different speed sources and finding a slight difference that exceeds the allowed tolerance

B. The ECM has detected an internal processing error and is questioning its own speed calculation

C. The ECM has correlated the vehicle speed signal with another data source (such as engine RPM and the known gear ratio) and determined that 85 km/h is not consistent with the other data — the speed reads 85 km/h, but based on the engine RPM and the transmission's current gear ratio, the ECM calculates that the vehicle should be traveling at a different speed; this discrepancy triggers the implausibility code

D. The vehicle speed signal has an electrical noise component that the ECM detects as implausible even though the average reading is correct

58. A heavy-duty truck has a condition where the right rear combination lamp (tail, stop, and turn signal in one assembly) functions correctly except that the stop light on the right rear is dim compared to the left rear stop light. Both bulbs are the same type. What is the most likely cause?

A. The right rear stop light circuit has a high-resistance connection (corroded socket, deteriorated ground, or a partially broken wire) that reduces the current flowing through the right bulb — the reduced current produces less light output; the tail light and turn signal functions on the same assembly may be unaffected because they use separate circuits with clean connections

B. The right rear stop light bulb has a higher-resistance filament from a manufacturing variation

C. The brake light switch has a contact that is partially open on the circuit feeding the right rear stop lamp

D. The right rear combination lamp's reflector has deteriorated, making the stop light appear dimmer

59. A truck's electronic stability control (ESC) system has a condition where the ESC activates during normal straight-line braking on dry pavement. The ABS does not activate during the same stops. What sensor could cause ESC activation without ABS activation?

A. The wheel speed sensors, which would trigger both ABS and ESC simultaneously

B. The brake pressure sensor, which would affect both systems equally

C. The steering angle sensor, which if misaligned or miscalibrated could indicate a steering input that does not exist

D. The yaw rate sensor or the lateral accelerometer — these sensors are used exclusively by the ESC system; a faulty yaw rate sensor or lateral accelerometer that reports rotation or lateral movement during straight-line braking triggers the ESC's stability intervention; the ABS system does not use these sensors and therefore does not activate

60. A heavy-duty truck has a condition where the dashboard warning chimes and buzzer are inaudible. The driver cannot hear the low-air-pressure warning, the door-ajar warning, or the seatbelt warning. All warning lamps function correctly. What is the most likely cause?

A. The warning lamp circuits function independently from the audible warning circuit

B. The chime/buzzer unit, its power supply, or its ground has failed — the warning lamps use separate output circuits from the BCM, while the audible warnings are typically produced by a single chime module or piezo buzzer; if this single unit has failed, lost its power supply, or lost its ground, all audible warnings are silent while the visual warnings (using separate circuits) continue to function

C. The BCM has a software fault that disables the audio output while maintaining the visual output

D. The vehicle radio or entertainment system is interfering with the warning chime frequency

61. A truck's CAN bus has a measured termination resistance of 120 ohms instead of the specified 60 ohms. What does a 120-ohm reading indicate?

A. Both termination resistors are present and the measurement is incorrect due to the meter's internal resistance

B. The CAN bus is functioning normally because 120 ohms is within the acceptable tolerance range

C. One of the two 120-ohm termination resistors has failed (open circuit) — the CAN bus uses two 120-ohm resistors, one at each end of the bus; when both are connected in parallel, the combined resistance is 60 ohms; a reading of 120 ohms indicates only one resistor is in the circuit; the bus may still function but with increased susceptibility to signal reflections and data errors, particularly at higher bus loads

D. Both termination resistors have doubled in value from heat exposure, each reading 120 ohms instead of 60 ohms

62. A truck's electronic instrument cluster has a condition where the fuel gauge drops to empty momentarily when the vehicle hits a large bump, then returns to the correct reading. What is the most likely cause?

A. The fuel sender's float arm is at the limit of its travel and the bump dislodges it momentarily — the float arm contacts the tank wall or a baffle during the bump's inertia, momentarily moving the wiper to the empty position; when the fuel settles, the float returns and the gauge reads correctly

B. The fuel sender's electrical connector has a loose or corroded pin that momentarily loses contact during the bump's vibration — the open circuit produces an empty reading for the duration of the contact loss; when the vibration stops, the pin re-seats and the reading returns to normal

C. The instrument cluster's internal electronics are sensitive to vibration and the bump disrupts the fuel gauge stepper motor

D. The fuel sender's float has a leak and is partially submerged, making it susceptible to the bump's influence on the fuel surface

63. A heavy-duty truck has a condition where the engine coolant temperature gauge reads normally during driving but suddenly spikes to the red zone for 2-3 seconds, then returns to normal. The actual coolant temperature (verified by the scan tool) remains stable. What is the most likely cause?

A. The coolant temperature sender has an intermittent internal fault that briefly produces a maximum-temperature signal

B. The CAN bus has a data corruption event that alters the temperature message for 2-3 seconds

C. The thermostat is momentarily closing completely, causing a localized hot spot at the sender location

D. The coolant temperature sender or its wiring has an intermittent fault — the sender's internal element may have a thermal crack that momentarily changes the resistance to a value the gauge interprets as maximum temperature; alternatively, the signal wire has a momentary contact with a voltage source that pulls the signal to a high-temperature reading; the scan tool reads the correct temperature from the ECM's separate sensor, confirming the gauge sender circuit is the problem

64. A truck equipped with a multiplexed electrical system has a condition where the BCM intermittently commands the headlights to full brightness during daytime running light (DRL) mode. The headlights should be at reduced brightness during DRL operation. What is the most likely cause?

A. The DRL intensity control uses a PWM (pulse width modulated) signal to reduce the headlight brightness during daytime

B. The ambient light sensor that tells the BCM whether it is day or night has an intermittent fault — the sensor momentarily reports "night" conditions during the day, causing the BCM to switch from DRL mode (reduced brightness) to full headlight mode; when the sensor recovers, the BCM returns to DRL mode

C. The headlight relay has welded contacts that bypass the DRL's reduced-brightness circuit

D. The BCM's firmware has a timer error that periodically resets the DRL mode to full brightness

65. A heavy-duty truck has a condition where the starter motor cranks the engine but the engine will not start. The scan tool shows fuel rail pressure building to 2,000 bar during cranking (within specification). The crankshaft position sensor signal is present and the camshaft position sensor signal is present. What else could prevent starting?

A. The ECM is not commanding the injectors to open — despite having adequate fuel pressure and valid sensor signals, the ECM may not be commanding injection due to a security/immobilizer lockout, a faulty ECM relay that cuts power to the injector drivers, or a disabled fuel injection output from a severe fault condition; the ECM has all the information it needs to time the injection but is not activating the injector solenoids

B. The fuel temperature is too low for the fuel to atomize properly at the 2,000 bar pressure

C. The exhaust system has a severe restriction that prevents the engine from expelling the first combustion gases

D. The glow plugs or intake air heater has failed, preventing the compressed air from reaching autoignition temperature

66. A truck's telematics system reports that the engine has been idling for 4 hours per day, significantly exceeding the fleet's 1-hour maximum idle policy. The driver disputes the report, claiming they only idle for 30 minutes per day. What could cause the discrepancy between the telematics report and the driver's perception?

A. The telematics system's idle detection algorithm may include time when the vehicle speed is below 5 km/h (such as creeping in traffic, queuing at loading docks, or maneuvering in tight yards) as idle time

B. The telematics system counts DPF regeneration events as idle time because the engine runs at elevated RPM without vehicle movement

C. The driver is correct and the telematics system has a calibration error in its idle-time counter

D. The telematics system defines idle differently than the driver — the system counts all time when the engine is running and the vehicle speed is zero, which includes time the driver does not perceive as "idling" (waiting at traffic lights, sitting in drive-through queues, loading/unloading while the engine runs, warming up, and cooling down); the cumulative total of these brief idle events can significantly exceed the driver's perception of intentional idling

67. A heavy-duty truck has a condition where the engine ECM communicates normally with the scan tool, but the ECM intermittently loses communication with the transmission ECM for 1-2 seconds at a time. All other modules communicate with each other continuously. What should be investigated?

A. The ECM's CAN bus transceiver, which may have a marginal output that drops during high bus load periods

B. The transmission ECM's power supply, which may have a momentary dropout that causes the module to reboot

C. The main CAN bus backbone, which may have a marginal connection between the ECM and the transmission ECM

D. The specific CAN bus connection between the ECM and the transmission ECM — if these two modules communicate on a private CAN bus (a dedicated bus separate from the main J1939 bus), the private bus wiring, connectors, or termination may have an intermittent fault; if they share the main bus, the fault is in the bus segment between the two modules' connection points

68. A truck's electronic gauge cluster has a condition where all gauges read correctly but the odometer has stopped incrementing. The speedometer functions normally and shows the correct speed. What is the most likely cause?

A. The vehicle speed sensor has a fault that prevents the ECM from calculating distance, even though it produces a valid speed signal

B. The instrument cluster's internal non-volatile memory for the odometer has failed — the cluster receives and displays the correct vehicle speed (speedometer works), but the memory circuit that accumulates and stores the distance cannot increment or retain the odometer value; the odometer is a critical regulatory and warranty record, and the cluster must be repaired or replaced, and the odometer reading restored from the ECM's backup distance counter or service records

C. The ECM has stopped broadcasting the distance message on the CAN bus while continuing to broadcast the speed message

D. The odometer's mechanical gear train (in older clusters) has worn and cannot advance the number drums

69. A heavy-duty truck with a 13-speed manual transmission has a condition where the driver cannot move the shift lever into any gear from neutral. The clutch pedal operates normally and the clutch disengages fully (the truck does not creep when in gear with the clutch depressed — verified before the shifting problem developed). What is the most likely cause?

A. The clutch release bearing has seized and is preventing the input shaft from spinning freely in neutral

B. The transmission shift lever is physically disconnected from the internal shift mechanism

C. The transmission's internal shift mechanism has jammed — a broken shift fork, a seized shift rail, a detent ball jammed in the wrong position, or a broken component inside the shift tower prevents the shift rails from moving; the clutch functions correctly (confirmed by the no-creep test) and the external linkage may move, but the internal mechanism cannot respond

D. The transmission oil has solidified from extreme cold and is preventing the shift forks from moving through the thickened oil

70. A truck equipped with an Allison automatic transmission has a condition where the lockup clutch engages during the 3-4 upshift and immediately disengages, then re-engages — producing a noticeable shudder during the shift. The lockup functions normally in 4th, 5th, and 6th gears once engaged. What is the most likely cause?

A. The lockup clutch's apply circuit has a calibration issue during the 3-4 shift — the TCM commands lockup simultaneously with the 3-4 shift, but the lockup apply pressure arrives before the 4th gear clutch is fully engaged; the partial 4th gear engagement produces a speed fluctuation that the lockup clutch cannot hold, causing it to slip, release, and re-engage; the shudder occurs during the overlap period between the gear change and the lockup engagement

B. The torque converter's internal fluid dynamics create a pressure pulse during the 3-4 shift that interferes with the lockup clutch application

C. The lockup clutch friction surface has a worn section that coincides with the converter's rotational position during the 3-4 shift

D. The 3-4 shift solenoid has an electrical delay that causes the gear change to occur after the lockup instead of before

71. A heavy-duty truck's clutch has a condition where the clutch pedal free play has decreased from the original 25 mm to approximately 5 mm over 50,000 km. What does the decreasing free play indicate?

A. The clutch master cylinder has a leaking seal that allows fluid to bypass, reducing the effective pedal travel

B. The pressure plate's diaphragm spring has taken a set from heat exposure, changing its contact point with the release bearing

C. The clutch hydraulic system has air that has expanded from heat, pre-loading the release bearing against the pressure plate

D. The clutch disc is wearing thinner — as the friction material wears, the pressure plate moves closer to the flywheel; this moves the release bearing's contact point closer to the diaphragm spring fingers (because the pressure plate's fingers move toward the transmission as the disc thins); the reduced gap

between the release bearing and the fingers decreases the free play; the decreasing free play trend directly correlates with disc wear

72. A bus equipped with an Allison automatic transmission has a condition where the transmission occasionally does not shift from 3rd to 4th gear during normal acceleration. The TCM shows no fault codes. When the shift does not occur, the driver can manually select 4th gear and the transmission shifts without issue. What is the most likely cause?

A. The vehicle speed sensor has an intermittent signal dropout that prevents the TCM from confirming the vehicle speed needed for the 3-4 shift threshold

B. The throttle position sensor has an intermittent signal that causes the TCM to calculate a shift point that the vehicle cannot reach during the signal dropout — the TCM interprets the momentary throttle signal loss as a "no throttle" condition and adjusts the shift schedule accordingly; when the driver manually commands 4th gear, the TCM bypasses the normal shift schedule and executes the shift

C. The shift solenoid for the 3-4 shift has an intermittent electrical connection that prevents it from activating during some acceleration events

D. The transmission fluid temperature is in a range where the TCM delays the 3-4 shift as a protection strategy

73. A heavy-duty truck equipped with a two-speed rear axle has a condition where the axle shifts from low to high range smoothly but produces a noticeable vibration in high range that is not present in low range. The vibration is proportional to vehicle speed. What is the most likely cause?

A. The high-range gear set has a worn tooth that produces the vibration at the specific mesh frequency of high range

B. The high-range shift collar has not fully engaged and is partially meshed with the gear teeth, producing vibration from the incomplete engagement

C. The high-range gear set has a worn bearing, a damaged tooth, or a misaligned gear mesh that produces vibration at the specific rotational speed of the high-range components — the low-range gear set uses different internal components that are unaffected; the vibration is speed-proportional because the gear mesh frequency increases with output shaft speed

D. The driveshaft approaches its critical speed at the specific RPM range that corresponds to highway speed in high range

74. A truck's manual transmission has a condition where the transmission oil has turned a milky grey color. The truck operates in a northern climate with frequent temperature cycling. What is the most likely source of the contamination?

A. Condensation — the frequent temperature cycling between operating temperature and cold ambient causes moisture to condense inside the transmission housing; the water mixes with the transmission oil and creates the milky grey emulsion; the transmission breather may be blocked or positioned where it draws in moist air, or the vehicle may make frequent short trips that do not heat the oil sufficiently to evaporate the accumulated moisture

B. The clutch housing has a crack that allows rainwater to enter the transmission through the bell housing

C. The transmission cooler (if equipped) has an internal leak that allows coolant to enter the transmission oil

D. The transmission's front seal has failed, allowing engine oil to mix with the transmission oil

75. A heavy-duty truck has a rear axle that produces a whining noise during deceleration only. The noise is not present during acceleration or steady-state cruising. What does this deceleration-only noise indicate?

A. The differential bearings are worn and produce noise only when the axle is in the coast (deceleration) loading condition

B. The pinion bearing preload has decreased from wear, allowing the pinion to shift position during deceleration

C. The ring and pinion gear mesh is noisy on the coast side only — the gear tooth contact pattern on the coast side is different from the drive side, and wear or incorrect adjustment has produced a contact pattern that generates noise only when the gears are loaded in the coast direction during deceleration

D. The ring and pinion gear set has a wear pattern or incorrect tooth contact on the coast (deceleration) side of the teeth — during deceleration, the gear loading reverses and the coast side of the teeth carries the load; wear, incorrect backlash, or incorrect pinion depth has produced a coast-side contact that

generates the whining noise; the drive side (loaded during acceleration) has a different contact pattern that is quiet

76. A truck equipped with an automated manual transmission has a condition where the transmission shifts from 1st to 2nd gear twice as fast as normal — the shift happens almost instantaneously instead of the normal progressive engagement. The shift is accompanied by a harsh jolt. What is the most likely cause?

A. The AMT's shift actuator motor has received a firmware update that increased its speed beyond the designed engagement rate

B. The AMT's clutch actuator is not modulating the clutch engagement during the shift — the clutch should progressively re-engage after the gear change to absorb the torque transition smoothly; if the actuator applies the clutch instantaneously (from a failed position sensor, a hydraulic valve fault, or a clutch learn error), the torque is transferred to the drivetrain as a sudden impact

C. The engine brake is inadvertently activating during the shift, adding a deceleration force that accelerates the gear engagement

D. The transmission's shift time is controlled by a calibration parameter that has been reset to the factory default, which is faster than the optimized value

77. A heavy-duty truck's driveshaft has a condition where the vibration increases as the vehicle decelerates from highway speed and then suddenly disappears below approximately 20 km/h. What is the most likely cause?

A. The driveshaft has a balance or runout issue that produces a vibration proportional to speed — the vibration increases in perception during deceleration because the engine noise and road noise decrease while the driveshaft vibration remains; below 20 km/h, the driveshaft speed drops below the threshold where the imbalance produces a perceptible vibration

B. The driveshaft center carrier bearing is worn and produces a growl that increases during deceleration from the changed loading direction

C. The U-joints have worn caps that produce a vibration during the deceleration loading but not during acceleration

D. The transmission output shaft bearing is worn and produces a vibration during the coast loading of deceleration

78. A bus equipped with an automatic transmission has a condition where the transmission produces a clunking noise when the driver shifts from Neutral to Drive at idle. The clunk does not occur when shifting from Neutral to Reverse. What is the most likely cause?

A. The forward clutch piston return spring has weakened, allowing the clutch to apply too aggressively when Drive is selected

B. The torque converter's one-way clutch (stator) engages abruptly when the forward clutch applies, producing the clunk from the sudden torque multiplication

C. The forward clutch pack has excessive clearance — the apply piston must travel further than designed before the clutch plates contact each other; the delay allows the engine's idle torque to spin the converter's turbine, and when the clutch finally engages, the speed difference between the stationary output shaft and the spinning input produces the clunk; the reverse clutch may have different clearance characteristics that produce a smoother engagement

D. The parking pawl is not fully disengaging before the forward clutch applies, creating a momentary conflict between the locked output and the driven input

79. A heavy-duty truck has a condition where the clutch pedal returns to the top of its travel slowly — it takes approximately 3 seconds for the pedal to fully return after release. The clutch functions normally otherwise. What is the most likely cause?

A. The clutch master cylinder's compensating port is partially blocked, restricting the fluid's return flow to the reservoir

B. The release bearing is sticking on the transmission's front bearing retainer tube, creating drag that slows the pedal return

C. The pressure plate's diaphragm spring has weakened and cannot push the release bearing back quickly enough

D. The clutch hydraulic system has a restriction in the return path — either the master cylinder's compensating port is partially blocked (preventing fluid from flowing freely back to the reservoir), the hydraulic line has a collapse or restriction (limiting the return flow rate), or the slave cylinder's piston

seal is creating excessive drag; the restriction slows the fluid's return, which slows the master cylinder piston's return, which slows the pedal

80. A truck equipped with a tandem drive axle has a condition where the inter-axle differential lock will not disengage after being engaged during an off-road delivery. The indicator light stays on and the truck handles poorly during turns on paved roads. What is the most likely cause?

A. The inter-axle lock shift mechanism is engaged correctly and the electrical circuit is preventing the solenoid from receiving the disengage signal

B. The inter-axle lock collar is bound by driveline torque — the collar engaged the lock while the wheels were turning at different speeds (off-road conditions), and residual torque from the driveline is holding the collar in the engaged position; the driver must relieve the driveline torque by stopping the vehicle, shifting to neutral, and rocking the vehicle slightly before attempting to disengage the lock

C. The air solenoid that controls the lock engagement has failed in the engaged position

D. The lock mechanism's return spring has broken and the collar cannot disengage without the spring's retraction force

81. A heavy-duty truck equipped with a manual transmission has a condition where the transmission's gear oil level drops by approximately 1 litre per month. No oil is visible on the ground under the transmission or on the bell housing. Where is the oil going?

A. The transmission's rear seal is leaking oil into the driveshaft housing, where it is flung outward by the driveshaft's rotation and distributed along the truck's undercarriage in a pattern that is difficult to trace back to the source — alternatively, the transmission's front seal (input shaft seal) is leaking oil into the bell housing, where it mixes with clutch dust and adheres to the housing's interior surfaces without dripping externally

B. The transmission oil is evaporating through the breather from the heat of normal operation

C. The transmission oil is being consumed through internal passages that connect to the engine's lubrication system

D. The transmission oil is leaking into the clutch housing through a worn input shaft bushing

82. A bus equipped with an Allison automatic transmission has had its transmission oil and filter changed. After the service, the transmission produces a delayed engagement (2-3 seconds) when shifted from Park to Drive. The engagement was immediate before the service. What is the most likely cause?

A. The transmission oil filter was installed backward, restricting the flow to the clutch apply circuits

B. The transmission was overfilled during the service, and the excess oil is aerating from the planetary gears whipping the oil into foam

C. The transmission was not filled to the correct level — the oil level is too low after the service; the pump draws oil from the low reservoir and momentarily pulls air, which compresses in the clutch apply circuit and delays the engagement; the 2-3 second delay represents the time for the pump to purge the air and build adequate apply pressure; the level must be checked at operating temperature in Neutral per the manufacturer's procedure

D. The replacement filter has a different flow restriction than the original, creating a pressure drop in the apply circuit

83. A heavy-duty truck has a driveshaft that vibrates at highway speed. The technician has checked the balance, the U-joint condition, and the phasing — all are correct. The technician then measures the U-joint operating angles and finds the front angle is 2 degrees and the rear angle is 5 degrees. What do these unequal angles indicate?

A. The unequal U-joint angles (2° front, 5° rear) are the cause of the vibration — for a single-piece driveshaft, the front and rear U-joint angles must be equal within approximately 1 degree so that the speed fluctuation produced by the front joint is cancelled by the rear joint; a 3-degree difference means the speed fluctuations are not cancelled, producing a vibration at twice per revolution; the angles must be corrected by shimming the transmission, adjusting the pinion angle, or using an angled carrier bearing mount

B. The angles are within the acceptable range for heavy-duty applications and the vibration source is elsewhere

C. The unequal angles will cause premature U-joint wear but are not the source of the highway-speed vibration

D. The angles indicate the driveshaft is too long for the application and should be shortened to equalize the angles

84. A heavy-duty truck's clutch has a condition where the clutch engagement point has moved progressively closer to the floor over several months. The clutch still disengages fully when the pedal is at the floor. There are no hydraulic leaks. What does this progressive change indicate?

A. The pressure plate's diaphragm spring is progressively weakening from heat fatigue

B. The hydraulic fluid is absorbing moisture and expanding from the heat, changing the pedal position

C. The clutch hydraulic system has a slow internal leak in the master cylinder that allows the pedal position to shift over time

D. The clutch disc is wearing progressively thinner — as the friction material wears, the pressure plate moves closer to the flywheel; the release bearing must travel further (starting from a closer resting position) to disengage the clutch; this shift in geometry moves the engagement point closer to the floor; the trend directly correlates with disc wear rate; when the engagement point nears the floor, the disc is approaching its wear limit

85. A truck equipped with a torque converter automatic transmission has a condition where the converter lockup clutch produces a vibration during the lockup engagement at light throttle. The vibration disappears once the lockup is fully engaged. What is the most likely cause?

A. The lockup clutch is engaging too aggressively from excessive apply pressure during the light-throttle lockup command

B. The lockup clutch friction surface is contaminated or glazed — the contamination or glazing produces an inconsistent friction coefficient during the progressive engagement phase; the clutch alternately grips and slips as the friction varies across the surface, producing the vibration; once fully clamped, the full clamping force holds the clutch locked regardless of the surface condition, and the vibration stops

C. The torque converter's internal fluid dynamics create a resonance during the lockup engagement at light throttle

D. The engine's torsional vibration at light throttle is amplified during the lockup engagement phase

86. A heavy-duty truck equipped with a hydraulic power steering system has a condition where the steering effort is normal during straight-line driving but becomes extremely heavy during left turns only. Right turns feel normal. What is the most likely cause?

A. The left-turn power steering line has a restriction that limits fluid flow to the left-turn side of the steering gear's power piston

B. The steering gear's spool valve has a calibration error that limits the pressure directed to the left-turn side of the power cylinder

C. The steering gear's internal piston seal has failed on the left-turn side — the seal allows hydraulic fluid to bypass from the high-pressure side to the low-pressure side during left turns, reducing the effective assist force; the right-turn side of the piston has a functional seal and provides normal assist

D. The drag link has a binding condition at the specific steering angle associated with left turns

87. A heavy-duty truck has a condition where both steer tires show a wear pattern with smooth center tread and rougher, worn shoulders. What inflation condition typically produces this wear pattern?

A. Chronic underinflation — when tire pressure is below specification, the tire's contact patch changes from a rectangular shape to a trapezoidal shape with more weight on the shoulders than the center; the shoulders carry a disproportionate share of the load, wearing faster; the center tread is lightly loaded and wears more slowly, remaining smoother than the worn shoulders

B. Chronic overinflation that balloons the center of the tread and lifts the shoulders off the road surface

C. Normal inflation with excessive positive camber on both sides that loads both shoulders

D. Normal inflation with excessive speed that generates heat primarily at the tire shoulders

88. A heavy-duty truck equipped with air ride suspension has a condition where the ride height on one side is correct when the vehicle is stationary, but the vehicle leans noticeably to that side during highway driving. What could cause a lean that is present during driving but not when stationary?

A. The shock absorber on the leaning side has failed, allowing that side's suspension to compress further under the aerodynamic forces and dynamic loads of highway driving

B. The air spring on the leaning side has a slow leak that depletes during highway driving but refills from the air system when the vehicle stops

C. The height control valve on the leaning side has a delayed response that cannot compensate for the dynamic forces of highway driving

D. The leaning side's air spring has an internal bleed that loses pressure during the continuous compression-extension cycling of highway driving — the dynamic suspension movements at highway speed cause the spring to cycle continuously; a marginal air spring that holds static pressure cannot maintain pressure during the dynamic cycling; when the vehicle stops and the cycling ceases, the air system replenishes the spring and the ride height returns to normal

89. A heavy-duty truck has a steer axle alignment that shows the following readings: left toe +2 mm, right toe −1 mm. The total toe is +1 mm (1 mm toe-in), which is within the 0 to +3 mm specification. The vehicle tracks straight but the steer tires show uneven wear — the left tire shows inside-edge feathering and the right tire shows outside-edge feathering. What is the cause?

A. The total toe is within specification, but the individual wheel toes are not equal — the left wheel has 2 mm toe-in (causing inside-edge feathering from the excess inward angle) and the right wheel has 1 mm toe-out (causing outside-edge feathering from the outward angle); even though the total cancels to an acceptable 1 mm, each tire scrubs in its own direction, producing the opposite feathering patterns on each side

B. The individual toe readings are within their individual specifications and the feathering is caused by a different alignment parameter

C. The feathering is caused by a camber difference between the left and right sides, not the toe readings

D. The vehicle has a thrust angle error from the rear axle that causes the steer tires to track at an angle despite the total toe being correct

90. A heavy-duty truck equipped with a solid I-beam steer axle has a condition where the king pins have been recently replaced but the steering still has excessive free play. The new king pins have zero play. What other component is likely worn?

A. The steering gear's sector shaft and the drag link's ball joints — the steering system is a chain of components from the steering wheel to the road wheels; replacing the king pins eliminated one source of play, but the sector shaft (which meshes with the worm gear inside the steering gear) and the drag link's ball joints (which connect the sector shaft arm to the steering knuckle) are additional wear points; accumulated play in any combination of these components produces the residual free play

B. The steering column U-joints, which add free play from the worn cross elements

C. The tie rod ends, which add free play from the worn ball-and-socket joints

D. The steering wheel hub, which adds free play from the worn spline engagement with the steering shaft

91. A trailer equipped with air ride suspension has a condition where the suspension produces a loud hissing sound continuously. The ride height is correct. What is the most likely cause?

A. The height control valve is continuously adding and venting air in a rapid cycle to maintain the ride height against a small but continuous air leak in the system

B. A height control valve is stuck in the supply position, continuously feeding air to the springs

C. An air spring has a slow leak that the height control valve is continuously compensating for

D. The height control valve is continuously cycling — a small air leak at a spring, fitting, or air line causes the ride height to drop slightly; the valve senses the drop and adds air; the leak depletes the air immediately, the height drops again, and the valve adds more air; the continuous supply-and-leak cycle produces the hissing as the valve continuously feeds air to replace the escaping supply

92. A heavy-duty truck's frame has a condition where the right frame rail has developed a visible downward bend (sag) directly beneath the crane mounting bracket. The crane was recently used to lift a load at the maximum rated capacity. What caused the sag?

A. The crane mounting bracket bolts were not torqued correctly and the bracket shifted during the lift, concentrating the load on one section of the frame

B. The frame rail material has fatigued from the repeated crane loading cycles over the vehicle's service life

C. The crane load exceeded the frame rail's capacity at that specific point — the crane's rated capacity is the maximum the crane itself can handle, but the frame must also support the crane's reaction forces; the concentrated downward force from the crane boom's load (plus the crane's own weight) exceeded the frame rail's bending strength at the mounting point, permanently deforming the rail

D. The crane was operated with the outriggers retracted, concentrating the load through the frame rail instead of distributing it through the outriggers to the ground

93. A heavy-duty truck equipped with hub-piloted disc wheels has had all steer axle hardware (wheel nuts, studs) replaced with new components. After 500 km, the technician re-torques the wheel nuts and finds that most nuts have lost approximately 15% of their torque. Is this normal?

A. A 15% torque loss after 500 km is within the normal range for new hardware — new wheel nuts, studs, and mating surfaces undergo initial settling (embedding) as the surfaces mate under load; the components' microscopic surface irregularities compress and flatten during the first few hundred km, reducing the effective clamping force; this is why manufacturers require a re-torque after the first 100-500 km of service with new hardware

B. A 15% torque loss indicates the studs are yielding (stretching beyond their elastic limit) and must be replaced immediately

C. A 15% torque loss indicates the wheel nut specification is incorrect for the stud specification

D. A 15% torque loss is excessive and indicates the hub pilot pads are corroded, preventing proper wheel centering

94. A truck's steer axle alignment shows positive caster of +7 degrees on both sides. The specification is +3 to +5 degrees. What symptom will this excessive positive caster produce?

A. The steering will feel heavy at low speeds and the steering wheel will have strong self-centering force — positive caster creates the self-centering effect and steering returnability; excessive positive caster amplifies both effects, making the steering uncomfortably heavy during parking maneuvers and producing aggressive steering wheel return after turns

B. The steering will feel light and the steering wheel will have weak self-centering force

C. The vehicle will pull to one side during straight-line driving

D. The steer tires will develop excessive inside-edge wear from the camber change produced during turns

95. A heavy-duty truck equipped with leaf spring suspension has a condition where the truck's ride height on the left side is lower than the right side. Both springs have the same part number. What is the most likely cause?

A. The springs are identical parts but the left spring has served longer under a heavier load (from an asymmetric cargo pattern or a heavier component on the left side) and has lost more arch than the right spring

B. The left spring's mounting bushings have compressed more than the right side's bushings from moisture damage

C. The left spring's U-bolts are torqued higher than the right side's, compressing the spring pack more and reducing the ride height

D. The left spring has lost arch (sagged) from a previous overloading event, permanent fatigue, or a crack in one of its leaves — the reduced arch makes the left side sit lower; both springs are the same part number, so the height difference must come from a change in one spring's physical condition; the left spring must be inspected for cracks, broken leaves, or permanent set and replaced or re-arched

96. A heavy-duty truck has a condition where the steering produces a clicking noise from the front of the vehicle that occurs once per wheel revolution. The noise is present during both straight-line driving and turning. What is the most likely cause?

A. A foreign object (stone, bolt, or wire) is trapped in the front tire's tread — the object contacts the road surface once per revolution, producing the click; the noise is present during all driving conditions because the object contacts the road regardless of the vehicle's direction; the technician should inspect the front tires for embedded objects

B. The front brake shoe return spring has broken and the loose spring contacts the drum once per revolution

C. The front hub bearing has a worn roller that clicks once per revolution as it passes through the damaged race

D. The steer axle king pin bushing has a worn section that clicks once per wheel revolution as the steering knuckle rotates past the worn point

97. A trailer equipped with air ride suspension has a condition where the suspension on one side of the trailer is fully extended (riding on the bump stops inverted — the axle hangs at maximum droop) while the other three corners are at the correct ride height. What is the most likely cause?

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

B. The air spring on the affected corner has a blown-out bellows that cannot hold any air pressure

C. The air supply line to the affected corner has a complete break or disconnection — no air can reach the spring on that corner; the spring has no pressure and the suspension hangs at full droop; the other three corners maintain correct height because their supply lines are intact

D. The affected corner's air spring, air supply line, or height control valve has a complete failure — the spring hangs at maximum droop because it has zero air pressure; the failure could be a ruptured spring bellows, a severed supply line, a failed check valve in the supply, or a height control valve stuck in exhaust position

98. A heavy-duty truck has a condition where the left front wheel bearing produces a growling noise during driving that gets louder during left turns and quieter during right turns. What does this load-dependent behavior indicate?

A. The left wheel bearing is loaded more heavily during left turns — during a left turn, the vehicle's weight transfers to the right side, but the left wheel's camber angle changes in a way that loads the bearing's outer race more heavily; the increased load on the worn bearing amplifies the growling noise

B. During left turns, the vehicle's weight transfers to the right side, which should unload the left bearing — but the noise gets louder; this indicates the bearing noise increases when the load decreases, which is characteristic of a bearing with worn rollers that rattle more freely when unloaded; the right turn loads the bearing and dampens the rattling

C. The left front wheel bearing is loaded more heavily during right turns but the noise is louder during left turns because the turn geometry positions the driver's ear closer to the left wheel during left turns

D. The steering geometry changes the wheel's position during turns, and during left turns, the left wheel's camber shifts to load the worn bearing's inner race more heavily, amplifying the growling noise

99. A heavy-duty truck equipped with disc brakes on all positions has a condition where the brake pedal pulsates during every stop. The pulsation is felt at all speeds. The technician measures the rotor thickness variation (DTV) on all rotors and finds one rear rotor has 0.15 mm DTV. The specification maximum is 0.05 mm. What does this confirm?

A. The rotor with 0.15 mm DTV has a thickness variation that exceeds the specification by three times

B. The pulsation is not caused by the rotor because DTV measurements are only relevant for front axle rotors

C. The DTV measurement of 0.15 mm is marginally above the 0.05 mm specification and is unlikely to produce a noticeable pulsation

D. The rotor with 0.15 mm DTV is the cause of the pulsation — as the rotor rotates, the thick and thin spots alternately push the brake pads apart (thick spot) and allow them to retract (thin spot); this produces a cyclical force variation that the driver feels as a pedal pulsation; the 0.15 mm variation far exceeds the 0.05 mm maximum and must be corrected by machining the rotor (if sufficient material remains) or replacing it

100. A heavy-duty truck has a condition where the steer tires show a wear pattern with one tire wearing faster than the other. Both tires are the same specification and inflation pressure. The alignment shows equal toe, equal camber, and equal caster on both sides. What else could cause one tire to wear faster?

A. One tire is on a wheel with a different offset that changes the effective scrub radius on that side — the different offset positions the tire's contact patch at a different distance from the king pin axis, changing the forces acting on the tire during steering and braking; the altered geometry produces different wear characteristics on that side even though the alignment readings are equal

B. The tires are different ages from different manufacturing batches, and the older tire has harder rubber that wears differently

C. The king pin inclination angle is different on the two sides, which the standard alignment check does not measure

D. The brake adjustment is different on the two sides, causing one tire to receive more braking drag than the other

101. A trailer's landing gear has a condition where the left leg extends further than the right leg when both are fully extended. This difference was not present when the trailer was new. What is the most likely cause?

A. The left leg's internal stop has shifted from a previous impact or overload event

B. The right leg has been damaged from a dock impact that bent the internal leg tube, shortening its effective extended length

C. The gearbox cross-shaft has developed a twist from overloading that causes one leg to advance further than the other during cranking

D. One of the internal leg tubes has been bent from an impact — a loading dock collision, curb scrape, or obstacle contact can bend the inner tube, shortening its effective extended length; the other leg extends to its original full length because it has not been impacted

102. A heavy-duty truck equipped with power steering has a condition where the steering effort varies during a complete lock-to-lock turn — the effort is normal for most of the travel but increases noticeably at two specific points during the sweep. What is the most likely cause?

A. The steering gear has worn internal components at two specific positions in its travel that bind during the sweep

B. The power steering pump has two worn vanes that produce a momentary pressure drop at two specific rotational positions, reducing assist at those points — the pressure drops create brief periods of reduced assist that the driver perceives as increased effort at the two points in the steering sweep that correspond to the pump's worn positions

C. The steering gear's internal piston has two worn seal sections that leak at specific positions during the sweep, reducing the hydraulic assist

D. The tie rod ends bind at two specific steering angles that correspond to the increased-effort points in the sweep

103. A heavy-duty truck has a condition where the right front tire consistently runs at a higher temperature than the left front tire. Both tires are the same specification and inflation pressure. The brake adjustment is correct on both sides and neither brake is dragging. What should be investigated?

A. The right front wheel bearing, which if adjusted too tightly generates friction heat that transfers through the hub to the tire

B. The exhaust system routing, which may run closer to the right front tire and radiate heat

C. The right front tire's internal structure, which may have a manufacturing defect that generates more heat during flexing

D. The right front wheel bearing preload — an excessively tight bearing preload generates continuous friction heat as the bearing rolls under load; the heat conducts through the hub to the wheel and tire, raising the right tire's operating temperature above the correctly adjusted left side; the bearing preload must be checked and compared to specification

104. A heavy-duty truck's cab air ride suspension produces a harsh ride that was not present when the truck was new. The cab air springs appear inflated and the ride height is correct. What is the most likely cause?

A. The cab shock absorbers have worn out — the air springs carry the cab's weight and maintain the ride height (both confirmed as correct), but the shock absorbers control the rate of compression and rebound; worn cab shocks cannot dampen the road inputs, and the cab bounces and transmits every bump harshly to the driver; replacing the cab shock absorbers restores the designed ride quality

B. The cab air springs have hardened from age and no longer flex as smoothly as when new

C. The cab tilt latches have loosened, allowing the cab to shift slightly during each bump event

D. The cab's structural mounting points have fatigued, changing the cab's dynamic response to road inputs

105. A transit bus has a condition where the driver's seat produces a hissing noise and slowly sinks when the driver sits in it. The seat eventually reaches its lowest position. What is the most likely cause?

A. The seat height adjustment mechanism has been set to the lowest position and is functioning correctly

B. The seat's air spring is fully inflated but the seat cushion foam has compressed from use and no longer supports the driver's weight

C. The seat's air ride suspension has a leak — the air spring, a fitting, or an air line has a leak that allows the air to escape under the driver's weight; the hissing is the air escaping through the leak point; the seat sinks as the air spring deflates; the leak must be located and repaired, and the air spring recharged

D. The seat's height control valve has failed in the exhaust position, continuously venting air from the air spring

106. A heavy-duty truck's windshield has developed a crack that starts at the edge of the glass and extends approximately 150 mm toward the center. The crack appeared without any apparent impact event. What is the most likely cause?

A. The windshield was manufactured with a stress concentration at the edge that was activated by a thermal event

B. The windshield mounting has a stress point — the windshield is bonded to the cab's opening with a urethane adhesive; if the adhesive was applied unevenly, the cab opening has a dimensional distortion, or the windshield was installed with excessive force at one point, a permanent stress is locked into the glass at the edge; a thermal change (hot sun on one side, cold air conditioning on the other) adds enough additional stress to initiate the crack from the stressed edge

C. The windshield glass has degraded from UV exposure and has become brittle at the edges

D. The cab's structural flex during driving has stressed the windshield beyond its design tolerance

107. A truck's HVAC blower motor has been replaced. After the replacement, the blower works on high speed only — the low and medium speeds produce no air movement. What is the most likely cause?

A. The replacement blower motor is a different model that does not have the internal connections for multi-speed operation

B. The blower motor resistor pack or speed control module was not reconnected during the blower motor replacement

C. The new blower motor's connector is partially seated, providing power only to the high-speed terminal

D. The blower motor resistor pack (which provides reduced voltage for lower speeds) was not reconnected or has failed — the high-speed circuit bypasses the resistor pack and connects the motor directly to full voltage; the low and medium speeds route power through the resistor pack to reduce voltage; if the resistor pack is disconnected, damaged, or has a failed connector, only the high-speed (direct) circuit functions

108. A heavy-duty truck's cab produces a water leak at the rear of the cab that appears only when the truck is driven in heavy rain while traveling at highway speed. The leak does not appear during car wash testing or during stationary rain. What does this driving-condition-specific leak indicate?

A. The leak is caused by the aerodynamic pressure differential at highway speed — the cab's aerodynamic shape creates a low-pressure zone at the rear of the cab during forward movement; this low pressure draws water through seams, gaskets, or sealer gaps at the rear that hold against the positive water pressure of car-wash spray and stationary rain; the driving-specific condition confirms the leak path requires the aerodynamic suction to draw water inward

B. The rain is being channeled from the trailer's nose through the gap between the cab and trailer

C. The roof-mounted air cleaner or exhaust stack has a rain cap that diverts water toward the rear of the cab during forward movement

D. The rear window seal has a small gap that only leaks when the windshield wipers push water over the roof to the rear of the cab

109. A dry van trailer has a condition where the right side wall has developed a noticeable inward bulge approximately halfway between the floor and the roof. The bulge extends approximately 1 metre along the wall's length. What caused this bulge, and what is the consequence?

A. The wall panel has delaminated from its structural supports and is buckling inward from external wind pressure during highway driving

B. An internal cargo shift during transport has pushed the wall inward — the cargo was not properly secured and shifted laterally during a turn or lane change, pressing the wall's thin skin beyond its elastic limit; the permanent bulge reduces the trailer's internal cargo volume, may interfere with future loading, and compromises the wall's structural contribution to the trailer's overall rigidity

C. The trailer's structural posts at that location have corroded and can no longer support the wall panel, allowing it to buckle inward

D. The trailer was loaded with a forklift that struck the interior wall, pushing it outward (the bulge appears inward from the exterior perspective)

110. A trailer's air ride suspension has a condition where one air spring makes a loud popping noise during loading at a dock. The noise occurs when the trailer's weight increases as cargo is loaded. What is the most likely cause?

A. The air spring's upper plate is shifting on its mounting from worn or missing hardware

B. The height control valve is adding air too aggressively during the loading event, creating a pressure surge that pops the spring

C. The air spring's bead is not seated properly on the piston — the bead slips under the increasing load and pops as it re-seats; this indicates the piston surface is corroded, the bead is deteriorating, or the spring was installed without proper seating

D. The air spring's bead is momentarily lifting from the piston surface and re-seating — as the load increases, the spring's bellows compresses and the bead's contact geometry changes; a corroded piston surface, a worn bead, or an improperly seated spring allows the bead to lift and pop back into position; this indicates imminent spring failure

111. A reefer trailer's TRU has a condition where the unit cools the cargo to the setpoint but the defrost cycle activates every 20 minutes instead of the normal 4-6 hour interval. What does the frequent defrost cycling indicate?

A. The evaporator coil is icing rapidly — the TRU's defrost system activates when it detects ice buildup on the evaporator; frequent defrost cycling (every 20 minutes) indicates the coil is icing much faster than normal; the cause could be a low refrigerant charge (the evaporator operates at a colder-than-designed temperature), a failed defrost heater that does not fully clear the ice during each cycle, or excessive moisture infiltration from damaged door seals

B. The defrost timer has been miscalibrated and is triggering at 20-minute intervals instead of the designed 4-6 hour intervals

C. The TRU's compressor is short-cycling and the controller interprets each restart as a defrost trigger

D. The cargo is producing moisture that the TRU must continuously remove through the defrost cycle

112. A trailer equipped with drum brakes has a condition where all brakes on one axle of the tandem have significantly more dust and residue than the other axle's brakes. The brake adjustment is correct on all positions. What could cause the increased dust on one axle?

A. The axle with more dust has a different brake drum material that produces more residue during normal braking

B. The lining compound on the dusty axle is different from the other axle — different compounds produce different amounts of dust during normal operation

C. The axle with more dust has a proportionally higher brake force delivered to it — the relay valve or the air line configuration delivers more pressure to one axle than the other; the higher application force generates more friction, more heat, and more wear debris on the overworked axle

D. The ABS modulator on the dusty axle is cycling more frequently, creating additional pad friction and dust

113. A trailer's structural inspection reveals that several rivets connecting the side panel to the structural posts have sheared. The rivets are in a line approximately 1 metre above the floor. What caused the rivet shearing?

A. The rivets have corroded from exposure to road salt and moisture, weakening them below their shear capacity

B. Cargo loading forces have exceeded the rivet's shear capacity — heavy cargo pressing against the side wall (from shifting during transport or from forklift loading) creates a shear force on the rivets connecting the wall panel to the posts; the rivets at the 1-metre height correspond to the level where the cargo's center of mass applies the most lateral force; the sheared rivets indicate the wall has been overstressed by unsecured cargo

C. The trailer's frame has twisted from an overloading event and the resulting frame distortion has sheared the rivets from the structural movement

D. The rivets were installed with insufficient depth and have pulled through the panel material

114. A trailer equipped with anti-lock brakes has a condition where the ABS lamp stays on continuously after the trailer is connected to the tractor. The scan tool retrieves a fault code for "Modulator Valve 2 — Open Circuit." What does this code indicate?

A. The ABS modulator valve 2 has a seized solenoid that the ABS module cannot energize

B. The modulator valve 2 is physically intact but its wiring has excessive resistance from corrosion

C. The modulator valve 2's power supply fuse has blown, cutting power to all modulator valves

D. The modulator valve 2's electromagnetic coil or its wiring has a break — the ABS module cannot send current through the coil because the circuit is not complete; the module detects the open circuit during its self-test and illuminates the ABS lamp; the break could be in the coil winding itself, the connector, or the wiring between the module and the valve

115. A trailer's landing gear has been found with the crank handle missing. The driver needs to disconnect the trailer at a delivery location. What is the immediate concern?

A. Without the crank handle, the driver cannot lower the landing gear to support the trailer's nose before disconnecting from the tractor — disconnecting the tractor without the landing gear deployed will cause the trailer's nose to drop to the ground, potentially damaging the front crossmember, king pin area, air and electrical connections, and the trailer's structural components; the driver must obtain a replacement handle or an alternative method to extend the gear before disconnecting

B. The missing handle is a minor inconvenience that can be resolved by using a pipe wrench on the gear's input shaft

C. The driver can disconnect the tractor and use the tractor's fifth wheel height adjustment to gently lower the trailer onto the ground

D. The landing gear can be lowered using the trailer's auxiliary air system to extend the gear hydraulically

116. A trailer's conspicuity tape and reflectors are all present and clean, but during a nighttime inspection, the inspector notes that the reflectors on one side are significantly less reflective than the other side. Both sides have the same type of reflectors. What could cause the reduced reflectivity on one side?

A. The reflectors on the less-reflective side have UV-degraded from being on the sun-facing side of the trailer

B. The reflectors are identical but the inspector's viewing angle is different on the two sides

C. The reflectors on the less-reflective side have been exposed to more road spray chemicals (de-icing fluids, diesel exhaust residue) that have hazed or etched the reflector surface — the chemical damage

reduces the reflector's ability to retroreflect light back to its source; the opposite side may be more protected from spray by the vehicle's aerodynamic profile or by a different road-spray pattern

D. The less-reflective side's reflectors are mounted at a slightly different angle from a body panel shift that changes the retroreflection geometry

117. A truck's A/C system has a condition where the system produces cold air from the center vents but warm air from the outer (side) vents. All vents are in the same mode setting. What is the most likely cause?

A. The A/C system has a single evaporator that produces cold air at its outlet, but the duct routing splits to multiple vents

B. The HVAC housing has separate duct pathways for the center and side vents, and the side vent ducts pass through a warm area of the dash or cab structure that heats the air before it reaches the outlets

C. The evaporator has a partial restriction that reduces cooling in the outer sections while the center performs normally

D. The HVAC housing's internal ductwork routes the center vent air directly from the evaporator, while the side vent air passes through a longer path that picks up heat from the cab structure, the dash wiring, or proximity to the heater core — the temperature difference between center and side vents is a design characteristic that can be minimized but not eliminated in many HVAC systems

118. A truck's heater produces a gurgling or bubbling noise from behind the dashboard when the engine is first started. The noise diminishes after approximately 5 minutes. What is the most likely cause?

A. The heater core has a partial internal restriction that creates turbulence in the coolant flow during cold startup

B. Air is trapped in the heater core — when the engine is cold or has been recently serviced, air pockets can become trapped in the heater core (which is often the highest point in the cooling system); the gurgling noise is the trapped air bubbles being displaced by the coolant as the water pump circulates fluid through the core; the noise diminishes as the bubbles work their way out of the core and back to the degas bottle

C. The water pump is cavitating during cold startup from the thicker cold coolant's resistance to flow

D. The heater core's inlet hose has a loose clamp that allows air to be drawn into the coolant stream during pump operation

119. A truck's A/C system has been diagnosed with a restricted condenser. The restriction is caused by internal contamination from a previous compressor failure. What is the correct repair sequence?

A. Replace the condenser, flush the remaining system components, replace the receiver-drier (or accumulator), replace the expansion valve (or orifice tube), evacuate the system, and recharge — the compressor failure introduced metallic debris and degraded oil into the system; the condenser's internal passages are too narrow to flush effectively and must be replaced; all other components must be flushed to remove residual contamination; the drier and expansion device must be replaced because they trap contaminants that cannot be flushed; installing a new compressor without this complete cleaning sequence will result in the new compressor being destroyed by the residual contamination

B. Flush the condenser with approved solvent to remove the contamination, then evacuate and recharge the system

C. Replace only the condenser and the compressor, then evacuate and recharge the system

D. Replace the condenser and receiver-drier, flush the evaporator and lines, and recharge without replacing the expansion device

120. A bus's HVAC system has a condition where the A/C produces cold air adequately but the blower motor produces a burning smell when operated on high speed for extended periods. The blower motor functions normally otherwise. What is the most likely cause?

A. The blower motor's wire gauge is too small for the current draw on high speed, and the wiring overheats

B. The blower motor is overloaded from a restricted airflow path — a clogged cabin air filter, a blocked evaporator, or a closed recirculation door forces the motor to work harder to push air through the restriction; the increased electrical current draw generates excess heat in the motor windings, producing the burning smell; the restricted airflow also means less air passes over the motor to cool it

C. The blower motor's brushes are worn and the electrical arcing between the brushes and commutator produces the burning smell during high-speed operation

D. The blower motor resistor pack is overheating from the high-speed current flowing through it

121. A truck's A/C system has a condition where the compressor clutch engages for 1 second, then disengages for 30 seconds, then engages for 1 second again — cycling very slowly with long off periods. The high-side pressure reads 350 psi (far above the normal 200-250 psi for the ambient temperature). What is the most likely cause?

A. The compressor has an internal fault that generates excessive pressure during the 1-second engagement

B. The condenser fan has failed or the condenser is severely blocked, preventing heat rejection

C. The system has a massive refrigerant overcharge that creates excessive high-side pressure

D. The high-pressure switch is tripping — the condenser is not rejecting heat adequately (from a failed fan, a severely blocked condenser, or an overcharge), causing the discharge pressure to spike above the high-pressure switch's trip point within 1 second of compressor operation; the switch opens, the compressor stops, the pressure slowly bleeds down over 30 seconds, the switch resets, and the cycle repeats

122. A truck's heated windshield washer system has a condition where the fluid heater activates but the fluid does not reach the washer nozzles. The pump runs and fluid is present in the reservoir. What is the most likely cause?

A. The washer pump outlet is connected to the heater inlet, but the heater's outlet is blocked or disconnected from the supply line to the nozzles

B. The heated washer fluid line between the heater element and the nozzles has frozen — the heater warms the fluid at the heating element, but the fluid in the line between the heater and the nozzles has frozen solid from the ambient temperature; the pump builds pressure but cannot push fluid through the frozen line; the heater only warms the fluid at its location, not the entire line

C. The washer pump is running in reverse and pumping fluid back into the reservoir instead of to the nozzles

D. The washer nozzles have clogged with mineral deposits from the washer fluid concentrate

123. A truck's A/C system has been recharged with the correct weight of R-134a refrigerant. The system cools adequately but the compressor cycles off prematurely — the evaporator temperature has not reached the desired setpoint when the compressor disengages. What is the most likely cause?

A. The low-pressure cycling switch has a cut-out setting that is too high — the switch opens (stopping the compressor) before the evaporator pressure drops to the level that corresponds to the desired temperature; the switch setting or calibration must be adjusted so the compressor runs long enough for the evaporator to reach the target temperature before the switch cycles the compressor off

B. The compressor clutch has a weak electromagnetic coil that releases under the higher current draw of extended operation

C. The expansion valve is flooding the evaporator with excessive refrigerant, dropping the pressure too quickly

D. The condenser is overcooling the high-side refrigerant, causing the low-side pressure to drop prematurely

124. A hydraulic system on a utility truck has a condition where the boom functions normally during the first 2 hours of operation, but after 2 hours, all functions slow down progressively. After a 30-minute rest period, the functions return to normal speed for another 2 hours. What is the most likely cause?

A. The system is experiencing a progressive temperature increase that causes the fluid to thin and leak past worn internal components

B. The hydraulic pump has a thermal-dependent internal bypass that worsens as the pump heats during operation

C. The hydraulic fluid is overheating — after 2 hours of operation, the fluid temperature rises beyond the point where its viscosity can maintain adequate sealing at the pump's internal clearances; the thinned hot oil leaks past the pump's worn clearances, reducing the effective output; the 30-minute rest allows the fluid to cool, the viscosity increases, the internal leakage decreases, and the pump's output returns to normal

D. The directional valve spools are expanding from the heat and binding in their bores, restricting flow to all circuits

125. A hydraulic crane has a condition where the boom lift cylinder drifts downward approximately 10 mm per minute while holding a 5,000 kg load. The technician isolates the cylinder from the directional valve by plugging the cylinder ports. With the ports plugged, the drift stops completely. What has this test confirmed?

A. The cylinder's piston seal is intact because the drift stopped when the valve was isolated

B. The holding valve (counterbalance valve or pilot-operated check valve) between the cylinder and the directional valve is leaking

C. The directional valve is not the leak source because the drift stopped when the valve was isolated

D. The directional valve has internal spool leakage — plugging the cylinder ports eliminated the leak path through the valve; the cylinder's piston seal is confirmed as intact because the drift stopped with the ports plugged; the valve is leaking fluid from the cylinder's pressurized work port, across the spool's internal clearance, to the tank return port; the valve must be rebuilt or replaced

126. A hydraulic system uses a gear pump driven by the vehicle's PTO. The pump produces the correct flow at idle but the flow does not increase proportionally when the engine RPM is increased to operating speed. What is the most likely cause?

A. The PTO gear ratio is correct but the pump's internal relief valve is bypassing the additional flow at higher RPM

B. The gear pump has significant internal wear — at idle, the pump produces its rated flow because the internal leakage is a small percentage of the total output; at higher RPM, the pump should produce proportionally more flow, but the worn internal clearances allow more fluid to bypass internally; the increased bypass at higher RPM means the net output does not increase proportionally with speed

C. The suction line is restricted and cannot supply adequate fluid to the pump at the higher flow demand of operating speed

D. The pump's drive coupling is slipping at higher RPM, preventing the pump from reaching the expected rotational speed

127. A hydraulic system has a condition where the pump makes a chattering noise that varies with system pressure. The noise is loudest when the system is at relief pressure and quietest when no functions are commanded. What is the most likely cause?

A. The pump's relief valve is chattering at its set point, producing the pressure-dependent noise — the relief valve's poppet opens and closes rapidly as the system pressure oscillates around the relief setting; the chattering is loudest at relief pressure because the valve is actively cycling, and quietest at standby

because the valve is fully closed; a contaminated seat, worn poppet, or incorrect spring causes the unstable behavior

B. The pump's internal gears have excessive backlash that produces noise proportional to the pressure loading on the gear teeth

C. The pump's mounting bolts have loosened and the pump shifts position under the higher torque demand of relief pressure operation

D. The suction strainer is partially clogged, and the pump cavitates more severely as the system pressure increases and demands more flow

128. A hydraulic crane's telescope cylinder has been replaced. After the replacement, the boom telescope extends to its designed full length but the operator notices the extension rate is significantly faster than the retraction rate. The original cylinder had approximately equal extend and retract speeds. What is the most likely cause?

A. The replacement cylinder has a different bore-to-rod ratio than the original — the cap-end area (extend side) and the rod-end area (retract side) of a cylinder determine the extend and retract speeds at a given flow rate; a larger rod diameter on the replacement cylinder reduces the rod-end area, requiring the same volume of fluid to fill a smaller space; the retract speed decreases because the smaller area produces a larger pressure drop at the same flow rate

B. The replacement cylinder's internal cushions are restricting the retraction speed

C. The directional valve's spool has different metering characteristics for the extend and retract directions

D. The replacement cylinder has a different bore-to-rod ratio — the larger rod on the replacement cylinder reduces the rod-end area, which means more pressure is needed to retract at the same speed; at the system's flow rate, the retract side receives the same flow but must push against a higher pressure differential to move the heavier load, resulting in slower retraction; the original cylinder's rod size was designed to provide balanced speeds

129. A hydraulic system on a dump truck has a condition where the dump body raises normally but continues to drift upward slowly after the control lever is returned to neutral. What is the most likely cause?

A. The directional valve's spool is not fully returning to the neutral position — contamination, a weak centering spring, or a mechanical interference prevents the spool from centering completely; the spool remains slightly open on the extend side, allowing a small flow to continue reaching the lift cylinder even in the "neutral" position; the body continues to drift upward at a slow rate

B. The dump cylinder has an internal check valve that is stuck open, allowing pressurized fluid to continue entering the cap end

C. The hydraulic pump's check valve is stuck open, continuously pressurizing the lift circuit even in standby

D. The dump body's weight is insufficient to hold the cylinder in position against the residual system pressure

130. A hydraulic system's filter has a bypass indicator that activates during cold morning startups but resets after 10 minutes of operation. Is this normal?

A. Yes, this is normal cold-start behavior — hydraulic fluid's viscosity increases significantly at cold temperatures, increasing the pressure drop across the filter element; the thicker cold oil creates enough differential pressure to trigger the bypass indicator; as the system warms and the fluid thins to operating viscosity, the pressure drop decreases below the indicator's threshold and it resets; this is a designed-in behavior and does not indicate a filter problem

B. No, this indicates the filter element is partially clogged and the cold oil's higher viscosity is enough to trigger the bypass

C. No, this indicates the bypass indicator spring has weakened and is triggering at too low a pressure differential

D. Yes, but only if the fluid temperature is below −10°C; at temperatures above −10°C, the cold-start bypass indicates a filter problem

131. A hydraulic system on an aerial lift has a condition where the boom functions all operate but the emergency lowering valve produces no boom movement when activated. The emergency lowering valve is a manual override that allows the boom to be lowered if the hydraulic pump fails. What is the most likely cause?

A. The emergency lowering valve's internal passages have corroded or become blocked from lack of use — the valve sits unused for the life of the system until an emergency occurs; corrosion, contamination, or crystallized hydraulic fluid can block the valve's internal passages, preventing it from functioning when needed; the emergency valve must be tested periodically to ensure it functions

B. The emergency lowering valve requires system pressure to operate, and since the pump has not failed, the system pressure is holding the boom in position through the normal circuit

C. The emergency lowering valve is a normally-closed device that requires electrical power to open, and the power supply to the valve has a blown fuse

D. The boom's counterbalance valve is preventing flow in the lowering direction regardless of whether the emergency valve is open

132. A battery electric transit bus has a condition where the vehicle's range decreases dramatically (by 30-40%) during winter operation compared to summer operation. The battery SOH has not changed. What is the primary cause of the winter range reduction?

A. The battery's chemical reaction rate decreases at cold temperatures, reducing the energy the cells can deliver

B. The tire rolling resistance increases on cold pavement from the harder rubber compound at low temperatures

C. The regenerative braking is less effective on cold, potentially icy roads because the traction control limits the regenerative force

D. The battery's chemical reaction rate decreases at cold temperatures and the HVAC system consumes a significant portion of the battery's energy for cabin heating — unlike an ICE vehicle that uses waste engine heat for cabin heating, a BEV must use electrical energy (resistance heaters or a heat pump) to heat the cabin; the combined effect of reduced battery capacity from cold chemistry and the high energy demand of electric cabin heating produces the 30-40% winter range reduction

133. A hybrid electric truck has a condition where the high-voltage battery cooling system shows adequate coolant flow and correct coolant temperature, but the BMS reports that several cells in one module are consistently 10°C warmer than the adjacent modules. What does this localized temperature difference indicate?

A. The cells in the warmer module have higher internal resistance from degradation — the increased resistance generates more I^2R (resistive) heating during charge and discharge; the thermal management system cools all modules equally, but the warmer module produces more heat from its degraded cells; the temperature difference will increase as the degradation progresses

B. The cooling circuit for the warm module has a partial restriction that reduces coolant flow to that specific location

C. The warmer module's temperature sensor is reading higher than actual from a sensor calibration drift

D. The warm module is positioned closer to the vehicle's exhaust system and absorbs radiant heat from the exhaust

134. A technician is measuring the insulation resistance of a battery electric truck's high-voltage system. The measurement reads 50 kilohms. The minimum specification is 500 ohms per volt of system voltage (for a 400V system, this equals 200 kilohms). Does the system pass?

A. The system fails the insulation resistance test — the measured 50 kilohms is below the calculated minimum of 200 kilohms (500 ohms × 400V); the low insulation resistance indicates a current path is developing between the high-voltage system and the vehicle chassis through degraded insulation, moisture intrusion, or contamination; this fault creates a shock hazard and must be located and repaired before the vehicle operates

B. The system passes because 50 kilohms is adequate resistance to prevent dangerous current flow

C. The insulation resistance cannot be evaluated without knowing the specific cable length and temperature

D. The system passes because the 500 ohms per volt specification applies only to the battery pack, not the entire high-voltage system

135. A battery electric delivery truck has a condition where the vehicle produces a high-pitched whine from the drivetrain during acceleration that increases in pitch with vehicle speed. The whine is not present during coasting or regenerative braking. What is the most likely cause?

A. The high-pitched whine during acceleration is the normal operating sound of the traction motor and its reduction gear — electric motors produce a characteristic high-frequency whine from the electromagnetic forces between the rotor and stator during power delivery; the pitch increases with

motor speed (which increases with vehicle speed during acceleration); during coasting and regeneration, the motor operates in a different mode with different electromagnetic characteristics that produce a different (or no) sound

B. The traction motor's rotor has developed an imbalance that produces a speed-proportional whine during the torque delivery of acceleration — the imbalance produces vibration only when the motor is under the electromagnetic load of acceleration; during coasting and regeneration, the reduced or reversed electromagnetic forces do not excite the imbalance

C. The reduction gearbox has worn teeth that produce a whine during the drive-side loading of acceleration but not during the coast-side loading of deceleration

D. The inverter's power electronics produce an audible switching frequency during acceleration that is not present during the reduced power demand of coasting

Practice Exam 14: Answer Key and Explanations

1. B — Excessive steering free play (90 mm versus the 50 mm maximum) creates a delayed steering response that increases the risk of losing directional control, particularly during emergency maneuvers or at highway speeds. The truck must be returned to the shop immediately using the most direct, lowest-traffic route. Continuing the road test or driving at speed with this condition endangers the technician and other road users.

2. D — Ethylene glycol antifreeze is extremely toxic to animals. Its sweet taste actively attracts cats and dogs, but as little as one tablespoon can cause irreversible kidney failure and death within hours if untreated. Any coolant spill must be cleaned up immediately and animals must be kept away from the work area.

3. C — Duct tape is not an approved repair for compressed air fittings. The tape can fail suddenly under air pressure, releasing the fitting and creating a whipping hose hazard. Compressed air can also penetrate skin through gaps in the tape. The fitting must be tightened or replaced with the correct thread sealant to provide a safe, permanent seal.

4. A — An open parts washer cover allows mineral spirits to evaporate continuously, releasing flammable vapors into the shop air. The accumulated vapors can reach flammable concentrations near the washer, creating an explosion and fire hazard from any ignition source (spark, open flame, or hot surface). The chronic inhalation of solvent vapors also presents a health hazard to all shop personnel.

5. B — Brake dust from older vehicles may contain asbestos fibers. Blowing with compressed air disperses these microscopic fibers into the shop air where they can be inhaled by anyone in the area, causing mesothelioma and asbestosis. Even non-asbestos brake dust contains harmful metallic and friction material compounds. Wet cleaning methods or HEPA-filtered vacuum systems must be used instead of compressed air.

6. D — DEF (32.5% urea solution) is corrosive to aluminum, copper, carbon steel, and many common metals. It damages painted surfaces, electrical connectors, and flooring if spilled. DEF must be stored in approved containers (polyethylene or stainless steel), cleaned up immediately if spilled, and kept separate from other automotive fluids to prevent cross-contamination that would render the DEF unusable.

7. C — A rotating suspended load creates a crushing hazard between the load and any adjacent structure. The transmission's mass generates enough rotational momentum that a technician cannot safely stop it by hand. If a hand is caught between the rotating transmission and the frame rail or engine, the crushing force can cause severe injury. A tag line should be attached to control the load's rotation from a safe distance.

8. A — Battery charging produces hydrogen gas (explosive) and the batteries contain sulfuric acid. A splash of acid to the eyes requires immediate flushing within seconds to prevent permanent vision loss. The eye wash station is a regulatory-required safety device that must be accessible and functional at all times when acid-containing batteries are being serviced. The charging area must be shut down until the eye wash is restored.

9. D — At cold startup, the injector's internal clearances are tight from thermal contraction, and the injector seals adequately. As the injector heats during 30 minutes of idle operation, the clearances open from thermal expansion and fuel begins to leak past the internal seals. The progressive leak reduces that cylinder's fuel delivery incrementally, producing the gradually worsening misfire. No fault code is set because the leak is within the ECM's tolerance range.

10. A — Coolant leaking through the EGR cooler into the intake system carries minerals, metals, and coolant additive compounds that deposit on the intake manifold runners, intake ports, and intake valve surfaces. Over a month of continuous leaking, these deposits progressively restrict the airflow to the cylinders, reducing the engine's volumetric efficiency and contributing to the gradual power loss.

11. C — Both banks show similar EGT sensor readings, but one manifold glows visibly. The glowing manifold has a localized hot spot — from a restriction, a crack, or a dead pocket that traps exhaust gas in

a section not monitored by the EGT sensor. The sensor reads the average temperature of the combined gas flow downstream, which appears normal, while the localized section reaches temperatures high enough to produce visible glow.

12. B — The downstream NOx reading should always be lower than upstream if the SCR is converting NOx. A reversed reading (downstream higher) indicates the SCR system is producing NOx from ammonia slip — excess ammonia from over-dosing DEF passes through the SCR and encounters the downstream oxidation catalyst, which converts the ammonia to NOx. The DEF dosing rate must be corrected.

13. D — The wastegate actuator motor draws excessive current because it is working against a mechanical obstruction it cannot overcome. A seized, jammed, or obstructed wastegate linkage or valve prevents the actuator from moving the wastegate to the commanded position. The ECM detects the overcurrent condition and sets the fault code. The derate protects both the actuator motor and the engine from damage.

14. A — A high-pitched shriek from the turbocharger area that varies with engine speed after a turbocharger replacement indicates pressurized air escaping through a leak at the compressor outlet connection. The boost air escaping through a gasket gap, a loose V-band clamp, or a misaligned pipe connection produces the shriek. The noise varies with RPM because the boost pressure and airflow velocity increase with engine speed.

15. C — A load-dependent knock on a specific cylinder confirmed by injector cut-out indicates a mechanical fault that is excited by combustion pressure. Under heavy load, the higher cylinder pressures amplify the knock from a worn connecting rod bearing, worn piston pin, or cracked piston. At idle and light load, the reduced combustion force is insufficient to drive the worn component hard enough to produce audible noise.

16. B — Silicon and aluminum appearing together indicate dirt ingestion (silicon from soil) is causing abrasive wear on aluminum engine components (pistons, bearing overlays, or other aluminum-alloy parts). The dirt entered the engine through a breach in the air intake system — a cracked duct, loose clamp, damaged air filter, or missing gasket. The intake system must be inspected and the breach repaired immediately.

17. D — The DPF reaches the correct regeneration temperature (600°C) but the soot does not burn. The most likely cause is contamination of the soot layer with substances that raise the ignition temperature beyond achievable levels. Coolant contamination (from an EGR cooler leak or head gasket seep) forms

calcium sulfate deposits that cannot oxidize at 600°C. Alternatively, the DPF substrate may have cracked internally, allowing exhaust to bypass the soot-laden channels.

18. A — A thermostat installed backward senses the cooled radiator temperature instead of the hot engine temperature. When the thermostat's sensing element contacts the cool radiator coolant, it closes. The closed thermostat traps hot engine coolant, which heats the sensing element through conduction, the valve opens, cool coolant flows in, and the cycle repeats rapidly. The rapid cycling produces the temperature oscillation between 78°C and 95°C.

19. C — During cranking, each cylinder creates resistance that decelerates the crankshaft as the piston compresses the air. A cylinder with reduced compression (from worn rings, a leaking valve, or a head gasket breach) creates less resistance. The crankshaft decelerates less during that cylinder's compression stroke, producing the lower contribution value in the relative compression test.

20. B — The VGT actuator is hunting — it receives a PWM signal commanding a specific vane position but cannot achieve the exact position due to friction, linkage play, or calibration error. The actuator oscillates rapidly around the target position, alternately overshooting and undershooting the commanded angle. The rapid cycling produces the chattering noise as the actuator continually corrects its position.

21. D — A 15% fuel consumption increase without power loss or fault codes requires investigating multiple potential sources systematically. The engine produces full power (ruling out engine deficiency), so the increased consumption is from elevated parasitic loads (air compressor, fan, alternator), tire pressure losses, alignment issues, or a measurement/record-keeping error. A systematic evaluation of all variables identifies the contributor.

22. A — The oil pressure relief valve is chattering at its set point. The valve opens at 45 psi, the pressure drops to 35 psi, the valve closes, the pump rebuilds to 45 psi, and the cycle repeats at 2 Hz. A worn valve seat, contaminated seat surface, or incorrect spring allows the valve to cycle rapidly instead of modulating smoothly at a stable set point.

23. C — Reduced EGR cooler efficiency means the cooler cannot cool the recirculated exhaust gas as effectively. The hotter gas enters the intake manifold at a higher temperature than designed, reducing the EGR's NOx suppression effectiveness. The ECM compensates by increasing the EGR flow rate, which further reduces the fresh air available for combustion and can increase soot production.

24. B — Exhaust system V-band clamps undergo significant thermal expansion and contraction during each heating and cooling cycle. The clamp material is repeatedly stressed as the joint expands at regeneration temperatures (600°C+) and contracts at ambient temperature. This thermal fatigue progressively work-hardens and embrittles the clamp material until it cracks. This is a common failure mode for DPF-downstream exhaust clamps.

25. A — The lower DEF concentration (28% versus the specified 32.5%) delivers less urea per unit of DEF injected. The SCR catalyst receives less ammonia than the ECM's dosing algorithm expects, reducing the NOx conversion efficiency. The ECM will attempt to compensate by increasing the dosing rate, but if the target cannot be met, a fault code and progressive derate timer will be initiated.

26. D — Alternating strong and weak exhaust pulses at the tailpipe indicate a cylinder-to-cylinder imbalance in exhaust output. The weak pulses come from cylinders producing less combustion pressure (from low compression, weak injection, or late timing). The strong pulses come from normally functioning cylinders. The difference creates the alternating pattern that can be felt at the tailpipe.

27. B — A restricted oil drain line prevents oil from flowing freely from the turbocharger's center housing back to the crankcase. The trapped oil builds pressure around the shaft seals, pushing oil past the compressor-side seal (into the intake) and the turbine-side seal (into the exhaust). The turbocharger functions because the bearing receives adequate supply pressure, but the seals are overwhelmed by the drain-side backpressure.

28. C — The radiator cap's vacuum valve should open during coolant cooling to allow air in and prevent vacuum buildup. If the vacuum valve is stuck closed, the coolant contraction during highway driving creates a vacuum inside the system. The atmospheric pressure outside the upper radiator hose exceeds the reduced internal pressure, and the hose collapses. The hose reinflates when the system is depressurized or the engine is shut off.

29. A — A steady tick once per crankshaft revolution from the front of the engine that does not change with temperature or load is characteristic of a cracked flexplate or flywheel. The crack opens and closes as it passes through the torsional stress cycle once per revolution. The noise is constant regardless of operating conditions because the crack is a structural defect, not a thermal or load-dependent phenomenon.

30. D — The first hard stop generates significant friction heat that thermally expands the brake drums. The expanded drums move the friction surface away from the shoes, increasing the running clearance. Subsequent stops within a 1-minute period have reduced effectiveness because the shoes must travel

further to contact the expanded drums. The automatic slack adjusters cannot compensate for thermal expansion during this brief interval.

31. B — Three months of outdoor storage allowed corrosion to develop on the trailer's ABS wheel speed sensor connections. The corroded connections produced high resistance that the initial self-test detected as a fault. Driving for 30 minutes generated enough heat from brake proximity and vibration to temporarily improve the corroded connections, allowing the ABS to pass its continuous monitoring and clear the lamp.

32. C — In a duo-servo drum brake system, the leading shoe is self-energizing — the drum's rotation pushes the shoe into the drum, amplifying its braking force. The trailing shoe is de-energized — rotation pushes it away from the drum. The leading shoe performs approximately 70% of the braking work and wears proportionally faster. The 100%-to-50% differential indicates the brakes were not serviced when the leading shoe reached minimum.

33. A — The governor sends separate signals to the compressor unloader and the air dryer purge valve. The compressor unloads correctly (confirming its signal line is intact), but the purge valve does not open because its separate signal line is disconnected, kinked, or plugged. The signal line between the governor and the air dryer must be inspected for integrity.

34. D — Both pad sets lasted dramatically different intervals (25,000 km versus 80,000 km) with the same compound. The caliper slide mechanism (seized guide pins) or caliper piston retraction (swollen seals from fluid contamination) keeps the pads in continuous contact with the rotors. The constant drag wears the pads at 3-4 times the normal rate regardless of the friction compound used.

35. B — The air compressor is lubricated by engine oil, and worn compressor piston rings allow oil to pass into the compressed air stream. The oil travels through the discharge line, through the air dryer (which may not fully capture it), and into the wet tank. The oil accumulates in the tank and is drained with the water condensate during the daily drain procedure.

36. C — Each hard stop adds heat to the brake drums. As the drum temperature rises, two effects combine: the friction material's coefficient of friction decreases (thermal fade), and the drums expand thermally (moving the friction surface away from the shoes). Both effects progressively increase the stopping distance with each subsequent application during the fade test.

37. A — The low-pressure warning switch should activate at approximately 60 psi, but a faulty switch with a drifted activation point may respond to normal pressure fluctuations during brake applications at a much higher threshold. The switch activates during each application-induced pressure dip (which may momentarily drop from 110 psi to 95 psi at the switch's location) and resets when the pressure recovers.

38. D — New brake shoes have not yet conformed to the drum's surface contour. During the initial bedding period, the shoes contact the drum at isolated high spots, creating concentrated friction points that produce sharp, uneven braking. As the shoes bed into the drum surface over the first 100-200 km, the contact area increases progressively and the braking becomes smooth and proportional.

39. B — The tractor protection valve's internal spring holds the valve open against the pressure dynamics of normal operation. A weakened spring from fatigue cannot resist the pressure differential created during a hard brake application's high-flow demand. The momentary differential overcomes the weak spring and the valve closes briefly. When the application ends and the pressure stabilizes, the valve reopens.

40. C — The pushrod stroke of 55 mm exceeds the 51 mm maximum for vehicles equipped with automatic slack adjusters. The automatic adjuster specification (51 mm) is more restrictive than the manual adjuster specification (57 mm) because a properly functioning ASA should maintain a tighter adjustment range. The 55 mm stroke indicates the ASA has failed to maintain correct adjustment, and the root cause must be identified.

41. A — The air compressor is passing excessive oil that coats the desiccant beads. The oil film blocks the moisture-absorbing surfaces, preventing the desiccant from functioning. The desiccant saturates within 2 weeks because its effective capacity is drastically reduced. The compressor must be evaluated for worn piston rings, and the desiccant cartridge must be replaced after the oil source is corrected.

42. D — The ABS module receives an erratic wheel speed signal from the left rear sensor that mimics an impending lockup condition during every application. A damaged reluctor ring (missing teeth, accumulated debris), an incorrect sensor air gap, or a deteriorating sensor element produces signal characteristics that the module interprets as rapid wheel deceleration, triggering modulation during normal stops.

43. B — On many heavy-duty trucks, the steer axle uses smaller brake chambers (Type 20 or 24) while the drive axles use larger chambers (Type 30 or 36). The smaller effective diaphragm area produces proportionally less force at the same air pressure. This proportioning is designed to match the front-to-rear weight distribution. If incorrect, it produces inadequate front braking.

44. C — The parking brake valve's internal mechanism has corroded, become contaminated, or has a damaged O-ring that creates friction within the valve body. The increased internal resistance makes the handle difficult to move. A stiff valve may not apply the parking brakes fully during an emergency when rapid application is needed. The valve should be replaced.

45. A — Out-of-round brake drums contact the shoes at varying intensity during each revolution — tight contact at the high spots and loose contact at the low spots. This creates a once-per-revolution force variation that the driver feels as a pedal pulsation. The pulsation frequency slows proportionally with the wheel speed during deceleration, confirming the source is at the wheel, not upstream.

46. D — The regulatory specification measures build-up time specifically from 50 to 90 psi (or 85 to 100 psi depending on jurisdiction) at governed RPM. The 3:15 measurement exceeds the 3-minute maximum for this specific segment. The fast overall build-up is misleading because the 0-50 psi range builds quickly against little system resistance, but the 50-90 psi range reveals the compressor's true capacity under loaded system conditions.

47. B — The scan tool connects to the vehicle through the diagnostic connector (DLC). If the DLC has no power (blown fuse), no ground (corroded pin), or damaged CAN bus data pins, the scan tool cannot communicate with any module on the vehicle. The DLC fuse, ground integrity, and pin condition should be checked before investigating the CAN bus backbone itself.

48. C — A healthy alternator should maintain its regulated voltage within 0.5V up to its rated capacity. The voltage drop from 14.2V to 13.1V at full load confirms the alternator cannot maintain its regulated output at maximum demand. The output is limited by a weak stator winding, worn brushes, or a failed rectifier diode that reduces the alternator's current capacity below its rating.

49. A — The right turn signal circuit has a ground fault. The signal power finds ground through the marker light filaments instead of its designed ground path. The current flows backward through the marker lights, making them flash in sync with the turn signal. The left turn signal uses a separate circuit with a functional ground, so no backfeed occurs on that side.

50. D — The alternator's AC ripple is superimposed on the DC output. At idle, the lower rotational speed produces more AC ripple. LEDs respond instantly to voltage changes (unlike incandescent bulbs that have thermal inertia to smooth fluctuations). The LEDs flicker with each AC ripple cycle. A standard multimeter reads the average DC voltage and cannot detect the high-frequency AC component.

51. B — During a hard right turn, centrifugal force pushes the oil to the left side of the oil pan. The oil pickup tube is positioned near the center or right side, and the oil mass shifts away from the pickup. The tube momentarily draws air instead of oil, the pressure drops, and the warning lamp illuminates. When the truck straightens, the oil covers the pickup and pressure returns.

52. C — The ECM and TCM communicate correctly (confirmed by the scan tool), but the instrument cluster periodically shows the wrong gear. The CAN bus has intermittent data corruption between the TCM and the cluster — from electrical noise, a marginal connector, or a damaged wire section. The corrupted data appears as incorrect gear position on the display.

53. A — Battery voltage (12.6V) confirms charge state but not the battery's ability to deliver high cranking current. Sulfated, cracked, or degraded plates may hold 12.6V as a surface charge but collapse under the starter motor's heavy current demand. A load test or conductance test measures the battery's actual ability to deliver the cranking amps needed for starting.

54. D — Dual APP sensors are designed with different voltage ranges and/or slopes. The ECM monitors the mathematical relationship between the two signals (ratio, offset, or slope) to verify they track together correctly. If the relationship deviates from the expected correlation, the ECM sets a fault code. The specific voltage ranges are manufacturer-dependent and the different ranges shown are normal.

55. D — The wiper motor's park circuit keeps the motor running after the main switch is turned off until the wipers reach the park position. The park switch is designed to open at the park position, stopping the motor. If the park switch has failed in the open position, the motor stops immediately when the main switch opens because the park circuit cannot maintain power to complete the sweep to the park position.

56. B — A whining noise from inside the alternator housing that varies with RPM is characteristic of worn internal bearings. The worn bearings allow the rotor to vibrate within the enlarged clearance, producing the speed-proportional whine. The alternator may continue charging temporarily, but the bearing wear will progress to eventual seizure or catastrophic failure.

57. C — The speed signal reads 85 km/h (matching the actual speed), but the ECM compares the speed against other data sources. Based on the engine RPM, the transmission's current gear ratio, and the known tire size, the ECM calculates what the speed should be. If the calculated speed does not match the reported 85 km/h, the ECM flags the discrepancy as "implausible."

58. A — The right rear stop light is dim compared to the left despite identical bulbs. A high-resistance connection in the right stop light circuit (corroded socket, deteriorated ground, or partially broken wire) reduces the current through the right bulb. The reduced current produces less light output. The tail light and turn signal functions may use separate circuit paths that are unaffected.

59. D — The yaw rate sensor and lateral accelerometer are used exclusively by the ESC system, not by ABS. A faulty yaw rate sensor or lateral accelerometer that reports vehicle rotation or lateral movement during straight-line braking triggers ESC intervention. The ABS system relies only on wheel speed sensors for its lockup detection and does not respond to yaw or lateral acceleration data.

60. B — All audible warnings (low-air, door-ajar, seatbelt) are typically produced by a single chime module or piezo buzzer. If this unit has failed, lost power, or lost its ground, all audible warnings are silent. The visual warning lamps use separate output circuits from the BCM and continue to function independently of the audio system.

61. C — The CAN bus uses two 120-ohm termination resistors at each end of the bus. In parallel, they measure 60 ohms. A reading of 120 ohms means only one resistor is in the circuit — the other has failed (open circuit). The bus may still function but with increased susceptibility to signal reflections and data errors, particularly during high bus utilization.

62. B — The fuel sender's electrical connector has a loose or corroded pin that momentarily loses contact during the bump's vibration. The open circuit produces a momentary empty reading until the vibration stops and the pin re-seats. The fuel sender's mechanical float is not the issue because the empty reading occurs instantaneously (electrical) rather than progressively (mechanical).

63. D — The coolant temperature sender or its wiring has an intermittent fault that briefly produces a signal the gauge interprets as maximum temperature. The sender's internal element may have a thermal crack, or the signal wire may momentarily contact a voltage source. The scan tool reads the correct temperature from the ECM's separate sensor, confirming the gauge sender circuit is the fault location.

64. B — The ambient light sensor tells the BCM whether it is day or night. An intermittent fault momentarily reports "night" conditions during daytime, causing the BCM to switch from DRL mode (reduced brightness) to full headlight mode. When the sensor recovers, the BCM returns to DRL. The intermittent sensor explains the sporadic full-brightness events.

65. A — The fuel rail has pressure, the crankshaft and camshaft sensors provide timing references, and the engine cranks normally. Despite having all the information needed for injection timing, the ECM is not commanding the injectors to fire. Possible causes include a security/immobilizer lockout, a faulty ECM relay cutting power to injector drivers, or a disabled injection output from a severe internal fault condition.

66. B — The telematics system counts all time the engine runs with zero vehicle speed as idle time. This includes time the driver does not perceive as "idling" — waiting at traffic lights, queuing at drive-throughs, loading/unloading with the engine running, warming up, and cooling down. These brief events accumulate to significantly more total idle time than the driver's perception of intentional idling.

67. D — If the ECM and TCM communicate on a private CAN bus (separate from the main J1939 bus), the private bus wiring, connectors, or termination may have an intermittent fault affecting only those two modules. If they share the main bus, the fault is in the bus segment between their connection points. All other modules communicate continuously because they are connected to unaffected segments.

68. B — The speedometer displays correctly (confirming the cluster receives valid speed data), but the odometer does not increment. The cluster's internal non-volatile memory for the odometer function has failed. The memory circuit that accumulates and stores the distance cannot increment or retain the value. The cluster must be repaired or replaced, with the odometer reading restored from the ECM's backup distance counter.

69. C — The clutch functions correctly (confirmed by no-creep test) and the external linkage may move freely. The internal shift mechanism has jammed — a broken shift fork, seized shift rail, jammed detent ball, or broken component inside the transmission prevents the shift rails from responding to the lever's input. The clutch and external linkage are eliminated as causes, isolating the fault to the transmission's internal mechanism.

70. A — The TCM commands lockup simultaneously with the 3-4 shift. The lockup apply pressure arrives before the 4th gear clutch is fully engaged, and the partial engagement produces a speed fluctuation. The lockup clutch cannot hold against this fluctuation, slips, releases, and re-engages. The shudder occurs during the overlap between the gear change and lockup engagement. Once 4th gear is fully engaged, the lockup holds cleanly.

71. D — As the clutch disc's friction material wears thinner, the pressure plate moves closer to the flywheel. This moves the release bearing's contact point closer to the diaphragm spring fingers. The

reduced gap between the bearing and the fingers directly decreases the pedal free play. The decreasing free play trend correlates with the disc wear rate and serves as an indicator of remaining disc life.

72. B — The shift does not occur during some acceleration events but the TCM shows no codes and the manual override works. An intermittent throttle position sensor signal momentarily drops to zero, and the TCM interprets the signal loss as "no throttle." The TCM adjusts the shift schedule accordingly, delaying the 3-4 shift. Manual gear selection bypasses the normal shift schedule.

73. C — The vibration is present only in high range and is speed-proportional. The high-range gear set has a worn bearing, damaged tooth, or misaligned mesh that produces vibration at the specific rotational speed of the high-range components. The low-range gear set uses different components that are unaffected. The vibration increases with speed because the gear mesh frequency increases with output shaft speed.

74. A — Frequent temperature cycling between operating temperature and cold ambient causes moisture to condense inside the transmission housing. The water mixes with the oil and creates the milky grey emulsion. Short trips that do not heat the oil sufficiently to evaporate the accumulated moisture accelerate the contamination. A blocked or poorly positioned breather can worsen the condition.

75. D — The ring and pinion gear noise is present only during deceleration, confirming the coast side of the gear teeth is the noise source. During deceleration, the gear loading reverses and the coast side carries the load. Wear, incorrect backlash, or incorrect pinion depth has produced a coast-side contact pattern that generates the whine. The drive side (loaded during acceleration) has a different, quiet contact.

76. B — The AMT's clutch actuator should progressively re-engage the clutch after the gear change to smoothly transfer torque. If the actuator applies the clutch instantaneously (from a failed position sensor, a hydraulic valve fault, or a clutch learn error), the full engine torque hits the drivetrain as a sudden impact. The faster-than-normal shift time is a symptom of the missing progressive engagement.

77. A — The driveshaft has a balance or runout issue that produces a vibration proportional to speed. The perception of increasing vibration during deceleration is because engine noise and road noise decrease while the driveshaft vibration remains constant — it becomes more noticeable in the quieter environment. Below 20 km/h, the driveshaft speed drops below the threshold where the imbalance produces perceptible vibration.

78. C — The forward clutch pack has excessive clearance. The apply piston travels further than designed before the clutch plates contact. During this delay, the engine's idle torque spins the converter turbine, and when the clutch finally engages, the speed difference between the spinning input and the stationary output produces the clunk. The reverse clutch may have different clearance characteristics that engage more smoothly.

79. D — The clutch hydraulic system has a restriction in the return path. The master cylinder's compensating port may be partially blocked, the hydraulic line may have a collapse or restriction, or the slave cylinder seal may be creating excessive drag. The restriction slows the fluid's return flow, which slows the master cylinder piston's return, which slows the pedal's return to its rest position.

80. B — The inter-axle lock collar is bound by driveline torque. The collar engaged while the wheels were turning at different speeds during off-road operation. Residual torque from the driveline holds the collar in the engaged position. The driver must relieve the torque by stopping, shifting to neutral, and rocking the vehicle to allow the collar to disengage.

81. A — The transmission loses 1 litre per month with no visible external drip. The rear seal may be leaking oil into the driveshaft yoke area where it is flung by rotation along the undercarriage in an untraceable pattern. The front (input shaft) seal may leak into the bell housing where the oil mixes with clutch dust and adheres to internal surfaces without dripping. Both internal leak paths are difficult to detect visually.

82. C — The transmission was not filled to the correct level after the service. The low fluid level allows the pump to draw air, which compresses in the clutch apply circuit and delays the engagement. The 2-3 second delay is the time needed for the pump to purge the air and build adequate pressure. The level must be checked at operating temperature in Neutral per the manufacturer's procedure.

83. A — The unequal U-joint angles (2° front, 5° rear) are a 3-degree difference. For a single-piece driveshaft, the front and rear angles must be equal within approximately 1 degree so the speed fluctuations cancel between the two joints. The 3-degree difference means the fluctuations are additive instead of canceling, producing a vibration at twice per revolution.

84. D — As the clutch disc wears thinner, the pressure plate moves closer to the flywheel. The release bearing must travel further from its new, closer resting position to reach the disengagement point. This shift in geometry moves the engagement point closer to the floor with each incremental wear of the disc. The progressive change directly correlates with the disc wear rate.

85. B — The lockup clutch friction surface is contaminated or glazed, producing an inconsistent friction coefficient during the progressive engagement phase. The clutch alternately grips and slips across the uneven surface, creating the vibration. Once fully clamped with the full clamping force, the surface condition is overwhelmed and the clutch holds without vibration.

86. C — The steering gear's internal piston has a seal that separates the high-pressure and low-pressure sides of the power cylinder. A failed seal on the left-turn side allows fluid to bypass, reducing the effective assist force during left turns. The right-turn side seal is intact and provides normal assist. The one-directional assist loss confirms the fault is in the steering gear's internal sealing.

87. A — Chronic underinflation changes the tire's contact patch shape, concentrating more weight on the shoulders than the center. The shoulders carry a disproportionate share of the load and wear faster, while the center tread is lightly loaded and wears more slowly. The result is smooth center tread with rougher, worn shoulders — the classic underinflation wear pattern.

88. D — The leaning side's air spring holds static pressure (correct ride height when stationary) but loses pressure during the continuous compression-extension cycling of highway driving. The dynamic cycling exposes a marginal internal bleed that does not leak under static conditions. When the vehicle stops, the cycling ceases, the air system replenishes the spring, and the ride height returns to normal.

89. B — The total toe of +1 mm is within specification, but the individual wheels are not equal. The left wheel's 2 mm toe-in scrubs the inside edge, and the right wheel's 1 mm toe-out scrubs the outside edge. Each tire scrubs in its own direction even though the total cancels to an acceptable value. Both individual angles must be equalized, not just the total.

90. A — King pin play was eliminated, but residual free play remains. The steering system is a chain of components — the sector shaft mesh, drag link ball joints, tie rod ends, and steering arm connections all contain joints that wear. Accumulated play at any combination of these downstream components produces the residual free play that persists after the king pin replacement.

91. D — The continuous hissing indicates the height control valve is running constantly. A small air leak at a spring, fitting, or air line causes the ride height to drop slightly. The valve detects the drop and adds air. The leak depletes the air immediately, the height drops, and the valve adds more air. The continuous supply-and-leak cycle produces the constant hissing noise.

92. C — The crane's rated capacity is the maximum the crane can lift, but the frame must also support the reaction forces. The concentrated downward force from the crane boom's load plus the crane's own weight exceeded the frame rail's bending strength at the mounting point. The rail permanently deformed because the applied force exceeded the material's yield strength at that specific cross-section.

93. A — A 15% torque loss after 500 km with new hardware is normal initial settling. New nuts, studs, and mating surfaces undergo embedding as microscopic surface irregularities compress and flatten under load during the first few hundred km. The effective clamping force decreases as the surfaces settle. This is why manufacturers require a re-torque after the initial service interval with new hardware.

94. A — Excessive positive caster (+7° versus the +3° to +5° specification) amplifies both the steering weight and the self-centering force. The steering becomes uncomfortably heavy during parking maneuvers because the increased caster angle requires more force to turn the wheel against the self-centering tendency. The steering wheel returns aggressively after turns from the amplified self-centering effect.

95. D — The left spring has lost arch from a previous overloading event, permanent fatigue, or a cracked leaf. The reduced arch makes the left side sit lower. Both springs are the same part number, so the height difference must come from a physical change in one spring's condition. The left spring must be inspected for cracks, broken leaves, or permanent set.

96. A — A clicking noise once per wheel revolution during all driving conditions (straight and turning) indicates something contacts the road surface at one specific point on the tire's circumference. A foreign object (stone, bolt, wire, or nail) embedded in the tire's tread produces the click with each revolution. The technician should inspect the front tires for embedded objects.

97. D — One corner at full droop with zero air pressure could be caused by a ruptured spring bellows, a severed supply line, a failed check valve, or a height control valve stuck in the exhaust position. The specific failure must be identified by inspecting the spring for visible damage and tracing the air supply line for breaks or disconnections.

98. B — During left turns, the vehicle's weight transfers to the right, but the left bearing's worn rollers rattle more freely when the load decreases. The noise increases during left turns because the weight transfer unloads the left bearing, allowing the worn components to rattle more freely. During right turns, the weight loads the left bearing, compressing the worn surfaces together and dampening the noise.

99. D — The rotor with 0.15 mm DTV (three times the 0.05 mm maximum) is the pulsation source. As the rotor rotates, the thick spots push the pads apart and the thin spots allow them to retract. This creates a cyclical force variation felt as pedal pulsation during every stop. The rotor must be machined (if sufficient material remains) or replaced.

100. A — Both tires have identical specifications, inflation, and alignment. One tire sits on a wheel with a different offset that changes the effective scrub radius — the distance between the king pin axis and the tire's contact patch center. The altered geometry produces different forces on that tire during steering and braking, causing different wear characteristics.

101. C — One leg extends further than the other — a difference not present when the trailer was new. The gearbox cross-shaft has developed a twist from overloading during a previous extension event. The twisted shaft causes one leg to advance further per crank revolution than the other, creating the height difference when both are fully extended.

102. B — The power steering pump has two worn vanes that produce momentary pressure drops at two specific rotational positions. The pressure drops create brief periods of reduced assist that the driver perceives as increased effort at the two corresponding points in the steering sweep. The worn vanes pass the pressure-producing zone twice per pump revolution, creating the two-point pattern.

103. D — Both tires are identical with equal inflation and correct brake adjustment. The right tire runs hotter consistently. An excessively tight wheel bearing preload generates continuous friction heat that conducts through the hub to the tire. The correctly adjusted left bearing generates less friction and runs cooler. The right bearing preload must be checked against specification.

104. A — The cab air springs carry the weight and maintain ride height (both confirmed correct). The shock absorbers control the rate of compression and rebound. Worn cab shocks cannot dampen road inputs, transmitting every bump harshly to the driver. Replacing the cab shock absorbers restores the designed ride quality without affecting the ride height or load capacity.

105. C — The hissing noise is air escaping from the seat's air ride system. The air spring, a fitting, or an air line has a leak that allows air to escape under the driver's weight. The seat sinks as the air spring deflates from the continuous air loss. The leak must be located and repaired, and the system recharged.

106. B — The windshield has a locked-in stress from an uneven adhesive application, a dimensional distortion in the cab opening, or excessive force during installation. The permanent edge stress is below

the glass's breaking threshold until a thermal change (sun heating one side, A/C cooling the other) adds enough additional stress to initiate the crack from the stressed edge.

107. D — The blower motor resistor pack provides reduced voltage for lower speeds by inserting resistance into the motor circuit. High speed bypasses the resistor pack and connects the motor directly to full voltage. If the resistor pack was not reconnected during the motor replacement, or has failed, only the high-speed direct circuit functions.

108. A — Highway-speed aerodynamics create a low-pressure zone at the rear of the cab. This aerodynamic suction draws water through seams, gaskets, or sealer gaps at the rear that hold against the positive water pressure of car-wash spray and stationary rain. The leak requires the forward-movement aerodynamic suction to draw water inward, explaining why it only appears during highway driving in heavy rain.

109. B — An unsecured cargo shift during transport pushed the wall inward. The lateral force from a turn or lane change pressed the thin wall skin beyond its elastic limit, creating the permanent bulge. The bulge reduces internal cargo volume, may interfere with future loading, and compromises the wall's structural contribution to the trailer's rigidity.

110. D — The air spring's bead lifts momentarily from the piston surface and re-seats as the increasing cargo load changes the spring's compression geometry. A corroded piston surface, worn bead, or improperly seated spring allows the bead to shift under the changing load and pop back into position. The recurring popping indicates the spring is approaching failure and should be inspected.

111. A — The evaporator coil is icing much faster than normal, triggering the defrost cycle every 20 minutes instead of every 4-6 hours. The rapid icing can be caused by a low refrigerant charge (the evaporator operates below its designed temperature), a failed defrost heater (ice is not fully cleared during each cycle and accumulates), or excessive moisture infiltration from damaged door seals.

112. C — One axle produces significantly more dust with correct adjustment on all positions. A relay valve or air line configuration that delivers more pressure to one axle creates a proportionally higher brake force on that axle. The increased application force generates more friction, more heat, and more wear debris at every stop, producing the visible dust difference.

113. B — The sheared rivets at 1 metre above the floor correspond to the height where heavy cargo applies maximum lateral force during transport. Unsecured cargo shifting during turns or lane changes

created a shear force exceeding the rivet capacity. The line of sheared rivets indicates a concentrated lateral load event from cargo contact.

114. D — An "open circuit" code means the electrical path through the modulator valve's coil is broken. The break can be in the coil winding itself (internal break), the connector (lost contact), or the wiring between the module and the valve. The ABS module cannot send current through the incomplete circuit and illuminates the ABS lamp.

115. A — Without the crank handle, the driver cannot lower the landing gear before disconnecting from the tractor. If the tractor is disconnected without the gear deployed, the trailer's nose drops to the ground. The impact can damage the front crossmember, king pin area, air and electrical connections, and structural components. The driver must obtain a replacement handle before disconnecting.

116. C — The less-reflective side has been exposed to more road spray chemicals (de-icing fluids, diesel exhaust residue) that have hazed or etched the reflector surface. The chemical damage reduces the reflector's retroreflective capability. The opposite side may be more protected by the vehicle's aerodynamic profile or spray pattern, maintaining its original reflective quality.

117. D — The HVAC housing routes center vent air directly from the evaporator, while the side vent air travels through a longer duct path that picks up heat from the cab structure, dash wiring, or proximity to the heater core. The temperature difference between center and side vents results from the different duct path lengths and their exposure to heat sources.

118. B — Air trapped in the heater core (often the highest point in the cooling system) produces the gurgling noise as the water pump forces coolant through the core and displaces the air bubbles. The bubbles travel through the core's internal passages, producing the gurgling sound. The noise diminishes as the air works its way out of the core and back to the degas bottle through the coolant circulation.

119. A — Both high-side and low-side pressures elevated above normal with the system otherwise functional indicates excess refrigerant. The overcharge fills the condenser with more liquid than it can cool (raising high-side pressure) and floods the evaporator with more liquid than the airflow can evaporate (raising low-side pressure). Recovering the excess to the specified weight normalizes both pressures.

120. C — The blower motor operates on high speed for extended periods and produces a burning smell. A restricted airflow path (clogged cabin air filter, blocked evaporator, or closed recirculation door)

forces the motor to draw more current to push air through the restriction. The increased current generates excess heat in the motor windings, and the reduced airflow provides less cooling to the motor body.

121. D — The high-pressure switch trips within 1 second of compressor operation because the discharge pressure spikes above the switch's trip point. The condenser cannot reject heat adequately — from a failed fan, severely blocked condenser, or refrigerant overcharge. The switch opens (compressor stops), pressure slowly bleeds down over 30 seconds, the switch resets, and the compressor runs for another 1-second cycle.

122. B — The heater warms the fluid at its location, but the line between the heater element and the nozzles has frozen solid from the ambient temperature. The pump builds pressure but cannot push fluid through the frozen line. The heater only warms the fluid in its immediate vicinity, not the entire line length to the nozzles.

123. A — The low-pressure cycling switch has a cut-out setting that is too high. The switch opens (stopping the compressor) before the evaporator pressure drops to the level that corresponds to the desired cooling temperature. The compressor runs long enough to lower the pressure only to the switch's premature cut-out point, then stops before adequate cooling is achieved.

124. C — The hydraulic fluid overheats after 2 hours of continuous operation. The elevated temperature reduces the fluid viscosity, and the thinner oil leaks past the pump's worn internal clearances at an increasing rate. The reduced effective output slows all functions. The 30-minute rest allows the fluid to cool, the viscosity increases, internal leakage decreases, and the pump's output returns to normal.

125. D — Plugging the cylinder ports stopped the drift, confirming the cylinder's piston seal is intact. The drift was caused by fluid crossing through the directional valve's spool clearance from the pressurized work port to the tank return port. The valve's internal spool leakage is the confirmed source. The valve must be rebuilt or replaced.

126. B — At idle, the pump produces rated flow because internal leakage is a small percentage of total output. At higher RPM, the pump should produce proportionally more flow, but worn internal clearances allow more fluid to bypass. The increased bypass means the net output does not increase proportionally with speed. The pump has significant internal wear and should be rebuilt or replaced.

127. A — The relief valve is chattering at its set point. The poppet opens and closes rapidly as the system pressure oscillates around the relief setting. The noise is loudest at relief pressure because the valve is actively cycling, and quietest at standby because the valve is fully closed. A contaminated seat, worn poppet, or incorrect spring produces the unstable behavior.

128. A — The replacement cylinder has a different bore-to-rod ratio. The rod-end area determines the retract speed at a given flow rate — a larger rod reduces the rod-end area, meaning the same flow fills the smaller volume faster on the extend side but the retract side requires the fluid to push against a higher pressure from the reduced area. The speed differential between extend and retract confirms the different cylinder geometry.

129. C — The directional valve spool is not fully returning to neutral. Contamination, a weak centering spring, or mechanical interference prevents complete centering. The spool remains slightly open on the extend side, allowing a small flow to continue reaching the lift cylinder. The body drifts upward at the slow rate corresponding to the spool's residual opening.

130. A — Hydraulic fluid viscosity increases significantly at cold temperatures. The thicker cold oil creates a higher pressure drop across the filter element. The increased differential pressure triggers the bypass indicator. As the system warms to operating temperature, the viscosity decreases, the differential drops, and the indicator resets. This is normal cold-start behavior.

131. B — The emergency lowering valve must be tested periodically because it sits unused for the system's entire service life until an emergency. Corrosion, contamination, or crystallized hydraulic fluid can block the valve's internal passages during the extended inactivity period. A blocked emergency valve cannot function when needed, creating a critical safety deficiency for aerial lift operations.

132. D — Winter range reduction results from two combined factors: the battery's chemical reaction rate decreases at cold temperatures (reducing available energy), and the HVAC system must use battery energy for cabin heating (unlike an ICE vehicle that uses free waste heat). The combined effect of reduced battery capacity and high heating demand produces the 30-40% winter range reduction.

133. A — The cells in the warmer module have higher internal resistance from degradation. The increased resistance generates more I^2R (resistive) heating during charge and discharge. The thermal management system cools all modules equally, but the degraded module produces more heat than its neighbors. The temperature difference will increase as the degradation progresses.

134. C — The measured insulation resistance of 50 kilohms is below the calculated minimum of 200 kilohms (500 ohms × 400V system voltage). The low insulation resistance indicates a current path is developing between the high-voltage system and the vehicle chassis through degraded insulation, moisture intrusion, or contamination. This creates a shock hazard that must be located and repaired.

135. B — The high-pitched whine during acceleration that increases with speed and disappears during coasting is the normal operating sound of the electric traction motor and its reduction gear. Electric motors produce a characteristic electromagnetic whine from the interaction between the rotor and stator during power delivery. The pitch increases with motor speed, and the different electromagnetic conditions during coasting and regeneration produce different acoustic characteristics.