PRACTICE EXAM 9: RED SEAL 310T SIMULATION (135 QUESTIONS)

1. A technician is removing a transmission from a heavy-duty truck. The transmission weighs approximately 350 kg. The shop has a transmission jack rated at 500 kg. During the removal, the technician realizes the transmission is heavier than expected because the torque converter is still attached. The combined weight is approximately 425 kg. Is the transmission jack adequate for this lift?

A. The jack is adequate — the 500 kg rating exceeds the 425 kg combined weight by 75 kg, providing a safety margin; however, the technician must ensure the load is centered and balanced on the jack's cradle and that the jack is on a level surface to prevent tipping from an off-center load

B. The jack is overloaded because the rating includes a 20% safety factor that is consumed by the additional converter weight

C. The jack is inadequate because the rating applies only to static loads and the dynamic forces of lowering a transmission exceed the static rating

D. The jack must be replaced with a 1,000 kg unit because jack ratings must be at least double the load weight

2. A technician is assigned to perform a diesel particulate filter removal on a truck that was driven into the shop. The technician reaches for the DPF immediately after the truck is parked. What critical safety consideration has the technician overlooked?

A. The DPF should be photographed before removal for warranty documentation purposes

B. The DPF bolts should be soaked with penetrating oil for at least 30 minutes before attempting removal

C. The DPF and surrounding exhaust components may be at temperatures exceeding 400°C from recent operation or regeneration — touching or working near these components without allowing adequate cool-down time risks severe burn injuries, and the radiant heat can ignite combustible materials in the work area

D. The DPF must be weighed before removal to verify it matches the manufacturer's specification for ash loading

3. A technician is using an impact wrench to remove lug nuts from a heavy-duty truck wheel. The impact wrench suddenly jerks violently in the technician's hands as a lug nut frees. What safety practice would have reduced this risk?

A. Using a longer extension bar on the impact wrench to provide additional leverage and reduce the reaction force

B. Using proper body positioning and maintaining a firm two-handed grip on the impact wrench with the body positioned to absorb the reaction force without being thrown off balance — anticipating the breakaway torque and bracing accordingly

C. Reducing the air pressure to the impact wrench to limit the maximum torque output below the lug nut's breakaway value

D. Switching to a cordless impact wrench that has a built-in soft-start feature to eliminate the sudden breakaway jerk

4. A technician notices that the shop's overhead crane has a frayed wire rope — several individual wires in one strand are broken and protruding from the rope's surface. The crane was used earlier today by another technician without incident. What action must be taken?

A. Wrap the frayed area with electrical tape to prevent the broken wires from snagging on the drum or sheave

B. Continue using the crane for loads that are less than 50% of the crane's rated capacity until the rope can be scheduled for replacement

C. Lubricate the frayed area with wire rope lubricant to prevent further deterioration and schedule replacement at the next maintenance interval

D. Remove the crane from service immediately — frayed wire rope with broken wires is a structural failure that indicates the rope has been compromised and may fail catastrophically under load; the rope must be inspected, measured against the rope retirement criteria, and replaced before the crane is used again

5. A technician is draining the cooling system on a heavy-duty diesel engine. The coolant contains ethylene glycol. Where should the drained coolant be collected?

A. In a standard floor drain that connects to the municipal sewer system, which is equipped to process automotive coolant

B. In a dedicated, clearly labelled collection container for recycling or proper disposal — ethylene glycol is toxic to humans and animals, and even small quantities are lethal if ingested; the coolant must not be allowed to drain onto the ground, into floor drains, or into any waterway

C. On the shop floor where it can be absorbed by floor-dry material and swept into the general waste bin

D. Into the waste oil tank where it will be collected with the used oil for recycling by the waste oil hauler

6. A technician is replacing a turbocharger on a heavy-duty diesel engine. Before removing the old turbocharger, what must the technician do to prevent contamination from entering the engine's intake and exhaust systems?

A. Cover all open intake and exhaust ports immediately after disconnecting each line — even brief exposure to the shop environment allows dirt, debris, fastener hardware, and insects to enter the engine's internal passages, where they can cause catastrophic damage to pistons, valves, turbocharger compressor wheels, and bearing surfaces

B. Run the engine briefly after disconnecting the turbocharger to blow any debris out of the ports before covering them

C. Spray compressed air into each port before covering to ensure no debris is present inside the passages

D. Leave the ports open during the repair to allow air circulation that prevents moisture accumulation inside the engine

7. A technician discovers a hydraulic hose with a visible bulge approximately halfway along its length. The hose is not leaking and the system operates normally. What is the correct action?

A. Monitor the bulge at each service interval and replace the hose only if the bulge increases in size or begins to leak

B. Wrap the bulge with a reinforcing sleeve and secure it with hose clamps as a temporary repair until a replacement can be ordered

C. The bulge has no structural significance because the hose's internal reinforcement provides the pressure containment

D. Replace the hose immediately — a bulge indicates the hose's internal reinforcement layers have failed at that point and the outer rubber cover is the only barrier containing the system pressure; the hose can rupture without warning under normal operating pressure, creating a burst failure that sprays hot hydraulic fluid at high velocity

8. A shop technician is asked to jump-start a heavy-duty truck that has dead batteries using a portable battery booster pack. What is the correct sequence for connecting the booster cables?

A. Connect the booster pack's negative cable to the dead vehicle's battery negative terminal first, then connect the positive cable to the battery positive terminal

B. Connect both cables to the dead vehicle's battery terminals first, then activate the booster pack's power switch

C. Connect the booster pack's positive cable to the dead vehicle's battery positive terminal first, then connect the negative cable to an engine ground point away from the battery — the ground connection is made away from the battery to prevent a spark near the battery's hydrogen gas vent that could ignite the gas and cause a battery explosion

D. Connect the booster pack to the dead vehicle's starter solenoid terminals directly to bypass the batteries entirely

9. A heavy-duty diesel engine develops a sudden, severe knock from the lower end of the engine accompanied by a significant drop in oil pressure. The knock is present at all RPM and does not change during an injector cut-out test. What is the most likely cause, and what immediate action is required?

A. A fuel injector has stuck open and is hydraulically locking the cylinder — the engine should be shut down and the injector replaced

B. The crankshaft harmonic balancer has failed and the outer ring is impacting the timing cover at each revolution

C. The engine's main bearing thrust washer has failed, allowing the crankshaft to shift axially and the flywheel to contact the bellhousing

D. A connecting rod bearing has catastrophically failed — the bearing has spun or disintegrated, and the connecting rod is impacting the crankshaft journal and/or the cylinder wall with each revolution; the engine must be shut down immediately to prevent the connecting rod from breaking through the block and causing complete, unrepairable engine destruction

10. A technician is performing a crankcase pressure test on a heavy-duty diesel engine. The manometer reading is 4.5 inches of water column. The manufacturer's maximum specification is 3.0 inches. What does this excessive reading confirm?

A. The piston rings, cylinder liners, or both have worn sufficiently to allow combustion gases to leak past the ring-to-liner seal at a rate that exceeds the crankcase ventilation system's capacity — the excessive blow-by pressurizes the crankcase beyond the ventilation system's design, confirming the engine is approaching or at overhaul condition

B. The crankcase ventilation filter is plugged and creating backpressure that falsely elevates the manometer reading

C. The oil filler cap seal is missing, allowing atmospheric pressure to enter the crankcase and register on the manometer

D. The turbocharger compressor seal has failed and is pressurizing the crankcase through the intake manifold breather circuit

11. A diesel engine equipped with a HEUI fuel injection system has a condition where injection control pressure (ICP) drops below specification under heavy load but is adequate at idle. What is the most likely cause?

A. The fuel transfer pump is unable to maintain adequate fuel supply to the HEUI injectors under heavy fuel demand

B. The engine oil viscosity is too low from fuel dilution, reducing the high-pressure oil pump's ability to build pressure

C. The high-pressure oil pump's internal clearances have worn, and the pump cannot maintain ICP at the higher flow demand of heavy-load injection — at idle, the oil demand per injection event is low and the pump can keep up; under heavy load, each injector draws more high-pressure oil per event, and the worn pump cannot supply the increased volume while maintaining pressure

D. The ICP sensor is reading incorrectly under the vibration conditions of heavy-load engine operation

12. A heavy-duty diesel engine has a condition where the coolant temperature is stable and within specification during highway driving but rises gradually during extended idle periods, eventually approaching the high-temperature warning threshold. What is the most likely cause?

A. The radiator core is partially restricted, limiting coolant flow at the lower pump speed of idle operation

B. The cooling fan is not engaging during idle — the fan clutch, fan relay, or fan control circuit is not activating the fan at idle speed; during highway driving, ram airflow through the radiator provides adequate cooling without the fan, but at idle there is no ram air and the fan must provide all the airflow; if the fan does not engage, the radiator cannot reject heat fast enough to keep up with the engine's idle heat production

C. The thermostat is stuck partially open, providing adequate cooling at highway speed but insufficient cooling at idle

D. The water pump cavitates at idle speed because the impeller design cannot generate adequate flow at low RPM

13. A diesel engine's oil analysis shows a sudden spike in lead, tin, and copper — all three metals appearing together in one sample. What engine component is the most likely source of this tri-metal combination?

A. The piston pin bushings, which are manufactured from a lead-tin-copper alloy for low friction

B. The engine's rocker arm shaft bushings, which contain all three metals in their bearing overlay

C. The camshaft thrust plate, which is pressed from a tri-metal blank for wear resistance

D. The connecting rod or main bearings — tri-metal engine bearings are constructed with a steel backing, a copper-lead intermediate layer, and a lead-tin overlay; the simultaneous appearance of all three metals indicates that the bearing overlay and intermediate layer are wearing rapidly, confirming accelerated bearing deterioration that requires immediate investigation

14. A technician is performing a cylinder leakage test and finds that cylinder 4 has 25% leakage. Air is heard hissing from the adjacent cylinder's injector port (cylinder 3). What does this leakage path indicate?

A. A head gasket failure between cylinders 3 and 4 — the gasket has blown at the fire ring between these two adjacent cylinder bores, creating a path for compressed air to pass from cylinder 4 into cylinder 3; this condition also allows combustion gas to cross between the cylinders during engine operation, reducing power and potentially causing overheating

B. A cracked cylinder head with a crack connecting the combustion chambers of cylinders 3 and 4

C. Both cylinders have leaking intake valves that are creating a shared pressure path through the intake manifold

D. The cylinder liner on cylinder 4 has a vertical crack that extends into the bore of cylinder 3 through the block wall

15. A heavy-duty diesel engine has a coolant leak that the technician has traced to the area behind the air compressor, which is bolted to the engine block. The air compressor shares the engine's cooling circuit. What is the most likely source of this leak?

A. The engine block has a crack behind the compressor mounting surface that is leaking coolant externally

B. The water pump shaft seal is located behind the air compressor on this engine design and is the leak source

C. The air compressor's head gasket or base gasket has failed at a coolant passage — the compressor shares the engine's cooling circuit through passages in the mounting gasket, and a failed gasket allows coolant to leak externally at the compressor-to-block interface

D. The engine's freeze plug behind the compressor has corroded through and is weeping coolant past the compressor's mounting surface

16. A diesel engine equipped with a common rail fuel system has a condition where the engine starts and runs but produces a rattling noise from the injectors that sounds different from the normal injection noise. The scan tool shows that the pilot injection events are not occurring. What does the absence of pilot injection cause?

A. Increased fuel consumption from the main injection event compensating for the missing pilot fuel volume

B. The main injection ignites against unpreheated combustion chamber conditions — without the pilot injection's small preliminary fuel charge that pre-heats the combustion chamber and begins the combustion process before the main injection arrives, the main injection encounters a colder, less prepared environment; the resulting delayed ignition and rapid pressure rise produces the harsh rattling noise (diesel knock) that is characteristic of missing pilot injection

C. Reduced exhaust gas temperature that prevents DPF regeneration from occurring during normal driving conditions

D. Increased NOx emissions from the higher peak combustion temperature that occurs without pilot injection pre-combustion

17. A technician discovers that a heavy-duty diesel engine's intake manifold has a crack approximately 100 mm long. The crack is on the lower surface of the manifold near a mounting bolt location. What symptom would this crack produce?

A. Excessive oil consumption from the crankcase ventilation system being drawn into the manifold through the crack

B. A rich running condition from fuel pooling at the crack location inside the manifold

C. Reduced exhaust gas temperature from the additional air diluting the fuel charge in the affected cylinders

D. An unmeasured air leak that allows ambient air to enter the intake manifold without passing through the mass airflow sensor or being accounted for by the boost pressure sensor — the ECM delivers fuel based on the measured air, but the actual air in the cylinders includes the unmeasured leak air, creating a lean condition that can cause higher combustion temperatures, increased NOx, and potential power loss

18. A diesel engine's turbocharger has been replaced with a new unit. During the first startup after installation, the technician observes blue smoke from the exhaust that clears within 30 seconds. Is this a concern?

A. Brief blue smoke during the first startup of a new turbocharger is normal — the manufacturer applies a protective oil coating to the turbocharger's internal surfaces during assembly and shipping, and this oil

burns off during the first few seconds of operation; if the smoke clears within 30-60 seconds and does not return, the turbocharger seals are functioning correctly

B. The blue smoke indicates the turbocharger was installed incorrectly and the oil drain line is restricted

C. The blue smoke confirms that the replacement turbocharger has a defective compressor-side seal that must be warranty-replaced

D. The blue smoke is caused by the new turbocharger's bearing running-in process and will continue for approximately 500 km

19. A heavy-duty diesel engine has a diagnostic trouble code for "Fuel Temperature — Above Normal." The engine is in a slight derate. What causes elevated fuel temperature, and what is the consequence?

A. Fuel return from the high-pressure injection system carries heat absorbed from the combustion process back to the tank

B. The fuel injection pump friction generates heat that raises the fuel temperature above the designed operating range

C. Hot fuel returning from the injection system and the fuel's absorption of engine compartment heat raises the fuel temperature — hot fuel is less dense than cool fuel, and the ECM must compensate for the reduced density by increasing injection duration to maintain the same energy output; if the fuel exceeds the temperature limit, the ECM derates to prevent the injection system from over-compensating and to protect fuel system components from thermal damage

D. The DEF dosing system shares a heat exchanger with the fuel system and the DEF heating is raising the fuel temperature

20. A diesel engine's exhaust produces an intermittent grey-white haze during steady-state highway driving. The haze is not present during acceleration or at idle. The engine has no fault codes. What is the most likely cause?

A. A very small coolant leak into one or more combustion chambers — the leak is minor enough that the engine runs normally and produces no fault codes, but the small amount of coolant that enters the cylinder vaporizes and exits as a grey-white haze; the haze is visible during steady-state because the exhaust flow is constant and even, while during acceleration the increased exhaust volume and turbulence dilute the haze to invisibility

B. Condensation in the exhaust system that vaporizes during steady-state driving when the exhaust reaches a specific temperature

C. Fuel contamination with a small percentage of biodiesel that burns at a slightly different rate than straight petroleum diesel

D. Normal exhaust vapor that is visible under specific ambient temperature and humidity conditions

21. A heavy-duty diesel engine has been running for 30 minutes after a cold start. The technician checks the engine oil level and finds it has dropped from the full mark (where it was before starting) to below the add mark. No external leaks are visible. Where has the oil gone?

A. The oil has not disappeared — it is circulating through the engine's oil passages, the turbocharger, the oil cooler, and the oil filter housing

B. The engine is consuming oil past the turbocharger seals at an accelerated rate during the warm-up period

C. The oil has drained into the air compressor housing through a failed seal between the engine and the compressor

D. The oil has been absorbed by the engine's internal thermal expansion — as the engine components heat up, the thermal expansion of the block, head, and oil passages increases the internal volume of the oiling system, displacing oil from the pan into the expanded passages; the oil level should return to normal when the engine cools down and the components contract

22. A diesel engine equipped with an SCR aftertreatment system has a condition where the DEF freezes in the tank during cold weather operation. The DEF tank heater is functional. What is the most likely cause of the freezing?

A. The DEF concentration is incorrect — standard DEF (32.5% urea solution) freezes at −11°C, and if the DEF has been diluted with water (reducing the urea concentration below 32.5%), the freeze point rises, causing it to freeze at temperatures that correctly mixed DEF would withstand; alternatively, the tank heater may be functional but undersized or slow to respond, allowing the DEF to freeze before the heater can warm it

B. The DEF storage tank insulation has degraded, allowing the tank to cool faster than the heater can warm it

C. The DEF quality sensor is misreading the concentration due to a calibration error that prevents the heater from activating

D. The engine coolant temperature is too low to supply adequate heat to the DEF tank heater circuit during cold weather

23. A technician is performing a routine service on a heavy-duty diesel engine and discovers that the oil filter element is a different brand than the one specified by the engine manufacturer. The aftermarket filter fits the housing perfectly and appears to have adequate filter media. Is this a concern?

A. No concern — any filter that physically fits the housing is acceptable because the filter element design is standardized across all manufacturers

B. No concern as long as the aftermarket filter has been used for the entire oil change interval and the oil analysis results are within normal parameters

C. A potential concern — aftermarket filters may not match the OEM specification for filtration efficiency (micron rating), dirt-holding capacity, bypass valve setting, burst pressure, or media quality; a filter that physically fits may not provide the same level of protection as the OEM-specified filter, potentially allowing particles through that the OEM filter would capture, or bypassing at a different pressure threshold

D. The only concern is warranty coverage — using non-OEM filters voids the engine warranty but does not affect engine protection

24. A heavy-duty diesel engine has a condition where the engine produces a rhythmic pulsing noise from the exhaust that is audible at idle and corresponds to the engine's firing order. The noise is louder on one bank of a V-configuration engine. What is the most likely cause?

A. An exhaust valve that is not seating fully on one cylinder — the leaking valve allows exhaust to escape into the port during all four strokes, creating a distinct pulsing noise that corresponds to the firing frequency

B. A cracked exhaust manifold on the affected bank — the crack allows exhaust pulses to escape externally, and the rhythmic pulsing corresponds to each cylinder's exhaust event on that bank; the noise is louder on one bank because the crack is on only one manifold, and the exhaust pulses from each cylinder on that bank escape through the crack in sequence

C. The turbocharger wastegate is stuck partially open on the affected bank's exhaust side, creating turbulence that pulses at the firing frequency

D. The EGR valve on the affected bank is stuck slightly open, allowing exhaust pulses to travel backward through the EGR cooler and resonate

25. A diesel engine's fuel system uses a fuel transfer pump mounted on the engine that draws fuel from the tank through a suction line. The engine runs normally when the tank is more than half full but stalls intermittently when the tank drops below a quarter full. What is the most likely cause?

A. The fuel gauge is inaccurate and the tank is actually running empty when it shows a quarter full

B. The fuel return line is routed too close to the exhaust and the reduced fuel volume at low tank levels heats up faster

C. Contamination (water, sediment, or microbial growth) has accumulated at the bottom of the fuel tank and is being drawn into the pickup tube when the fuel level drops low enough to expose the contamination zone to the pickup

D. The fuel pickup tube or sock filter inside the tank is partially clogged or the suction line has a small crack — at higher fuel levels, the hydrostatic pressure of the fuel column above the pickup assists the transfer pump's suction; at lower fuel levels, this pressure assistance decreases, and the weakened pump or cracked line cannot maintain adequate suction against the reduced head pressure, causing intermittent fuel starvation

26. A diesel engine has a condition where the coolant temperature cycles between 78°C and 92°C during highway driving. The normal operating temperature should be a stable 88°C. What is causing this cycling?

A. The thermostat is opening and closing erratically — a thermostat that does not maintain a stable opening position allows alternating periods of full coolant flow to the radiator (cooling the engine below the set point) and blocked flow (engine heats back up); this cycling behavior indicates a thermostat that is marginal or has debris on its valve seat preventing smooth, stable regulation

B. The cooling fan clutch is cycling between engaged and disengaged at highway speed due to a faulty temperature sensor

C. The water pump impeller is slipping on its shaft, alternating between periods of full flow and reduced flow

D. The radiator cap is cycling between sealed and venting due to a weak pressure spring that cannot maintain consistent system pressure

27. A diesel engine equipped with an exhaust brake has a condition where the exhaust brake provides strong retardation when first activated but the retarding force gradually decreases over 30 seconds to near zero. What is the most likely cause?

A. The exhaust brake's butterfly valve is functioning correctly but the engine's valve timing advances during sustained braking, reducing the compression available for the exhaust brake to work against

B. The engine oil temperature rises during exhaust brake use, thinning the oil and reducing the compression that the exhaust brake relies on for retardation

C. The exhaust brake valve's actuation mechanism (air cylinder or electric motor) gradually loses its holding force — an air leak in the actuation cylinder allows the butterfly to slowly open against the exhaust backpressure, or an electric actuator loses its holding current due to a thermal protection circuit; as the valve opens, the exhaust restriction decreases and the retarding force drops proportionally

D. The turbocharger's wastegate opens progressively during exhaust brake use to protect the turbocharger from over-speed, gradually reducing the exhaust backpressure that creates the retarding force

28. A technician is diagnosing a diesel engine that has low power and excessive white smoke from the exhaust during the first 5 minutes of operation, even in warm ambient temperatures. After 5 minutes, the engine runs normally with no smoke. No fault codes are present. What is the most likely cause?

A. The engine's glow plug or intake air heater system is not activating during the initial startup period

B. The fuel injection timing is retarded during the cold-start enrichment phase and returns to normal after the ECM transitions to the warm running algorithm

C. The fuel injectors are worn and cannot atomize fuel properly until the fuel reaches operating temperature in the injection pump

D. One or more glow plugs or intake heater elements have failed — the engine receives inadequate cold-start combustion assistance, causing incomplete combustion (white smoke from unburned fuel vapor) and reduced power during the initial minutes when the cold cylinder walls absorb the compression heat; once the engine block absorbs enough heat to maintain autoignition temperature without assistance, combustion normalizes

29. A heavy-duty diesel engine equipped with a DPF has completed 500,000 km without a DPF ash cleaning service. The DPF backpressure at idle is within specification, but the DPF backpressure under load is significantly higher than specification. What does this load-dependent backpressure elevation indicate?

A. The DPF substrate has developed cracks from thermal stress that create additional flow resistance under the higher exhaust volume of loaded operation

B. The exhaust gas temperature sensors are reading inaccurately under the vibration conditions of loaded driving

C. The turbocharger is producing excessive exhaust gas volume under load that overwhelms the DPF's flow capacity regardless of ash loading

D. Ash has accumulated in the DPF channels to a level that does not significantly restrict exhaust flow at the low volume of idle but creates measurable restriction at the higher exhaust flow rates of loaded operation — the DPF requires an off-vehicle ash cleaning service to remove the non-combustible ash accumulation and restore the channels' full flow capacity

30. A heavy-duty truck has a condition where the air compressor builds pressure to the governor's cut-out setting normally, but during the unloaded (resting) phase, the system pressure drops from 125 psi to 100 psi within 2 minutes before the governor cuts in again. This pressure drop occurs with the brakes released and the engine running. What is the most likely cause?

A. The governor is cutting out at too high a pressure and cutting in at too low a pressure, creating an exaggerated pressure band

B. A significant air leak exists in the system that consumes air at a rate of approximately 12.5 psi per minute — this rate exceeds the maximum allowable loss and the leak must be located and repaired; the compressor builds to cut-out correctly, confirming the compressor and governor are functional, but the stored air is escaping through the leak during the unloaded phase

C. The air dryer purge cycle is removing excessive air during each purge event, dropping the system pressure below the normal band

D. The compressor's unloader mechanism is not fully unloading, causing the compressor to partially compress air against the closed governor valve and creating a backpressure that appears as a pressure drop on the gauge

31. A tractor-trailer combination has a condition where the trailer service brakes apply normally but the trailer spring brakes do not apply when the tractor's red trailer supply valve is pulled out. Air is heard exhausting from the gladhand area when the valve is pulled. The trailer was recently connected. What is the most likely cause?

A. The trailer's spring brake relay valve has a failed seal that prevents it from exhausting hold-off air

B. The tractor's tractor protection valve is stuck open and is not closing when the red valve is pulled

C. The trailer's ABS module is blocking the spring brake release signal through an electronic interlock

D. The gladhand connection is on the wrong coupling — the supply (emergency) gladhand and the service (control) gladhand have been cross-connected, so pulling the red valve exhausts air from the service circuit instead of the supply circuit; the supply line that should lose pressure and trigger the spring brakes retains its air through the incorrect connection

32. A heavy-duty truck equipped with air disc brakes has a condition where the left front brake produces significantly more stopping force than the right front on a brake roller tester. Both pads are the same brand and have similar remaining thickness. Both chambers are the same type. What should the technician investigate?

A. The right front caliper's slide mechanism — if the slide pins are seized, corroded, or the slider boots are torn and contaminated, the caliper cannot float freely on its guides, and only the mechanically-applied inner pad contacts the rotor while the floating outer pad does not apply with equal force; the left caliper slides freely and both pads apply evenly, producing the force difference

B. The right front ABS modulator valve, which may be restricting air to the right front chamber during the roller test

C. The right front rotor thickness, which if thinner than the left would reduce the clamping force from the same pad pressure

D. The air line routing to the right front, which may be longer and create a slight delay that appears as reduced force on the tester

33. A school bus equipped with hydraulic disc brakes has a brake fluid leak at the left rear caliper. The caliper bleeder screw is weeping fluid. The technician tightens the bleeder screw, but fluid continues to weep. What is the most likely cause?

A. The bleeder screw thread is worn and cannot seal against the caliper bore

B. The caliper bore around the bleeder screw seat has corrosion or pitting that prevents the bleeder screw from seating against a clean surface

C. The bleeder screw threads are stripped in the caliper body, allowing fluid to bypass the thread engagement and weep past the screw — the caliper body must be replaced because the stripped threads cannot be adequately repaired to maintain a reliable fluid seal under brake system pressure

D. The brake fluid is contaminated with petroleum-based product that has swelled the bleeder screw O-ring beyond its seating capacity

34. A heavy-duty truck's air brake system has passed all static tests (build-up time, leak-down, low-pressure warning, and tractor protection valve closure), but during a loaded hill descent, the driver reports the brakes are fading — requiring progressively more pedal effort and travel to maintain speed. What is the most likely cause?

A. The air system pressure drops during the sustained descent because the compressor cannot keep up with the repeated brake applications

B. The brake drums are overheating from the sustained braking and the heat causes the drums to expand away from the shoes, reducing the friction surface contact — simultaneously, the overheated brake lining material undergoes thermal degradation that reduces its coefficient of friction; both effects combine to produce the progressive loss of braking force characteristic of brake fade

C. The ABS system is limiting the maximum application pressure during the descent to prevent rear wheel lockup on the grade

D. The relay valves are restricting air flow due to moisture contamination that has frozen at the valve seats during the altitude change

35. A heavy-duty truck has a condition where the parking brake will not release after the vehicle has been parked overnight in −30°C weather. The air system pressure is adequate and the parking brake valve has been pushed in. What is the most likely cause?

A. The parking brake valve linkage has frozen in the cab from moisture condensation inside the valve body

B. The spring brake chambers' power springs have stiffened from the extreme cold and are resisting the hold-off air pressure

C. The air supply line to the spring brake chambers has a low point where moisture has accumulated and frozen, blocking the airflow

D. Moisture in the spring brake hold-off air line or in the spring brake chamber itself has frozen, creating an ice plug that blocks the hold-off air from reaching the spring brake piston — the air system has pressure, but the ice prevents the air from passing through the frozen section to compress the springs; thawing the affected line or chamber resolves the immediate issue, and improving air system drying prevents recurrence

36. A heavy-duty truck's front brakes have been recently serviced with new brake shoes. After the service, the driver reports a pulsation felt through the brake pedal during the first few stops. The pulsation gradually diminishes over the first 100 km of driving and then disappears entirely. What caused this temporary pulsation?

A. The new brake shoes had an initial surface irregularity or a slight thickness variation from the manufacturing process — during the first 100 km of driving, the shoes bed into the drums through normal braking friction, which wears the high spots and creates a uniform contact surface; once the shoes are fully bedded, the pulsation disappears because the shoe-to-drum contact is even

B. The brake drums were contaminated with anti-corrosion coating from the new shoes that needed to be burned off

C. The automatic slack adjusters needed 100 km to adapt to the new shoe thickness and establish the correct adjustment

D. The new shoes had a temporary bonding agent on their surface that produced an inconsistent friction coefficient until it wore off

37. A tractor-trailer combination has a condition where the trailer brakes feel progressively weaker over a 4-hour driving period. At the beginning of the trip, the trailer brakes are strong and responsive. By the 4th hour, the trailer barely contributes to braking. Tractor brakes remain consistent throughout. What should be investigated?

A. The trailer's air reservoir drain valves, which may be leaking air slowly over the 4-hour period and depleting the trailer's stored air

B. The trailer relay valve, which may be developing an internal bypass leak as it heats from repeated cycling over the 4-hour period

C. The trailer's relay valve for a progressive internal bypass leak that worsens with heat — as the valve components heat from repeated use over the 4-hour trip, thermal expansion changes the internal clearances and a marginal seal begins to bypass more aggressively; application air meant for the brake chambers leaks past the worn seal and exhausts through the valve's exhaust port, reducing the pressure delivered to the chambers

D. The trailer brake linings, which may be glazing from the first hour's friction and progressively losing coefficient of friction

38. A technician discovers that the quick release valve on the front axle brake circuit has a continuous air leak from its exhaust port even when the brakes are released. What is the consequence of this leak?

A. The air system will consume air continuously, causing the compressor to cycle more frequently and potentially reducing the air available for brake applications

B. The quick release valve's internal seal or diaphragm has failed — the valve should be completely sealed when the brakes are released, with no air passing through; the continuous leak consumes system air, may prevent the front brakes from receiving full application pressure (if the leak rate exceeds the supply rate during rapid applications), and must be corrected by replacing the valve

C. The leak is providing a bleed function that prevents moisture accumulation in the front brake lines

D. The exhaust port leak is normal operation designed to prevent pressure buildup in the front brake chambers between applications

39. A bus equipped with hydraulic brakes and an ABS system has a condition where the ABS activates during normal stops on dry pavement at speeds below 15 km/h. The ABS warning lamp is not illuminated. The tire sizes are matched and correctly inflated. What should the technician investigate?

A. The brake fluid viscosity, which if too thick in cold weather could cause uneven pressure delivery to the calipers

B. The ABS modulator valve, which may be sticking and releasing pressure intermittently during low-speed stops

C. The brake pad compound, which if too aggressive could be causing momentary lockup at low-speed stops

D. The wheel speed sensors and reluctor rings — an air gap that is too large on one sensor produces a weaker signal at low wheel speeds (where the signal amplitude is naturally lowest), and the ABS module may interpret the weak signal as a sudden wheel deceleration (impending lockup); the ABS activates to prevent what it perceives as a lockup event, even though the wheel is turning normally

40. A heavy-duty truck's air dryer has a condition where the desiccant cartridge requires replacement every 3 months instead of the normal 12-month interval. The compressor oil pass-by has been tested and is within specification. What is the most likely cause of the accelerated desiccant degradation?

A. The compressor discharge temperature is excessively high — an inadequately cooled compressor produces discharge air at temperatures above the desiccant's rated operating range, thermally degrading the desiccant material and reducing its moisture absorption capacity; the elevated temperature causes the desiccant to break down and lose its effectiveness prematurely

B. The air dryer's purge valve is cycling too infrequently, preventing adequate desiccant regeneration between loading cycles

C. The air dryer mounting location exposes it to direct sunlight and road heat that degrades the desiccant through thermal cycling

D. The air dryer's heater element is stuck on, continuously heating the desiccant and driving moisture out of the bed during the loading cycle

41. A technician is testing the spring brake function on a heavy-duty truck. With the parking brakes applied (spring brakes engaged), the technician applies the service brakes with the foot valve. The

pushrod on a rear chamber moves further out during the service application. What does this additional pushrod travel during the compounding event indicate?

A. The spring brake diaphragm on that chamber has failed, allowing service air to push through the spring cavity

B. The automatic slack adjuster on that wheel is not maintaining proper adjustment and should be inspected

C. The additional pushrod travel during compounding (simultaneous spring and service brake application) is normal — the service brake air pushes the pushrod further out than the spring brake alone because the service air adds force to the spring force through the same pushrod; the total pushrod stroke during compounding should remain within the chamber's maximum stroke specification

D. The spring brake power spring has weakened and is not applying its full rated force before the service air adds to it

42. A tractor-trailer combination has a condition where the trailer ABS lamp illuminates immediately when the trailer is connected to the tractor and remains on continuously. The tractor's ABS system functions normally. What is the most likely cause?

A. The tractor's J560 connector Pin 7 (auxiliary power for trailer ABS) has no voltage due to a blown fuse, a failed relay, or an open wire in the tractor's auxiliary circuit

B. The trailer's ABS ECU has detected a fault during its power-up self-test and is indicating the fault with the continuous lamp — the fault could be a wheel speed sensor fault, a modulator valve fault, a power supply fault, or an internal ECU fault; the scan tool must be connected to retrieve the specific fault code from the trailer's ABS module

C. The trailer's ABS lamp bulb is the wrong wattage and is drawing excessive current that the ABS module interprets as a fault

D. The tractor's ABS module is sending a CAN bus message to the trailer's ABS that commands the lamp to stay on

43. A heavy-duty truck equipped with drum brakes has a condition where the right rear brake drum is visibly glowing red-hot after a 50 km highway drive. The other drums are warm but not excessively hot. What is the most immediate concern, and what should the technician do?

A. The right rear brake is dragging severely and the glowing drum is a fire hazard — the technician must keep all personnel away from the drum, not spray water on the drum (thermal shock can shatter it), and allow the drum to cool naturally before investigating the cause of the drag; once cooled, the brake must be inspected for a seized S-cam, broken return spring, stuck anchor pin, or failed automatic slack adjuster

B. The ABS modulator on the right rear is stuck in the apply position and must be disconnected immediately

C. The tire on that wheel must be removed immediately to prevent it from catching fire from the radiant heat of the drum

D. The technician should apply the service brakes repeatedly to attempt to free the stuck brake shoes from the drum through thermal cycling

44. A transit bus has a condition where the brake pedal has no free play — the brakes begin to apply the instant the pedal is touched. What is the consequence of zero pedal free play?

A. Zero free play means the pushrod is in constant contact with the foot valve's internal piston, holding the piston slightly off its home position — this can cause the valve to maintain a slight residual output pressure that partially applies all brakes continuously, resulting in brake drag, accelerated wear on all brake components, elevated drum temperatures, increased fuel consumption, and reduced brake life

B. Zero free play improves the driver's braking response time by eliminating the dead zone at the top of the pedal travel

C. Zero free play causes the low-pressure warning to activate intermittently because the valve draws a small amount of air during the constant contact

D. Zero free play only affects the parking brake function and does not impact the service brake operation

45. A heavy-duty truck's air brake system has been diagnosed with a contaminated air system — oil from the compressor has saturated the air dryer desiccant, coated the inside of the air tanks, and contaminated all downstream valves and chambers. What is the required corrective action for this level of contamination?

A. Replace the air dryer cartridge and drain all tanks — the oil will flush out of the valves and chambers during normal operation

B. Replace the air dryer cartridge only and add an oil-coalescing filter between the compressor and the dryer to capture future oil pass-by

C. The entire air system must be decontaminated — the air compressor must be repaired or replaced to stop the oil source, the air dryer cartridge replaced, all tanks drained and flushed, and all valves, relay valves, quick release valves, and brake chambers inspected and cleaned or replaced as needed; oil contamination degrades rubber components (diaphragms, seals, O-rings) throughout the system, and residual contamination continues to damage components if not thoroughly removed

D. Replace the compressor and air dryer and flush the tanks with brake cleaner solvent to dissolve the oil residue

46. A heavy-duty truck has a condition where the air pressure gauge for the secondary circuit fluctuates by 5 psi during each brake application, then returns to the previous reading when the pedal is released. The primary circuit gauge remains stable. What does this fluctuation indicate?

A. Normal operation — the secondary circuit gauge shows the pressure drop during each application because the secondary circuit directly feeds the front brake chambers, and the volume consumed by each application is visible as a temporary gauge drop

B. The secondary circuit has a leak that is triggered by the brake application and stops when the brakes are released — a valve or chamber in the secondary circuit loses air only when the application pressure pushes against a marginal seal

C. The secondary circuit reservoir is undersized for the number of brake chambers it serves, producing a visible pressure fluctuation with each application that the larger primary reservoir does not exhibit

D. The secondary circuit gauge sender is more sensitive than the primary gauge sender and is displaying normal pressure variations that the primary gauge cannot detect

47. A heavy-duty truck has a condition where the engine starts and runs normally, but the alternator does not begin charging until the engine RPM exceeds approximately 1,500 RPM. At idle, the battery warning lamp is on and the voltmeter reads battery voltage only. Above 1,500 RPM, the lamp extinguishes and the voltage rises to the normal charging range. What is the most likely cause?

A. The alternator belt is slipping at idle speed — at low RPM, the belt cannot overcome the alternator's initial resistance and slips on the pulley; at higher RPM, the increased belt speed provides enough friction to drive the alternator and initiate charging

B. The voltage regulator is set to a higher-than-normal activation threshold that requires elevated RPM to trigger charging

C. The alternator's rotor has weak residual magnetism from demagnetization and cannot self-excite at low RPM

D. The alternator has a high-resistance connection in its field circuit (exciter wire) — the resistance reduces the initial field current below the level needed for self-excitation at idle; at higher RPM, the alternator generates enough internal voltage to overcome the resistance and begin charging; the root cause is a corroded connector, a damaged wire, or a poor connection in the exciter circuit

48. A truck's body controller module (BCM) has a condition where it intermittently reboots during driving — the dashboard flashes, the BCM's outputs momentarily cycle off and back on, and then the system resumes normal operation. The BCM has been replaced with a new unit and the problem persists. What should be investigated?

A. The BCM's power supply and ground connections — since the replacement BCM exhibits the same behavior, the fault is not in the module itself; an intermittent power supply dropout or ground interruption causes the BCM to lose power momentarily and reboot; the power supply wire, ground wire, connectors, and the fuse feeding the BCM must be inspected for loose, corroded, or damaged connections

B. The CAN bus backbone, which may have an intermittent fault that triggers the BCM's watchdog timer and forces a reboot

C. The ignition switch, which may have a worn contact that momentarily interrupts the BCM's power supply during vibration

D. The alternator's voltage regulator, which may produce a voltage spike that disrupts the BCM's internal power supply

49. A technician is diagnosing a truck's electrical system and finds that the voltage at the headlight connector reads 12.3 volts with the engine off and the lights on. After starting the engine, the voltage at the same connector rises to only 12.8 volts instead of the expected 14+ volts. What does the small increase in voltage with the engine running indicate?

A. The alternator is producing adequate output but the charging voltage is being consumed by resistance in the wiring between the alternator and the headlight circuit

B. The battery is fully charged and is rejecting the alternator's output, keeping the headlight voltage near battery resting voltage

C. The alternator is producing its rated output but the voltage drop in the charging circuit between the alternator output terminal and the battery (and subsequently to the headlight circuit) is consuming most of the alternator's voltage increase — the voltage at the alternator output may be 14.4V, but by the time it reaches the headlight connector, the wiring losses reduce it to 12.8V; the charging circuit must be tested for excessive voltage drop

D. The headlight circuit has its own voltage regulator that limits the voltage to protect the bulbs from overvoltage damage

50. A heavy-duty truck equipped with a multiplexed lighting system has a condition where all exterior lights function correctly except the left turn signal on the trailer, which does not flash. The tractor's left turn signal works normally. The BCM shows no fault codes for the left turn circuit. What should the technician check?

A. The trailer ABS module, which on some systems controls the trailer turn signal function through the auxiliary circuit

B. The J560 connector and the trailer's left turn signal wiring — since the BCM shows no fault for the left turn output (confirming the BCM is sending the correct signal to the J560 connector), the fault is downstream of the connector in the tractor-to-trailer interface or the trailer's wiring; check for voltage at the correct J560 pin while the left turn is activated, then trace the circuit through the connector and trailer wiring to the lamp

C. The BCM software version, which may not support the specific trailer configuration connected to the tractor

D. The tractor's flasher module, which may be sending the left turn signal at a frequency that the trailer lamps cannot respond to

51. A truck has a condition where the starter motor cranks the engine at a noticeably slower speed than normal. Battery voltage during cranking is 10.2 volts (within specification). The batteries are fully charged and load-test within specification. What is the most likely cause?

A. The engine oil is the incorrect viscosity and is creating excessive cranking resistance in the cold engine

B. The air compressor is loaded during cranking and adding parasitic resistance that slows the cranking speed

C. The starter motor's internal resistance has increased from worn brushes, a dirty commutator, or a partially open armature winding

D. The starter motor is worn internally — worn brushes that make inconsistent contact with the commutator, a contaminated or grooved commutator surface, or a partially shorted armature winding all increase the motor's internal resistance; the motor draws adequate current (the batteries maintain voltage) but converts less of the electrical energy to mechanical torque, resulting in slower cranking speed

52. A truck's scan tool can communicate with all modules on the J1939 CAN bus, but the data refresh rate is very slow — values update every 3-4 seconds instead of the normal real-time update. What is the most likely cause?

A. A high bus load from excessive message traffic — an aftermarket device, a misconfigured module, or a failing module that is flooding the CAN bus with messages can consume the bus's bandwidth, slowing the data transfer rate for all modules including the scan tool; the bus is functional (communication exists) but congested

B. The scan tool cable is too long, introducing propagation delay that slows the data transfer

C. The CAN bus baud rate has been reduced from the standard 250 kbps to a lower rate by a programming error

D. The 9-pin diagnostic connector has corrosion that increases the signal path resistance and slows data transfer

53. A truck's left headlight is brighter than the right headlight. Both bulbs are the same wattage and were installed at the same time. The voltage at each headlight connector measures identically at 13.8 volts with the engine running. What could cause the brightness difference despite equal voltage?

A. The left headlight reflector is cleaner and reflects more light than the right, making the left appear brighter even with equal bulb output

B. The right headlight lens has internal fogging or haze from moisture intrusion that diffuses the light and reduces the perceived brightness

C. The right headlight bulb, despite being the same wattage rating, has developed a higher internal resistance from a partially broken filament — it draws less current and produces less light even though it receives the same voltage; the voltage measurement appears equal because the reduced current draw also reduces the circuit's voltage drop

D. The headlight aiming on the left side is higher, projecting the beam further and making it appear brighter to the driver

54. A truck equipped with electronic engine controls has a condition where the engine derate level increases progressively over a 3-day period — on day one, the derate is 5%, on day two it is 25%, and by day three the engine is in a full 100% derate (idle only). What type of fault code is responsible for this escalating derate pattern?

A. An active emission-related fault code with a progressive derate timer — regulations require that emission-related faults trigger an escalating derate schedule to compel the operator to have the fault repaired within a specific timeframe; the derate increases from a mild reduction to idle-only over a predetermined period (often 4-6 hours of engine operation) to prevent indefinite operation with a non-compliant emission system

B. A critical engine protection fault that progressively reduces power as a mechanical condition worsens over the 3-day period

C. A transmission fault code that restricts engine power through the CAN bus communication between the TCM and ECM

D. A cascading series of unrelated fault codes that coincidentally set over the 3-day period and compound their individual derates

55. A heavy-duty truck has a condition where the instrument cluster's LCD display shows garbled text and missing segments on the digital readouts. The analog gauges on the same cluster function correctly. What is the most likely cause?

A. The CAN bus data is corrupted and the cluster cannot interpret the garbled incoming data for the digital displays

B. The alternator's AC ripple is interfering with the LCD driver circuit inside the cluster

C. The cluster's power supply voltage is fluctuating outside the LCD driver's operating range

D. The instrument cluster's internal LCD driver circuit or the LCD panel itself is failing — the analog gauges use stepper motors driven by a different internal circuit, which explains why they function correctly while the LCD displays malfunction; the failure is internal to the cluster and the LCD or its driver must be repaired or the cluster replaced

56. A technician measures the resistance between the positive and negative battery cables with the cables disconnected from the batteries and all switches off. The reading is 2,500 ohms. What does this resistance represent?

A. The vehicle's normal circuit resistance from the combined resistance of all the electrical components connected between the positive and negative battery cables

B. The combined parallel resistance of every electrical device in the vehicle that is connected between the positive and negative power rails — each device (ECM, BCM, ABS module, instrument cluster, relays, etc.) has an internal resistance, and all of these resistances in parallel produce the measured value; a significantly lower reading would indicate a short circuit, and an open reading would indicate a disconnected main cable

C. An abnormally low reading that indicates a partial short circuit somewhere in the vehicle's wiring harness

D. Leakage through the battery cables' insulation that indicates the cables need replacement

57. A heavy-duty truck's back-up alarm has a volume that is noticeably lower than when it was new. The alarm sounds, but it is difficult to hear over ambient noise. What is the most likely cause?

A. The alarm's internal piezoelectric element or speaker cone has degraded from weather exposure, vibration, and age, reducing its acoustic output

B. The alarm's mounting bracket has loosened, allowing the alarm to vibrate against the frame and absorb the sound energy

C. The alarm's power supply circuit has developed resistance that reduces the voltage and current to the alarm, limiting its acoustic output — the alarm still functions but at reduced volume because it is receiving less electrical energy than its design requires for full output

D. The alarm is designed to reduce its volume automatically as its internal components reach operating temperature during extended reverse operations

58. A technician is diagnosing a truck with a complaint that the dash-mounted clock resets to 12:00 every time the ignition is turned off. All other electronic settings (radio presets, seat memory) retain their settings through the ignition cycle. What is the most likely cause?

A. The clock is powered by a separate "keep-alive" circuit that has a blown fuse, an open wire, or a corroded connector — while most electronic devices share a common memory-keep-alive circuit, the clock may have its own dedicated circuit that has failed, causing it to lose power and reset when the ignition is turned off; the other devices retain settings because their keep-alive circuit is separate and functional

B. The clock's internal backup battery has expired and needs replacement

C. The instrument cluster's firmware has a bug that resets the clock to a default value during each power-down cycle

D. The body controller module's keep-alive memory for the clock function has reached its write-cycle limit

59. A truck equipped with a trailer ABS system has a condition where the trailer ABS warning lamp comes on intermittently during driving and the scan tool shows a fault code for "Modulator Valve 1 — Open Circuit." The wiring between the ABS ECU and the modulator has been inspected and appears intact. What should the technician check next?

A. The ABS ECU's output driver for the affected modulator channel, which may have an internal thermal protection fault

B. The trailer's air supply to the modulator, which if low could cause the ECU to set an electrical code

C. The modulator's electrical connector at the valve body — the connector may appear to be properly connected when visually inspected, but the internal pins may be corroded, pushed back, or loosely seated, creating an intermittent open circuit that manifests during driving vibration

D. The modulator valve's internal coil, which may have developed an intermittent open from a broken wire inside the coil that makes and breaks contact with vibration — an intermittent internal coil break produces a resistance reading that fluctuates between normal and infinite (open) as the broken wire ends touch and separate during driving vibration

60. A heavy-duty truck has a condition where the engine starts and runs, but the electronic throttle pedal produces no response — the engine idles regardless of pedal position. The scan tool shows the throttle position sensor reading at 0% at all times. What is the most likely cause?

A. The ECM's throttle input processing circuit has failed and cannot read the pedal sensor signal

B. The throttle position sensor has failed or its connector has become disconnected — the sensor produces a 0% signal regardless of pedal position, which the ECM interprets as the pedal being fully released; the ECM cannot detect the driver's throttle input and defaults to idle speed

C. The electronic throttle relay has failed in the open position, preventing power from reaching the pedal assembly

D. The transmission control module is overriding the throttle signal through the CAN bus to protect the transmission from a detected overspeed condition

61. A truck's charging system has a condition where the alternator output voltage is correct at the alternator output terminal (14.2V) but the battery terminal voltage reads only 13.0V with the engine running. What is consuming the 1.2 volts between the alternator and the battery?

A. Resistance in the charging circuit wiring — the output cable, fusible link, battery cable, or their connections have excessive resistance that creates a 1.2-volt drop under the current load of the charging system; the maximum allowable drop for the entire charging circuit is typically 0.5 volts, and 1.2 volts indicates a significant problem that is preventing the alternator from effectively charging the batteries

B. The voltage regulator is operating in a power-saver mode that intentionally reduces the voltage delivered to the battery

C. The battery's internal resistance is creating a voltage differential between its terminals and the alternator's output

D. The 1.2-volt difference is within normal specification for a heavy-duty truck charging circuit with multiple batteries

62. A truck's electronic instrument cluster has a condition where the oil pressure gauge reads approximately 15 psi higher than the actual oil pressure verified by a mechanical test gauge installed at the engine's oil gallery. What is the most likely cause?

A. The oil pressure sensor is out of calibration and is sending a signal that corresponds to a higher pressure than the actual reading

B. The instrument cluster's gauge driver is applying an incorrect scaling factor to the sensor signal

C. The oil pressure sensor has developed a resistance drift that shifts its output signal upward — the sensor's internal resistance has changed from aging, corrosion, or damage, producing an output voltage or resistance value that the ECM or cluster interprets as a higher pressure than the actual reading at the gallery

D. The CAN bus is introducing a data offset on the oil pressure message that adds approximately 15 psi to the displayed value

63. A heavy-duty truck has a complete electrical failure — nothing works (no lights, no dash, no cranking). The battery disconnect switch is in the ON position. Battery voltage across the battery posts reads 12.6V. What is the single most likely failure point?

A. The ignition switch has failed in the completely open position, preventing power from reaching any circuit

B. The main fusible link or the battery cable connection between the battery and the vehicle's power distribution system has failed — a blown fusible link, a completely corroded battery cable terminal, or a broken cable creates a single-point open circuit that disconnects the fully charged battery from every vehicle system simultaneously

C. The body controller module has failed and is preventing all electrical power from reaching any circuit

D. The battery has an internal open circuit between its posts and its internal plates, making it appear charged but unable to deliver current

64. A technician is testing a circuit and measures 12.4 volts at the power input to a module and 12.4 volts at the module's ground pin relative to battery negative. What does 12.4 volts at the ground pin indicate?

A. The module's ground connection is intact and properly grounded to the vehicle chassis

B. The module is drawing excessive current that is elevating the ground potential above zero

C. The measurement technique is incorrect — ground voltage should be measured with the meter's negative lead on the battery positive terminal, not the negative terminal

D. The module's ground circuit has an open — a good ground reads near 0 volts relative to battery negative; a reading of 12.4 volts at the ground pin means the module is not connected to ground, and the voltmeter is reading the voltage that passes through the module's internal circuitry from the power input to the ungrounded output pin; the module cannot function because it has no return path for current

65. A truck equipped with an electronic logging device (ELD) has a condition where the ELD records excessive "driving" events while the vehicle is parked with the engine running. The ELD uses the vehicle's speed signal to determine when the vehicle is moving. What is causing the false driving events?

A. The ELD's speed threshold is set too low and even minor speed signal noise from the vehicle speed sensor registers as vehicle movement — the ELD interprets any speed above its minimum threshold (typically 5 mph/8 km/h) as driving; if the speed signal produces even brief noise spikes above this threshold while the vehicle is parked with the engine running, the ELD records a driving event

B. The ELD's GPS module is detecting satellite drift that the device interprets as vehicle movement

C. The engine's crankshaft position sensor signal is being misinterpreted by the ELD as a vehicle speed signal

D. The ABS module is broadcasting a non-zero wheel speed on the CAN bus during engine idle from electrical noise on the sensor circuits

66. A truck's heated windshield has a condition where the heating works on the right half of the windshield but not on the left half. The heating element is embedded in the windshield glass. What is the most likely cause?

A. The left half's heating zone has a separate power supply relay that has failed in the open position

B. The heated windshield timer module has a fault that disables the left heating zone while leaving the right active

C. One of the heating element bus bars (the conductive strips at the edges of the windshield that distribute current to the embedded heating wires) has a broken connection — heated windshields typically have bus bars on both sides that connect to the individual heating wires; if the bus bar or its

connection on the left side has broken or corroded, current cannot reach the heating wires on the left half while the right half continues to function through its intact bus bar

D. The windshield glass on the left side has developed a delamination that insulates the heating elements from the outer glass surface

67. A heavy-duty truck has a condition where the starter motor engages and cranks the engine normally for the first start of the day, but if the driver shuts the engine off and immediately tries to restart, the starter does not engage — no click, no cranking. After waiting 10 minutes, the starter works again. What is the most likely cause?

A. The starter solenoid has an internal thermal protection circuit that opens when the solenoid heats from the first start and needs 10 minutes to cool and reset before allowing another engagement

B. The ignition switch has a thermal interlock that prevents rapid restarts to protect the starter motor from overheating

C. The neutral safety switch needs time to reset its internal mechanism after each start cycle before allowing another engagement

D. The batteries need 10 minutes to recover their surface charge after the first cranking event before they can supply adequate current for another start

68. A truck's ABS warning lamp illuminates and the scan tool retrieves a fault code for "System Configuration Error — Invalid Wheel Configuration." The truck has recently been converted from single tires to wide-base single tires on the drive axle. What is the most likely cause of this fault?

A. The ABS module needs to be reprogrammed with the new tire size configuration

B. The wide-base tires produce a different wheel speed signal frequency due to their different rolling circumference — the ABS module's programmed tire size does not match the actual tire size, causing the module to calculate incorrect wheel speeds and detect a configuration error; the module must be recalibrated or reprogrammed with the correct tire parameters for the wide-base tires

C. The wide-base tires require a different reluctor ring with more teeth to produce the same signal frequency as the dual tire configuration

D. The ABS modulator valves are calibrated for the braking characteristics of dual tires and must be replaced with single-tire-specific modulators

69. A heavy-duty truck with a 13-speed manual transmission has a condition where the transmission shifts normally through all 13 gears during upshifts, but the driver cannot downshift from 7th gear to 6th gear. All other downshifts work correctly. The 7th-to-6th downshift requires a range section shift from high range to low range. What is the most likely cause?

A. The 6th gear synchronizer has worn beyond its effective range for downshifts while still functioning for upshifts

B. The clutch brake is interfering with the range shift by partially stopping the input shaft during the downshift attempt

C. The driver is not timing the shift correctly and is attempting the range downshift at too high or too low a road speed for the RPM match

D. The range shift cylinder or its air supply has a fault that prevents the high-to-low range shift under the dynamic conditions of a downshift — the cylinder may have adequate force for the static upshift (where the vehicle speed is increasing and the range gears are more easily matched) but insufficient force for the dynamic downshift (where the range synchronizer must overcome the higher speed differential)

70. A truck equipped with an Allison automatic transmission has a condition where the transmission produces a shudder during the torque converter lockup clutch engagement. The shudder is present only during the lockup transition and disappears once the lockup is fully engaged. What is the most likely cause?

A. The torque converter's stator one-way clutch is intermittently locking and releasing during the lockup transition

B. The lockup clutch apply piston has a warped surface that contacts the converter housing unevenly during engagement

C. The lockup clutch friction material is contaminated or glazed, causing an inconsistent friction coefficient during the initial engagement phase — the clutch alternately grips and slips before reaching full clamping force, producing the shudder; once fully engaged, the clutch holds steadily and the shudder stops

D. The turbine shaft has developed a slight bend that causes a vibration during the speed transition of the lockup engagement

71. A heavy-duty truck's clutch hydraulic system uses DOT 3 brake fluid. A technician accidentally tops up the clutch master cylinder with power steering fluid (ATF). What is the consequence?

A. Power steering fluid (ATF) is petroleum-based and is chemically incompatible with the rubber seals used in DOT 3 hydraulic systems — the ATF will cause the master cylinder and slave cylinder seals to swell, soften, and deteriorate, leading to hydraulic leaks and clutch failure; the entire hydraulic system must be drained, flushed, and all rubber components (seals, hoses, cups) replaced

B. The power steering fluid will provide temporary lubrication but must be flushed at the next scheduled service

C. The two fluids are compatible because they are both hydraulic fluids designed for automotive applications

D. The power steering fluid will reduce the clutch hydraulic system's operating pressure but will not damage the seals

72. A heavy-duty truck equipped with an automated manual transmission (AMT) has a condition where the clutch teaches (adapts) a new engagement point after every ignition cycle — the clutch engagement is rough for the first 2-3 shifts of each driving session, then smooths out. What does this repeated learn cycle indicate?

A. The AMT's clutch position sensor has a temperature-dependent calibration error that shifts the sensor's reading between cold and warm operation

B. The AMT's TCU memory is not retaining the learned clutch engagement parameters through the ignition-off cycle

C. The clutch disc is wearing unevenly, causing the engagement point to vary between each driving session

D. The AMT's TCU battery or keep-alive power circuit has failed — the learned clutch parameters (kiss point, engagement position, and release point) are stored in volatile memory that requires continuous power to retain; when the keep-alive power is lost during ignition-off, the stored parameters are erased and the TCU must relearn the clutch engagement point at the beginning of each driving session

73. A truck's driveshaft has been repaired by a driveline shop that welded a new yoke to the tube. After the repair, the technician notices a vibration that was not present before the repair. The driveshaft was dynamically balanced after the weld. What else could cause the vibration?

A. The weld may have introduced a heat-affected zone that weakened the tube, and the tube is flexing at speed

B. The new yoke's ears may not be in the correct phase with the original yoke's ears — the weld may have been performed with the new yoke clocked at an incorrect angle relative to the existing yoke at the other end of the shaft, creating a phasing error that produces a vibration at twice per driveshaft revolution even though the shaft is balanced

C. The driveline shop used a different balance weight material that does not adhere to the tube at high rotational speeds

D. The dynamic balancing machine did not simulate the actual vehicle operating conditions and the balance is only valid at the machine's test speed

74. A heavy-duty truck with a tandem drive axle has a condition where the inter-axle differential makes a clicking noise that increases with vehicle speed during straight-line driving. The noise does not change when the diff lock is engaged. What does this unchanged-by-lock behavior indicate?

A. The noise source is in a component that rotates regardless of the lock position — the power divider's input gears, the drive pinion bearing, or the input shaft components that are always rotating and loaded identically whether the lock is engaged or not; the differential gears stop rotating relative to each other when the lock is engaged, so if the noise were from the differential gears, it would change or stop when the lock engages

B. The differential lock mechanism itself is the noise source and the clicking is the lock collar vibrating against its engagement teeth

C. The noise is from the rear driveshaft U-joint and is unrelated to the inter-axle differential

D. The noise source is the wheel bearings on the drive axle, which are always loaded regardless of the lock position

75. A truck equipped with a manual transmission has a condition where the shift lever vibrates excessively at highway speed, making it uncomfortable for the driver to rest their hand on the lever. The vibration corresponds to driveshaft speed. What is the most likely cause?

A. The shift lever detent mechanism has worn, reducing the friction that normally dampens vibration transmitted through the shift tower

B. The transmission's shift tower isolation mount (the rubber or urethane bushing that connects the shift lever housing to the transmission case) has deteriorated, allowing vibration to transfer directly from the case to the lever

C. The transmission's countershaft bearing is worn, and the imbalanced countershaft rotation transmits vibration through the case to the shift tower and lever

D. The engine mounts have deteriorated, allowing the engine-transmission assembly to vibrate at the driveshaft frequency

76. A heavy-duty truck's automatic transmission has a condition where the fluid temperature climbs steadily during city driving with frequent stops. The transmission cooler was recently serviced. What should the technician verify about the cooler service?

A. The cooler was not flushed with solvent that is incompatible with the transmission fluid and is contaminating the fluid

B. The cooler circuit was contaminated with the wrong fluid type during the service that is reducing the fluid's heat transfer properties

C. The cooler lines may have been reconnected in the wrong orientation — if the inlet and outlet lines are reversed, the fluid flow through the cooler is in the opposite direction from the designed flow pattern

D. The cooler lines were reconnected in the reverse orientation (inlet to outlet and vice versa), which on some systems can reduce the cooler's effectiveness by routing the fluid through the cooler in a direction that bypasses internal baffles or reduces the effective heat exchange surface area; alternatively, the cooler may have been reinstalled with a restricted line that limits flow

77. A truck's clutch pedal has a condition where it slowly drops to the floor over approximately 10 seconds when held in the depressed position, then returns to normal position when released. The clutch hydraulic fluid level is correct and no external leaks are found. What is the most likely cause?

A. The clutch master cylinder's primary seal is leaking internally — fluid bypasses past the worn seal under sustained pedal pressure, allowing the piston to slowly advance and the pedal to drop; when the pedal is released, the piston return spring pushes the piston back and the seal re-seats, restoring normal pedal position for the next application

B. The clutch slave cylinder has an internal leak that only occurs under sustained pressure

C. The clutch disc is slipping and the pedal drop is caused by the disc material compressing under the sustained clamping force

D. Air in the hydraulic line slowly compresses under the sustained pedal pressure, allowing the pedal to drift downward

78. A technician is setting up a new ring and pinion gear set in a drive axle. The gear marking compound shows a contact pattern that is centered vertically on the tooth face but positioned entirely on the heel (outer edge) of the ring gear teeth. What adjustment is needed?

A. Move the pinion closer to the ring gear centerline by removing shims behind the pinion bearing

B. Move the pinion away from the ring gear centerline by adding shims behind the pinion bearing

C. Decrease the backlash by moving the ring gear closer to the pinion — this shifts the contact pattern from the heel toward the toe, centering it on the tooth face

D. Increase the pinion bearing preload to prevent the pinion from deflecting outward under load

79. A heavy-duty truck has a condition where the driveshaft produces a vibration only during acceleration, not during steady-speed cruising or deceleration. The vibration increases with engine torque. What is the most likely cause?

A. The driveshaft slip yoke has worn splines that have free play — under acceleration torque, the splines load in one direction and the worn clearance creates a vibration; during cruising and deceleration, the splines load in different directions that do not excite the worn clearance

B. An imbalanced driveshaft, which would vibrate at all operating conditions regardless of load direction

C. The rear U-joint has worn bearing caps that produce vibration only under the loading conditions of acceleration

D. The engine-transmission assembly shifts position under acceleration torque (from worn engine mounts), changing the driveshaft angles and creating a torque-dependent vibration that disappears when the mounts unload during cruising or deceleration

80. A truck equipped with a two-piece driveshaft and a center carrier bearing has a condition where the center carrier bearing mount (rubber isolator) has completely separated from its metal bracket. The driveshaft appears intact. What is the immediate consequence of this failure?

A. The driveshaft will produce a slight vibration that increases gradually over the next 5,000 km as the bearing wears without its support

B. The center carrier bearing housing will drop from its designed position, changing the angles of both driveshaft sections — the altered angles create a vibration, and the unsupported bearing housing may contact the frame or other components during driving; the vehicle should not be operated until the mount is replaced because the driveshaft sections can misalign severely enough to cause a driveshaft separation

C. The center carrier bearing can still function without its rubber mount because the bearing itself provides the support

D. The driveshaft will be slightly noisier but the vehicle can continue to operate safely until the next scheduled maintenance interval

81. A heavy-duty truck's differential has been rebuilt with a new ring and pinion gear set. After 5,000 km of operation, the technician drains the axle and finds fine metallic particles in the gear oil. Is this a concern?

A. Fine metallic particles in the gear oil after 5,000 km of operation with a new gear set is normal break-in debris — new ring and pinion gears produce fine wear particles as the gear teeth's surface asperities wear smooth during the initial contact pattern establishment; the oil should be changed at this interval to remove the break-in debris, and subsequent oil changes should show decreasing particle content as the gears seat

B. Any metallic particles in the gear oil indicate a defective ring and pinion installation that must be disassembled and corrected

C. The fine particles are from the carrier bearings, not the gears, and indicate the bearings were not adequately preloaded

D. The metallic particles indicate the gear oil is the wrong specification and is not providing adequate film strength for the new gears

82. A technician replaces the clutch on a heavy-duty truck and the clutch pedal has significantly more free play than before the replacement. The technician has adjusted the free play to the manufacturer's specification. What does the increased free play with a new clutch indicate compared to the old clutch?

A. The new clutch disc is thicker than the worn disc it replaced, and the increased thickness pushes the pressure plate away from the flywheel — this moves the release bearing further from the pressure plate fingers, requiring more pedal travel to take up the increased gap before the release bearing contacts the fingers; the result is more free play at the pedal, which is normal with a new, full-thickness disc

B. The release bearing was not installed correctly and is sitting too far from the pressure plate fingers

C. The clutch master cylinder pushrod needs to be lengthened to compensate for the new disc thickness

D. The pilot bearing is the wrong size and is holding the input shaft too far forward in the flywheel bore

83. A fleet of identical trucks has one vehicle that consistently produces driveline vibration complaints. The driveshaft, U-joints, and carrier bearing have all been replaced with new components. The engine and transmission mounts are in good condition. The vibration persists after all replacements. What should be checked next?

A. The companion flange at the rear axle for runout or damage that is introducing a wobble at the connection point

B. The transmission output shaft for runout that is imparting vibration to every driveshaft installed on the vehicle

C. The rear axle pinion flange and the transmission output flange for runout — if either flange has excessive runout, every driveshaft installed on the vehicle will vibrate because the flange itself is imparting a wobble to the driveshaft at the connection point; the driveshaft can be perfectly balanced and still vibrate if the flanges it bolts to are not running true

D. The frame alignment, which may have a diamond condition that introduces a driveshaft angle incompatible with vibration-free operation

84. A heavy-duty truck's PTO makes a whining noise when engaged at idle. The noise increases in pitch and volume when the engine RPM is increased. The PTO was recently installed. What is the most likely cause?

A. The PTO gear mesh with the transmission gear is too tight — the PTO's mounting gaskets or shimming determines how deeply the PTO gear meshes with the transmission's PTO drive gear; if the mesh is too tight, the gear teeth are over-engaged and produce a high-pitched whine from the excessive contact pressure

B. The PTO's internal bearings are defective from the factory and need warranty replacement

C. The PTO gear is running in the wrong direction due to a reversed installation that works but produces noise

D. The transmission oil level is too low for the PTO gear to receive adequate splash lubrication

85. A truck equipped with a limited-slip differential has a condition where the differential produces a rhythmic chattering noise when making tight, slow-speed turns in a parking lot. The chattering is not present during highway driving or straight-line operation. What is the most likely cause?

A. The limited-slip differential's friction modifier additive in the gear oil has been depleted or the gear oil has been replaced with conventional gear oil that lacks the friction modifier — the modifier controls the engagement characteristics of the differential's clutch packs; without it, the clutch packs engage and disengage abruptly during the speed differential required for tight turns, producing the chatter

B. The spider gears inside the differential are worn and produce the chattering as they rotate during tight turns

C. The ring gear has a chipped tooth that contacts the pinion once per revolution and is only audible at the low speeds of parking lot maneuvering

D. The differential case bearings are worn and produce a noise that is masked by road noise during highway driving

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BLOCK F — STEERING, CHASSIS/FRAMES, SUSPENSIONS, TIRES, WHEELS & HUBS (Questions 86–103)

86. A heavy-duty truck has a condition where the steering becomes momentarily heavy (requires more effort) when hitting bumps at highway speed. Between bumps, the steering effort is normal. What is the most likely cause?

A. The power steering pump belt is slipping momentarily under the increased load that occurs when the steering absorbs the bump input

B. The steering damper is seized — a functional steering damper absorbs road shock input that would otherwise be transmitted to the steering system; a seized damper transfers the bump force directly to the steering gear, momentarily overloading the power steering system's assist capacity and making the steering feel heavy during the bump event

C. The king pins are worn and allow the steering knuckle to shift position during bump events, requiring more steering effort to re-center

D. The power steering gear's internal relief valve is set too low and opens momentarily under the pressure spike created by the bump input

87. A truck equipped with a recirculating ball steering gear has developed excessive play at the steering wheel center position. The drag link, tie rod ends, and king pins have been inspected and are within specification. What steering gear adjustment can correct this condition?

A. Replace the steering gear's worm shaft bearings to eliminate internal axial play that contributes to center lash

B. Replace the steering gear's spool valve with a tighter tolerance unit that reduces the internal hydraulic clearance

C. Adjust the steering gear's input shaft bearing preload to eliminate the free play at the worm-to-ball-nut interface

D. Adjust the steering gear's over-center (sector shaft) adjustment to reduce the clearance between the sector shaft teeth and the ball nut's rack teeth at the center position — the over-center adjustment specifically controls the mesh tightness at the straight-ahead position; tightening this adjustment reduces the free play at center without affecting the steering effort during turns

88. A heavy-duty truck has a steer tire blowout on the right front while traveling at highway speed. What is the correct driver response?

A. Firmly grip the steering wheel, maintain a straight course, gradually release the accelerator, and apply the brakes gently to slow the vehicle to a safe stop — do not brake hard (which shifts weight to the damaged wheel) or remove both hands from the wheel (the deflated tire's rolling resistance will pull the vehicle sharply to the right); controlled deceleration on the shoulder is the priority

B. Apply the brakes firmly and immediately to stop the vehicle as quickly as possible

C. Accelerate briefly to stabilize the vehicle before applying the brakes

D. Immediately steer to the left shoulder (oncoming traffic lane) because the damaged right tire will pull the vehicle to the right and the left shoulder provides a safety margin

89. A truck's leaf spring suspension on the steer axle has a condition where the ride height is noticeably lower on the left side. Both springs are the same part number and were installed at the same time. What is the most likely cause?

A. The left spring has a cracked main leaf that is allowing the spring to sag under the vehicle's weight

B. The left spring shackle pins and bushings are worn more than the right side, allowing the spring to sit lower in its hangers

C. The left spring has taken a set (sagged) from fatigue, overloading, or a combination of both — springs lose their arch over time, and the left spring's reduced arch lowers the ride height on that side while the right spring retains more of its original arch

D. The left spring U-bolts are over-torqued, compressing the spring beyond its designed arch

90. A heavy-duty truck equipped with disc brakes on the steer axle has a condition where the left front brake produces a metallic scraping noise during wheel rotation that stops when the brakes are applied. What is the most likely cause?

A. The left front caliper piston is over-extended and the piston edge is contacting the rotor surface during rotation

B. The left front brake pad is installed backward with the metal backing plate facing the rotor instead of the friction material — the metal backing contacts the rotor during rotation and the noise stops when the brake is applied because the application force pushes the metal plate flush against the rotor; alternatively, a pad retaining clip or anti-rattle spring has shifted and is contacting the rotor

C. The left front rotor has a high spot from casting porosity that contacts the pad at one point per revolution

D. The left front wheel bearing has excessive play that allows the rotor to wobble and contact the pad intermittently

91. A trailer with air ride suspension has a condition where the rear of the trailer bounces excessively after the vehicle crosses a bridge expansion joint. The bounce takes 4-5 cycles to dampen. What component has most likely failed?

A. The air springs have lost their nitrogen pre-charge from extended service life

B. The height control valve is responding too quickly to the suspension input and over-correcting with each bounce cycle

C. The air spring bellows have developed internal wear that changes their spring rate during compression and extension

D. The shock absorbers on the trailer suspension have lost their damping ability — the shock absorbers are the only components that resist the air springs' natural oscillation; without adequate damping, the springs bounce freely at their natural frequency after being disturbed, taking multiple cycles to dissipate the energy through friction rather than the 1-2 cycles that functional shock absorbers would achieve

92. A heavy-duty truck has a condition where the front tires produce an audible "thumping" noise at highway speed that corresponds to wheel rotation frequency. The tires are balanced and the tread appears normal. The noise is not present at low speeds. What is the most likely cause?

A. The tires have developed flat spots from extended parking in cold weather — the flat spot produces a thump at each revolution as the flattened section contacts the road; at low speeds the thump is too slow to be audible, but at highway speed the frequency becomes noticeable

B. The tire tread has a manufacturing variation in rubber density that creates a heavy spot despite being balanced

C. The brake drums are contacting the shoes at one point per revolution, producing the rhythmic thump

D. The wheel studs are slightly different lengths, creating an imbalance that produces a thump at the rotational frequency

93. A truck's fifth wheel has been diagnosed with excessive jaw wear. The jaw faces show deep grooves from the king pin's repeated contact. What is the consequence of operating with worn jaws?

A. The worn jaws allow lateral movement of the king pin, reducing coupling security

B. The worn jaws will cause premature wear on the fifth wheel top plate from the increased articulation angle

C. Worn jaw faces allow the king pin to sit loosely in the coupling, creating free play that produces a clunking noise during acceleration and braking transitions and potentially compromising coupling security — in extreme cases, the worn jaws may not retain the king pin securely, risking trailer separation

D. The worn jaws increase the effort required to couple and uncouple the trailer from the tractor

94. A truck equipped with hub-piloted aluminum wheels has a recurring issue where the wheels develop cracks at the lug nut bolt holes. The correct torque is applied during every installation. What should be investigated?

A. The wheel nut flanges, which may be too large for the bolt hole countersink and are concentrating stress at the hole edge

B. The wheel mounting procedure — the technician may be using an impact wrench without a final torque wrench pass, and the impact may be applying instantaneous torque spikes that exceed the aluminum's fatigue limit at the bolt holes; alternatively, the incorrect nut style (stud-piloted nuts on hub-piloted wheels) may be creating a bending load on the bolt holes that causes fatigue cracking

C. The steer axle alignment, which if incorrect could create cyclic bending loads on the wheel bolt holes during cornering

D. The brake drum weight, which if excessive could create a centrifugal force at highway speed that stresses the bolt holes

95. A trailer's self-steering tag axle has a condition where the axle steers correctly during right turns but does not steer during left turns — the tires scrub straight ahead during left turns. What is the most likely cause?

A. The steering linkage on the left side of the tag axle has seized from corrosion

B. The tag axle's steering cylinder or linkage has a failed component on one side that prevents movement in the left-steer direction

C. The self-steering geometry is asymmetric due to a previous alignment adjustment that was performed incorrectly

D. The self-steering mechanism has a failed or seized component on the left-steer side — the steering linkage, the pivot point, the centering spring, or the steering stop on the left side is preventing the axle from rotating in the left-steer direction; the right-steer components are functional, allowing normal steering during right turns

96. A heavy-duty truck's frame inspection reveals a crack at the upper flange-to-web radius of the right frame rail near the cab mount location. The crack extends approximately 25 mm. What is the correct immediate action?

A. Stop-drill the crack tip to arrest propagation and contact the frame manufacturer for the approved repair procedure — the stop drill removes the stress concentration at the crack tip and prevents the crack from growing further while the proper repair is planned; the vehicle should not operate at gross weight until the repair is completed

B. Weld the crack closed using MIG welding and continue operating the vehicle normally

C. The crack is too small to affect frame integrity and should be monitored at the next scheduled inspection

D. Apply an epoxy repair compound to the crack and reinforce with a fiberglass patch

97. A truck's power steering system has a condition where the steering assist cuts out intermittently during driving, requiring the driver to exert significantly more effort to turn the wheel. The assist returns after a few seconds. The fluid level is correct. What should be investigated?

A. The steering gear's internal spool valve for contamination that intermittently blocks the hydraulic assist passages

B. The power steering pump belt for proper tension and condition — the belt may be slipping intermittently from inadequate tension or a worn belt surface

C. The power steering pump's flow control valve for a sticking condition that intermittently diverts the pump's output to the bypass rather than to the steering gear

D. The power steering pump, its belt, and the fluid lines for the source of the intermittent loss — a loose belt that slips under heavy steering load, a failing pump with intermittent internal bypass, a kinked hose that restricts flow during certain steering positions, or a clogged filter screen (if equipped) that intermittently starves the pump can all produce intermittent assist loss

98. A truck's steer axle has a condition where both tires show even tread wear across the face but one tire has significantly more tread remaining than the other after the same mileage. Both tires are the same brand, model, and were installed at the same time. What could explain the different wear rates with even wear patterns?

A. The tire with less remaining tread was manufactured from a softer rubber compound batch than its partner

B. The brake on the side with more wear is dragging slightly, generating heat that accelerates the rubber degradation and wear rate on that tire while the other side's brake runs freely

C. The side with more wear carries slightly more of the steer axle load — from an off-center engine, an asymmetric fifth wheel position, or a frame twist that biases the steer axle load to one side

D. The tire with more wear has been exposed to more direct sunlight (driver's side in North America) that has UV-degraded the rubber and accelerated the wear rate

99. A truck equipped with a single rear axle has a condition where the vehicle vibrates severely at exactly 90 km/h. Above and below this speed, the vibration is minimal. The tires have been balanced and the driveshaft has been checked. What should be investigated?

A. The rear axle housing for a resonant frequency that amplifies vibration at the specific road speed where the axle housing's natural frequency matches the excitation input from the road surface

B. A tire with a separated belt or internal defect that becomes apparent only at the specific frequency corresponding to 90 km/h

C. The engine mounts, which may resonate at the specific engine RPM that corresponds to 90 km/h in the current gear

D. The driveshaft's critical speed — the driveshaft may be operating at or near its critical speed (the RPM where its natural bending frequency matches its rotational frequency) at 90 km/h; at critical speed, any imbalance or runout is amplified by resonance, producing severe vibration that diminishes above and below this speed

100. A truck's steer axle has a measured toe setting of zero (neither toe-in nor toe-out). The manufacturer's specification calls for 2 mm of toe-in. What symptom will zero toe produce?

A. Zero toe will cause both steer tires to wear on their inside edges because the tires are angled slightly outward relative to the direction of travel — the 2 mm of toe-in is specified to compensate for the natural tendency of the steer axle to toe-out under driving loads; without the compensating toe-in, the dynamic toe becomes slightly toe-out during driving, scrubbing the inside edges

B. Zero toe will cause the vehicle to wander at highway speed because the tires are not pointed in the same direction

C. Zero toe will cause the steering wheel to vibrate because the tires are fighting each other for directional control

D. Zero toe will have no measurable effect on tire wear because the deviation from the 2 mm specification is too small

101. A trailer equipped with an air ride suspension has one air spring that is constantly venting air from its base. The technician replaces the air spring, but the venting continues with the new spring. What is the most likely cause?

A. The replacement air spring has a manufacturing defect identical to the original's fault

B. The air spring piston (the component the spring sits on) has a damaged or corroded surface that prevents the spring's base from sealing against it

C. The air supply fitting at the spring's base has a crack that is leaking air and was mistaken for a spring leak — replacing the spring does not address the cracked fitting, which continues to leak with the new spring installed

D. The height control valve on that corner is continuously adding air that exceeds the spring's pressure rating, forcing air past the base seal

102. A heavy-duty truck has a condition where the steering pulls to the left during braking and to the right during acceleration. The alignment is within specification. What is the most likely cause?

A. The engine mounts are worn and allow the engine-transmission assembly to shift position under acceleration and braking forces, changing the effective axle alignment and steering geometry

B. Unequal caster side-to-side, combined with the weight transfer that occurs during braking (forward) and acceleration (rearward), produces directional changes at the steer axle

C. The steer axle king pin inclination is unequal side-to-side, creating a directional bias that reverses with weight transfer direction

D. Worn engine or transmission mounts that allow the powertrain to shift position — under acceleration, the engine torque reaction twists the assembly one direction, shifting the frame's geometry and steering to the right; under braking, the deceleration forces shift the assembly the opposite direction, changing the steering pull to the left; the mounts must be replaced to stabilize the powertrain position

103. A trailer equipped with drum brakes has a condition where all four brake drums on the tandem axle are blue-colored from heat. The brake adjustment is correct and no single brake is dragging. What operating condition would cause all four brakes to overheat simultaneously?

A. The trailer's axle bearings are all adjusted too tightly, generating heat that transfers from the bearings to the drums

B. The trailer's tire pressures are all significantly underinflated, causing excessive rolling resistance that the brakes must overcome during every stop

C. The trailer's brake linings are a higher-friction-coefficient material than the OEM specification, generating more heat during normal braking

D. The trailer has been subjected to sustained heavy braking — either from a long, steep downhill descent, an overloaded trailer that required more braking force than normal, or a driver who rides the brakes during driving; all four drums overheat simultaneously because the excessive braking demand is shared equally across all drum positions

104. A heavy-duty truck's cab has a condition where water collects on the inside of the windshield during rain — not from external leaks but from condensation forming on the glass surface. The defrost system is functioning and the A/C is operational. What is the most likely cause of the persistent condensation?

A. The HVAC system's recirculation door is stuck in the recirculate position — the system continuously recirculates the moisture-laden cab air instead of introducing drier outside air; the A/C dehumidifies the air, but if the recirculation mode prevents fresh air from entering, the moisture content of the cab air builds faster than the A/C can remove it, and the cold windshield provides a condensation surface

B. The windshield has a factory defect in its glass composition that attracts moisture more than normal windshield glass

C. The cab's door seals are leaking rainwater that evaporates on the cab floor and raises the humidity inside the cab

D. The heater core has a micro-leak that introduces moisture into the HVAC airstream in the form of coolant vapor

105. A transit bus has electrically heated steps at the front and rear passenger doors. The front steps heat normally in winter, but the rear steps do not produce heat. The circuit breaker for the heated steps is not tripped. What should the technician check?

A. The front and rear step heaters share a common ground and a fault in the rear ground would only affect the rear heater

B. The heated step control relay, which controls both front and rear heaters simultaneously

C. The rear step heater circuit — since the front steps work (confirming the control circuit, circuit breaker, and power supply are functional), the fault is isolated to the rear step's dedicated wiring,

connector, or heating element; check for voltage at the rear heater connector to determine whether the fault is in the supply wiring or the heater element itself

D. The bus body controller module, which may have disabled the rear step heater due to a detected overcurrent condition

106. A heavy-duty truck's cab tilt indicator on the dashboard shows the cab is not fully latched even though the cab is fully lowered and the latch mechanism is confirmed as engaged. What is the most likely cause?

A. The cab tilt latch position switch or sensor is misadjusted, damaged, or has a wiring fault — the physical latch is engaged (verified manually) but the electrical switch that reports the latch position to the dashboard indicator is not detecting the latched condition due to misalignment, a faulty switch, or an open wire in the switch circuit

B. The cab tilt hydraulic cylinder retains residual pressure that prevents the cab from fully settling against the latch

C. The cab mounting bushings have compressed, lowering the cab slightly and misaligning the latch mechanism with the striker

D. The dashboard indicator lamp is faulty and illuminates regardless of the switch input

107. A truck equipped with power-adjustable heated mirrors has a condition where the left mirror adjusts in all four directions (up, down, left, right) but the heater does not function. The right mirror's heater works normally. What is the most likely cause?

A. The left mirror's heating element has failed (open circuit) — since the mirror adjusts in all directions, the power supply, ground, and mirror control circuit are all functional; the heater element is a separate component within the mirror assembly with its own circuit, and an open heating element prevents current flow through that specific circuit while leaving the adjustment circuits unaffected

B. The mirror heater relay has a contact that controls only the left heater and has failed while the right heater contact remains functional

C. The body controller module has disabled the left heater output due to a detected overcurrent condition on that specific circuit

D. The left mirror's temperature sensor has malfunctioned and is reporting a temperature above the heater activation threshold

108. A heavy-duty truck has a condition where the driver's door will not latch closed — the door bounces open after the driver pushes it closed. The striker and latch mechanism are clean and lubricated. What is the most likely cause?

A. The door hinges have sagged, lowering the door so that the latch and striker are no longer aligned vertically

B. The door check arm (the device that holds the door at intermediate positions) has seized in a partially extended position, preventing the door from closing far enough for the latch to engage the striker

C. The door weather seal has swollen from age and chemical exposure, pushing the door outward before the latch can fully engage the striker

D. The striker plate position has shifted from loosened mounting screws, or the striker is worn and the latch fork cannot fully capture and hold the striker — if the striker is too far from the latch's engagement position, the latch cannot close fully around the striker, and the door's weather seal pressure pushes the door back open

109. A flatbed trailer used for hauling construction equipment has a condition where the deck boards are cracked and splintered in the area where the equipment tracks contact the floor during loading. What is the correct repair approach?

A. Replace the damaged deck boards with standard lumber of the same thickness and width

B. Reinforce the damaged areas with steel plates bolted over the existing deck boards

C. Apply a rubber mat over the damaged area to distribute the equipment's track load over a wider surface area

D. Replace the damaged deck boards with hardwood or composite boards rated for the concentrated loads of tracked equipment — standard lumber may not have adequate strength for the point loads created by steel equipment tracks; the replacement boards must match or exceed the original specification for load rating and be properly secured to the crossmembers

110. A trailer's air system has a condition where the service brakes apply but feel weak even though the air pressure reading at the gladhand is correct. The tractor's brakes are strong. What should be checked on the trailer?

A. The trailer's relay valve crack pressure, the air line condition between the relay valve and the brake chambers, the brake adjustment on all wheel positions, and the lining condition — the air supply is adequate (confirmed at the gladhand), so the issue is in the trailer's ability to convert that air pressure into braking force at the wheels

B. The tractor's foot valve output pressure, which may be sending a weaker signal to the trailer circuit than to the tractor circuit

C. The trailer's ABS system, which may be limiting the brake application pressure due to a detected fault

D. The gladhand seal, which may be allowing a pressure loss between the gladhand connection and the trailer's relay valve

111. A trailer equipped with a refrigerated body has a condition where frost forms on the outside surface of the trailer walls in specific areas — the frost pattern appears as rectangular patches on the exterior skin. What do these frost patches indicate?

A. The trailer's exterior skin has areas of thinner gauge metal that conduct cold more efficiently than the surrounding panels

B. The refrigeration unit is overcooling the cargo area and the excess cold is penetrating the insulation

C. The insulation panels behind the frost patches have failed, deteriorated, or are missing — the frost forms on the exterior skin where the interior cold penetrates directly through the uninsulated wall section; intact insulation prevents the cold from reaching the outer skin, and the frost-free areas confirm the insulation is functional everywhere except the affected patches

D. Moisture has penetrated the trailer's exterior skin and frozen between the skin and the insulation layer

112. A trailer's emergency (supply) gladhand has a damaged seal. Air is audibly leaking from the gladhand connection when the trailer is connected to the tractor. What is the immediate consequence of this leak?

A. The leak reduces the trailer's air supply pressure, potentially causing the spring brakes to partially apply during driving

B. The leak will cause the tractor protection valve to close and apply the trailer spring brakes because the tractor's system cannot maintain pressure with the continuous leak at the gladhand

C. The leak increases compressor cycle frequency and wastes fuel but has no effect on braking performance

D. The leak allows moisture to enter the trailer's air system through the damaged seal, contaminating the trailer's desiccant

113. A trailer's landing gear has been found with one leg shorter than the other when both are fully extended. The legs were the same length when the trailer was new. What is the most likely cause?

A. The shorter leg's internal stop has shifted from a previous overload event that compressed the stop position

B. The internal leg tube on the shorter side has bent from an impact (hitting a loading dock, scraping a curb, or contacting an obstruction during backing) that shortened its effective length

C. The gearbox cross-shaft has twisted, advancing one leg further than the other during cranking

D. One leg has been replaced with an incorrect part number that has a different extended length specification

114. A trailer equipped with side skirts (aerodynamic fairings mounted between the trailer's frame and the ground) has one skirt panel that has come loose and is hanging by its rear mounting bracket. What is the immediate concern?

A. The loose skirt panel creates an aerodynamic disturbance that increases fuel consumption by disrupting the designed airflow pattern under the trailer; more critically, the hanging panel is a road hazard — it can contact the road surface, break free entirely and strike following vehicles, or catch on road infrastructure; the panel must be secured or removed before the trailer operates

B. The loose panel will damage the trailer's air lines and electrical harness that are routed along the frame behind the skirts

C. The skirt panel protects the landing gear from road debris and the loose panel exposes the gear to potential damage

D. The loose panel will cause the trailer to track slightly to one side from the asymmetric aerodynamic forces

115. A trailer's brake system has been converted from S-cam drum brakes to air disc brakes on all axle positions. After the conversion, the driver reports that the brakes feel different — the pedal effort required for a given deceleration rate has changed. Is this expected?

A. No — drum and disc brakes should feel identical to the driver because the air system delivers the same pressure regardless of the foundation brake type

B. No — the conversion should have included a new relay valve calibrated for the disc brake system's different pressure requirements

C. Yes — disc brakes have different application characteristics than drum brakes, including more linear response, less brake fade during sustained use, and potentially different sensitivity to pedal input; the driver needs time to adapt to the different feel, and the system may require a relay valve or proportioning adjustment to match the driver's expectations

D. Yes — disc brakes always require more pedal effort than drum brakes due to the higher clamping force needed to compress the caliper piston

116. A trailer's structural inspection reveals that the trailer's main I-beam has a crack in the bottom flange directly below a point where a heavy object was dropped onto the deck during loading. The crack extends approximately 50 mm. What is the correct assessment?

A. The crack is cosmetic and the I-beam retains its full structural capacity as long as the crack does not extend into the web

B. The crack compromises the I-beam's structural integrity at a critical stress point — the bottom flange of an I-beam carries the tensile load when the beam is loaded from above, and a crack in this flange under a known impact point indicates the material has been stressed beyond its yield strength; the crack must be professionally repaired according to the manufacturer's approved procedure or the beam section replaced

C. The crack will self-arrest at its current length because the stress has been relieved by the fracture

D. The crack can be welded by any certified welder using standard mild steel welding procedures

117. A truck's A/C system has a condition where the compressor runs continuously without cycling off, the vent temperature is colder than normal (approaching 0°C), and frost is visible on the evaporator housing. What component has most likely failed?

A. The compressor clutch relay is stuck in the closed position, bypassing the normal cycling controls

B. The high-pressure switch has failed in the closed position, preventing the system from recognizing a high-pressure condition

C. The condenser fan has failed, preventing the high-side pressure from rising enough to trigger the high-pressure switch

D. The evaporator temperature sensor or the low-pressure cycling switch has failed in the closed (run) position — these components normally cycle the compressor off when the evaporator reaches near-freezing temperature or the suction pressure drops to a preset minimum; if either fails closed, the compressor runs without interruption, the evaporator temperature drops below freezing, and ice forms on the evaporator and its housing

118. A truck's cab heater produces heat only when the engine RPM is above 1,500. At idle, the heater produces lukewarm air. The engine reaches full operating temperature at idle. What is the most likely cause?

A. The heater core has a partial internal restriction from corrosion or deposits that limits coolant flow through the core — at idle, the water pump output is at its minimum and cannot push adequate coolant through the restricted core; at higher RPM, the increased pump output forces more coolant through the restriction, providing enough flow for effective heat transfer

B. The thermostat is opening too early at idle, diverting coolant to the radiator before it reaches full temperature

C. The coolant level is slightly low and the heater core is partially air-locked at idle when coolant flow is minimal

D. The blend door actuator is responding to the engine RPM signal and is partially closing the blend door at idle

119. A truck's A/C system has been evacuated and recharged, but the system produces only marginal cooling. The manifold gauges show normal pressures for the ambient temperature. The compressor engages and runs continuously. What should the technician check?

A. The condenser fan speed, which may be running too fast and overcooling the high side

B. The evaporator core for a wax or oil film that insulates the fins and reduces heat absorption from the air

C. The HVAC blend door position — normal refrigerant pressures confirm the A/C system is functioning correctly; the marginal cooling is likely caused by the blend door being partially open to the heater core, mixing heated air with the cooled air and raising the vent temperature; the blend door actuator, its control signal, and the door's mechanical position must be verified

D. The refrigerant type, which may have been mixed with a non-compatible refrigerant during the charge

120. A transit bus has separate heating zones for the driver's area and the passenger compartment. The driver's area heats normally, but the passenger compartment has cold spots near the rear of the bus. What is the most likely cause?

A. The rear heating duct has collapsed or become disconnected, preventing heated air from reaching the rear passenger area

B. The passenger compartment's heater core is partially restricted, limiting the flow of hot coolant to the rear section of the core

C. The air circulation fans in the passenger compartment are operating at reduced speed due to a faulty fan speed controller

D. The rear windows have insufficient insulation, allowing cold air infiltration that overwhelms the heating system's capacity at the rear

121. A truck's A/C system has a refrigerant leak that the technician has located at the compressor shaft seal. What operating condition most commonly causes compressor shaft seal failure?

A. Extended periods of A/C system inactivity — when the system is not operated for months (during winter), the shaft seal's rubber element dries out and loses its flexibility from lack of refrigerant oil lubrication; when the system is activated in spring, the hardened seal cannot conform to the shaft surface and leaks; periodic operation during winter maintains seal lubrication and flexibility

B. Excessive system charge that increases the pressure differential across the seal beyond its design capacity

C. Contaminated refrigerant that chemically attacks the seal material and causes it to deteriorate

D. Excessive compressor RPM from a pullley ratio mismatch that creates centrifugal force exceeding the seal's design capacity

122. A truck's heated windshield washer system has a condition where the washer fluid becomes extremely hot during operation — hot enough that the driver can feel the heat on the windshield glass. What is the concern?

A. Extremely hot washer fluid can thermally shock the cold windshield glass, creating a rapid temperature differential that can crack the windshield — this is particularly dangerous in winter when the windshield is at sub-zero temperatures and the sudden application of hot fluid creates a temperature gradient exceeding the glass's thermal stress limit

B. The hot fluid will dissolve the windshield wiper rubber and cause the blades to deteriorate prematurely

C. The hot fluid will evaporate before it reaches the windshield, providing no cleaning action

D. The hot fluid will damage the washer nozzles' plastic bodies from thermal degradation

123. A truck's HVAC system has a condition where the A/C compressor clutch engages but the compressor does not turn — the clutch plate spins against the pulley without driving the compressor shaft. The belt drives the pulley normally. What has failed?

A. The compressor clutch air gap is too wide, preventing the magnetic field from generating adequate pull force to lock the clutch plate to the pulley

B. The A/C system pressure is too high, creating a mechanical load that prevents the clutch from holding

C. The compressor clutch plate has delaminated from the hub or the hub's spline connection to the shaft has stripped — the clutch plate engages against the pulley face, but the connection between the plate and the compressor shaft is broken, allowing the plate to spin on the pulley without transmitting torque to the compressor's internal mechanism

D. The compressor's internal components have seized and the clutch plate is designed to slip as a protective feature to prevent belt damage

124. A hydraulic system on a utility truck has a condition where the boom cylinder extends normally but makes a loud banging noise at the end of the extension stroke. The noise is not present during retraction. What is the most likely cause?

A. The relief valve is set too high, allowing the cylinder to extend with excessive force that impacts the end cap

B. The cylinder is over-pressurizing at the end of stroke because the directional valve does not shift to neutral quickly enough when the operator releases the control

C. The cylinder's internal cushion on the cap end (the deceleration device designed to slow the piston before it contacts the end cap) has failed — without the cushion, the piston slams into the cap at full speed and force, producing the banging noise; the retraction direction has its own cushion on the rod end that is still functional, which is why the noise only occurs during extension

D. The boom's mechanical stop is contacting the frame before the cylinder reaches full extension, transmitting the impact force through the cylinder as a bang

125. A hydraulic system's pressure gauge shows pressure fluctuations of 200-300 psi at a frequency of approximately 4 cycles per second during normal operation. The fluctuations are visible on the gauge needle. What is the most likely cause?

A. The pressure gauge's internal mechanism is worn and the needle is oscillating from mechanical play

B. The hydraulic system has a standing pressure wave (resonance) in the hydraulic lines — the system's line lengths, diameters, and fluid properties create a condition where pressure waves reflect off closed ends (cylinder caps, valve spools) and constructively interfere at a specific frequency, amplifying the pressure oscillation

C. The pump's internal gear mesh is producing pressure pulses at the gear mesh frequency that are not being adequately dampened by the system's accumulator or the fluid's natural compressibility

D. The relief valve poppet is chattering at its set point, producing the rapid pressure fluctuations as it opens and closes at high frequency

126. A hydraulic system has been recently serviced and the reservoir was drained and refilled with new hydraulic oil. After the service, all hydraulic functions operate but are noticeably noisier than before. The noise is a continuous whining from the pump area. What is the most likely cause?

A. The new hydraulic oil has a different viscosity than the original specification, changing the pump's internal clearances and flow characteristics

B. Air was introduced into the system during the oil change and has not been fully purged — the air in the fluid causes the pump to cavitate as it compresses the air bubbles, producing the whining noise; the system needs to be operated through all functions at low pressure to circulate the fluid and allow the air to separate at the reservoir

C. The new oil contains anti-foam additives that interact with the pump's internal surfaces differently than the previous oil

D. The pump was damaged during the oil change from running dry for a brief period when the system was first started

127. A hydraulic crane has a condition where the operator cannot feather (precisely control at slow speed) the boom extend function — the boom either moves at full speed or not at all. The boom retract function feathers normally. What is the most likely cause?

A. The boom extend function's proportional valve spool is sticking from contamination, preventing smooth modulation

B. The boom extend directional valve spool is contaminated or has a scored surface that causes it to stick — the spool cannot modulate smoothly from closed to open; instead, it sticks in the closed position until enough pilot force builds to overcome the sticking, then jumps to a fully open position; the retract spool operates independently and is not affected

C. The boom extend flow control valve is set to maximum flow and cannot be reduced to allow feathering

D. The operator's control lever has a mechanical fault that prevents smooth input on the extend side

128. A hydraulic system's filter bypass indicator has activated. The technician replaces the filter element, resets the indicator, and returns the system to service. Within 30 minutes of operation, the bypass indicator activates again. What does the rapid filter loading indicate?

A. The replacement filter element is the wrong micron rating and is too fine for the system's normal contamination level

B. The system has an active, ongoing contamination source — the pump, a cylinder, or a valve is generating metallic wear debris at a rate that loads the new filter within 30 minutes; alternatively, the system's fluid has been contaminated with an external substance (water, wrong fluid, or environmental contamination) that overwhelms the filter's capacity

C. The filter bypass indicator is defective and is activating at too low a pressure differential

D. The hydraulic fluid has aged beyond its service life and the fluid's suspended contaminants are clogging the new filter

129. A hydraulic system on a dump truck uses a single-acting cylinder for the dump body hoist — the cylinder has only one hydraulic port (cap end) and the body's weight retracts the cylinder during lowering. The body lowers too slowly. What controls the lowering speed?

A. The body's weight and the hydraulic fluid's viscosity are the only factors controlling the lowering speed

B. The pump's check valve, which prevents fluid from flowing back through the pump during lowering

C. The weight of the dump body combined with the atmospheric pressure acting on the rod end of the cylinder

D. The flow control or metering valve in the return line — as the body's weight pushes the piston down, fluid is forced out of the cap end through the return line to the reservoir; a metering valve or flow control in this return path regulates how quickly the fluid can exit, controlling the descent speed; if this valve is set too restrictively or has become partially clogged, the body lowers too slowly

130. A hydraulic system has a condition where the pump's suction line vibrates visibly during operation. The vibration can be felt by touching the line. What does this vibration indicate?

A. The pump is cavitating from a restricted suction supply — the pump is trying to draw more fluid than the restricted suction line can deliver, creating a partial vacuum in the line; the alternating collapse of vacuum bubbles and the turbulent flow through the restriction cause the visible vibration in the suction line

B. The pump's mounting bolts are loose and the pump's vibration is being transmitted to the connected suction line

C. The suction line is the wrong diameter for the pump and the flow velocity exceeds the recommended maximum for the line size

D. The reservoir's breather cap is plugged, creating a vacuum inside the reservoir that pulls the suction line inward

131. A hydraulic system uses a pilot-operated check valve to hold a load in position. The load drifts slowly downward when the system is off. What is the most likely cause of the drift?

A. The pilot-operated check valve's main poppet has contamination on its seat that prevents it from sealing completely

B. The pilot pressure line has a small leak that allows residual pilot pressure to partially open the check valve

C. The pilot-operated check valve's poppet seat has contamination, a nick, or wear that prevents it from sealing fully — even a microscopic particle on the seat allows a slow, steady flow past the check valve under the load's pressure; the drift is slow because the leak path is very small, but it is continuous because the load provides constant pressure against the compromised seal

D. The cylinder's rod seal has failed and fluid is leaking externally past the rod, lowering the load as the fluid escapes

132. A battery electric bus has a condition where the regenerative braking force varies significantly during a single deceleration event — the regenerative braking feels strong initially, then weakens abruptly, then returns to full strength. The battery SOC is at 50%. What is the most likely cause?

A. The battery cells have developed inconsistent internal resistance from aging, and certain cell groups temporarily limit the charging current during regeneration

B. The VCU is modulating the regenerative torque based on a fluctuating wheel speed signal from a faulty wheel speed sensor

C. The inverter's power electronics are overheating intermittently, triggering thermal derating that reduces the regenerative current

D. The traction motor has a phase winding fault that intermittently reduces the motor's generating capacity — when the faulty winding's intermittent connection opens, the motor's generator output drops and the regenerative braking force weakens; when the connection re-establishes, the full regenerative force returns

133. A plug-in hybrid electric truck has a condition where the high-voltage battery's state of health (SOH) has dropped from 95% to 78% in 6 months. Normal degradation for this battery chemistry is approximately 2-3% per year. What could cause this accelerated degradation?

A. The vehicle is being operated primarily in electric mode on short trips that don't allow the battery to reach its thermal management operating temperature

B. The battery's thermal management system has failed — the cells are operating outside their optimal temperature range (either too hot or too cold) during charging and discharging; elevated temperatures accelerate chemical degradation of the cell chemistry (electrolyte decomposition, lithium plating, SEI layer growth), and cold temperatures cause lithium plating during charging; without thermal management, the cells degrade at many times the normal rate

C. The DC fast charging station used by the fleet has a calibration error that routinely overcharges the battery to 105% SOC

D. The regenerative braking system is feeding current to the battery at a rate exceeding the cells' maximum charge rate specification

134. A technician is performing routine maintenance on a hybrid bus and needs to check the coolant level in the high-voltage battery cooling circuit. The coolant is a dedicated dielectric (non-conductive) coolant. Why is dielectric coolant required for this circuit?

A. Dielectric coolant is required because a leak in the cooling circuit could allow coolant to contact high-voltage components — conductive coolant (such as standard ethylene glycol with corrosion inhibitors) would create an electrical path between the high-voltage system and the vehicle chassis through the leaked fluid, creating a shock hazard; dielectric coolant does not conduct electricity and eliminates this risk

B. Dielectric coolant has a higher specific heat capacity than standard coolant, making it more effective at cooling battery cells

C. Dielectric coolant is required because it does not freeze at the temperatures encountered during overnight parking in winter climates

D. Dielectric coolant is required because standard coolant's chemical composition corrodes the aluminum battery cell housings

135. A battery electric truck equipped with a two-speed transmission for the electric traction motor has a condition where the transmission will not shift from first gear to second gear during acceleration. The motor operates normally in first gear. What should be investigated?

A. The motor's torque output, which may be insufficient for the transmission to execute the shift at the current vehicle speed

B. The transmission's synchronizer, which may have failed from the electric motor's instant torque delivery that stresses the synchronizer differently than a combustion engine

C. The shift actuator, its control signal, and the shift enable conditions — the two-speed transmission uses an electronically controlled shift actuator (electric motor or solenoid); if the actuator has failed, its wiring is open, or the VCU's shift-enable conditions are not met (specific speed range, specific torque reduction during shift, specific motor RPM), the shift will not execute; the VCU must verify specific conditions before commanding the shift to protect the transmission from damage

D. The high-voltage battery SOC, which may be too low for the VCU to authorize a shift that would temporarily increase the motor's current draw

Practice Exam 9: Answer Key and Explanations

1. A — The 500 kg jack exceeds the 425 kg combined load by 75 kg, providing a 15% safety margin. The jack is adequate for this lift as long as the load is properly centered and balanced on the cradle. An off-center or unbalanced load shifts the center of gravity outside the jack's stability envelope, creating a tipping hazard that is independent of the weight rating. The technician must also ensure the jack is on a level, clean floor surface.

2. C — The DPF and its surrounding exhaust components can reach temperatures exceeding 600°C during active regeneration and remain above 400°C for an extended period after the engine is shut down. Touching these surfaces causes instant severe burns, and the radiant heat can ignite shop rags, cardboard, or other combustible materials placed near the exhaust. The technician must allow adequate cool-down time and verify surface temperatures with a non-contact thermometer before working near aftertreatment components.

3. B — Impact wrenches produce a sudden, high-torque reaction force when a fastener breaks free. Proper body positioning means standing balanced with feet shoulder-width apart, maintaining a firm two-handed grip, and positioning the body to absorb the reaction force in the direction it will occur. Anticipating the breakaway and bracing accordingly prevents the tool from jerking the technician off balance, which can cause wrist, arm, or shoulder injuries.

4. D — Frayed wire rope with visible broken wires is a structural failure that indicates the rope has exceeded its safe service life. Wire rope fails progressively — the visible breaks represent a fraction of the total damage, as internal wires may also be broken, corroded, or fatigued. The rope must be compared against the retirement criteria (number of broken wires per rope lay, wire diameter reduction, core deterioration) and replaced. Continued use risks catastrophic failure under load.

5. B — Ethylene glycol is toxic — as little as 100 ml can be fatal to an adult human, and its sweet taste makes it attractive and dangerous to children and animals. The coolant must be collected in a clearly labelled container and disposed of through an approved recycling or hazardous waste program. Allowing coolant to drain onto the ground, into floor drains, or into waterways violates environmental regulations and creates a direct poisoning hazard.

6. A — Any open intake or exhaust port on an engine is a direct path to the combustion chamber and the engine's internal components. Even a small piece of debris — a washer, a nut, a pebble, or an insect — that enters through an uncovered port can be drawn into the turbocharger compressor (destroying the wheel), ingested into a cylinder (scoring the liner and damaging the piston), or lodged in a valve seat (preventing sealing). Ports must be covered immediately upon disconnection.

7. D — A bulge in a hydraulic hose indicates the internal reinforcement layers (braided steel or spiral wire) have failed at that point. The outer rubber cover is the only remaining barrier containing the system pressure, which can exceed 3,000 psi. The hose can rupture without warning, spraying hot hydraulic fluid at high velocity — causing burns, injection injuries, fire, and environmental contamination. The hose must be replaced immediately regardless of whether it is currently leaking.

8. C — The correct jump-start sequence connects the positive cable to the dead battery's positive terminal first, then connects the negative cable to an engine ground point away from the battery. The ground connection is made away from the battery to prevent a spark near the battery's hydrogen gas vent. Lead-acid batteries produce hydrogen gas during charging and discharging, and a spark at the battery terminal can ignite this gas, causing a battery explosion that sprays sulfuric acid.

9. D — A sudden, severe lower-end knock accompanied by a significant oil pressure drop is the classic presentation of a catastrophic connecting rod bearing failure. The bearing has spun in its bore or disintegrated, and the connecting rod is now impacting the crankshaft journal and potentially the cylinder wall with each revolution. The engine must be shut down immediately — continued operation risks the connecting rod breaking through the engine block, which converts a repairable bearing failure into a complete engine replacement.

10. A — Crankcase pressure of 4.5 inches of water column exceeding the 3.0-inch maximum confirms that combustion gases are leaking past the piston ring-to-cylinder liner seal at a rate that overwhelms the crankcase ventilation system. This blow-by measurement is the definitive indicator that the engine's internal sealing has degraded to the point where an overhaul should be planned. The test confirms what oil consumption, power loss, and oil analysis may have suggested but could not definitively prove.

11. C — HEUI (Hydraulically actuated Electronically controlled Unit Injector) systems use high-pressure engine oil to actuate the injectors. The high-pressure oil pump must supply adequate oil volume and pressure to all injectors simultaneously. At idle, each injection event draws a small amount of high-pressure oil, and the worn pump can keep up. Under heavy load, each injection event draws significantly more oil, and the worn pump's enlarged internal clearances cannot maintain pressure against the increased demand.

12. B — During highway driving, ram airflow through the radiator provides substantial cooling without requiring the fan. At idle, there is zero ram airflow and the fan must provide 100% of the radiator's airflow. If the fan does not engage at idle (from a failed fan clutch, relay, temperature sensor, or control circuit), the radiator has no airflow and cannot reject the engine's heat production. The coolant temperature rises progressively until the fan eventually engages (if it can) or the high-temperature warning activates.

13. D — Lead, tin, and copper appearing together is the signature combination of tri-metal engine bearings. The overlay layer contains lead-tin alloy (the softest, first layer to wear), and the intermediate layer contains copper-lead alloy (exposed as the overlay wears through). The simultaneous presence of all three metals at elevated levels indicates the bearing overlay has worn through and the intermediate

layer is now wearing — a condition that progresses rapidly toward complete bearing failure if not addressed.

14. A — Compressed air introduced into cylinder 4 during a leakage test should remain in that cylinder if all sealing surfaces are intact. Air escaping into the adjacent cylinder 3 (heard at its injector port) confirms a direct path exists between the two combustion chambers. The only component that seals between adjacent cylinder bores is the head gasket. A blown fire ring between cylinders 3 and 4 creates this inter-cylinder leak path.

15. C — Many heavy-duty diesel air compressors are bolted to the engine block and share the engine's cooling circuit through passages in the mounting gasket. When this gasket fails at a coolant passage, coolant leaks externally at the compressor-to-block mounting surface. The leak appears to originate from behind the compressor because the gasket is sandwiched between the two components. Replacing the compressor mounting gasket and properly torquing the mounting bolts corrects the leak.

16. B — Common rail injection systems use pilot injection events — small, precisely timed fuel charges injected milliseconds before the main injection — to pre-heat the combustion chamber and initiate a controlled pressure rise before the main fuel charge arrives. Without pilot injection, the main injection encounters a colder, less prepared combustion environment. The resulting delayed ignition produces a rapid, uncontrolled pressure rise (diesel knock) that is significantly harsher and louder than the smooth combustion achieved with pilot injection.

17. D — A cracked intake manifold introduces unmeasured air into the intake system. The ECM calculates fuel delivery based on measured airflow (from the MAF sensor or MAP sensor), but the crack allows additional air to enter after the measurement point. The cylinders receive more air than the ECM knows about, creating a lean condition. The lean mixture burns hotter (increasing NOx), may cause power loss, and the ECM cannot compensate because it does not know the additional air exists.

18. A — Turbocharger manufacturers apply a protective oil coating to internal surfaces during assembly to prevent corrosion during storage and shipping. During the first startup, this oil enters the exhaust stream and burns as brief blue smoke. The smoke should clear within 30-60 seconds as the protective coating is consumed. If the smoke persists beyond this period, it indicates a genuine oil seal problem that requires investigation.

19. C — Fuel returning from the high-pressure injection system carries absorbed heat back to the tank, and the fuel picks up additional heat from the engine compartment's ambient temperature. Hot fuel is less dense — each cubic centimetre of hot fuel contains less energy than the same volume of cool fuel.

The ECM must increase the injection duration to compensate for the reduced energy density, and if the temperature exceeds the system's compensation range, the ECM derates to prevent over-injection and protect injection components from thermal damage.

20. B — A steady grey-white haze during constant-speed highway driving that is absent during acceleration and idle suggests a very small coolant leak into the combustion chambers. The leak is too minor to produce visible white steam during acceleration (where the increased exhaust volume and turbulence dilute the vapor) or at idle (where the lower cylinder pressures may not force coolant through the leak path). During steady-state, the consistent combustion conditions allow the small amount of vaporized coolant to appear as a visible haze.

21. D — When a cold engine is started, the engine block, cylinder head, oil passages, and all internal components begin to absorb heat and expand thermally. This expansion increases the internal volume of the oiling system — the block's oil galleries, the head's oil passages, the oil cooler, and the turbocharger's oil cavity all increase slightly in volume. Oil that was in the pan flows into these expanded passages, lowering the dipstick reading. When the engine cools and the components contract, the oil returns to the pan and the level normalizes.

22. A — Standard DEF (AUS 32) is a 32.5% urea solution that freezes at −11°C. If the DEF has been diluted with water — from condensation, improper mixing, or contamination — the urea concentration drops below 32.5%, and the freeze point rises above −11°C. The diluted DEF freezes at temperatures that correctly mixed DEF would withstand. The DEF quality sensor should detect the incorrect concentration, but a slow dilution process may stay within the sensor's tolerance range initially.

23. C — An aftermarket filter that physically fits the housing may not meet the OEM's performance specifications. Critical parameters include filtration efficiency (the percentage of particles at a specific micron size that the filter captures), dirt-holding capacity (how much contamination the filter can hold before bypassing), bypass valve setting (the pressure at which the valve opens to allow unfiltered oil to flow), and burst pressure (the maximum pressure the element can withstand). A filter that fails any of these specifications may not protect the engine adequately.

24. B — A cracked exhaust manifold on one bank allows exhaust pulses to escape externally through the crack. Each cylinder on the affected bank exhausts in its firing order sequence, and each pulse escapes through the crack, producing the rhythmic pulsing noise. The noise is louder on the affected bank because the crack is the leak source. The unaffected bank's intact manifold contains all exhaust pulses and directs them to the turbocharger, producing no external noise.

25. D — At higher fuel levels, the weight of the fuel column above the pickup tube creates hydrostatic head pressure that assists the transfer pump's suction. As the fuel level drops, this head pressure decreases. A partially clogged pickup tube sock filter or a small crack in the suction line becomes significant when the head pressure assistance is lost — the pump cannot draw adequate fuel against its own internal resistance plus the restriction, causing intermittent fuel starvation that only manifests at low tank levels.

26. A — A stable thermostat maintains a consistent opening position that regulates coolant flow and holds the temperature at the set point. An erratic thermostat alternates between opening (allowing coolant to flow to the radiator, dropping the temperature below the set point) and closing (blocking flow, allowing the temperature to rise above the set point). This cycling behavior indicates the thermostat's wax element is failing, debris is preventing smooth valve movement, or the thermostat is hunting because of a calibration issue.

27. C — The exhaust brake relies on a butterfly valve in the exhaust system that closes to create backpressure against the engine's exhaust stroke. The valve must remain firmly closed to maintain the retarding force. If the actuation mechanism — an air cylinder or electric motor — cannot maintain its holding force against the exhaust pressure, the valve gradually opens. An air cylinder with a slow leak loses its clamping force progressively, and an electric actuator with a thermal protection circuit may reduce current to the motor as it heats.

28. D — White smoke during the first 5 minutes of operation indicates unburned fuel vapor is passing through the cylinders without igniting. The engine's cold-start combustion assistance (glow plugs or intake air heater) is responsible for helping the compressed charge reach autoignition temperature when the cold cylinder walls absorb compression heat. If these components have failed, the engine relies solely on compression heat, which is insufficient until the block absorbs enough heat to stop stealing from the compressed charge.

29. D — DPF ash is non-combustible residue from engine oil additives that passes through the DPF channels but is not oxidized during regeneration. Over 500,000 km, this ash accumulates progressively in the channels. At idle's low exhaust flow rate, the accumulated ash does not significantly restrict flow. At loaded operation's high flow rate, the same ash mass creates measurable restriction because the exhaust volume attempting to pass through the narrowed channels is much greater. The DPF requires off-vehicle ash cleaning to restore its full flow capacity.

30. B — The compressor builds to cut-out normally (confirming the compressor and governor are functional), but the stored air drains from 125 to 100 psi in 2 minutes during the unloaded phase. This 12.5 psi/minute loss far exceeds the acceptable maximum (typically 2-4 psi/minute for the combination). The leak is consuming air faster than the normal resting losses, and the compressor must cut in again after only 2 minutes instead of the normal 5+ minutes. The entire system must be leak-tested to locate and repair the source.

31. D — The supply (emergency) gladhand and the service (control) gladhand are color-coded and positioned to prevent cross-connection, but mistakes happen. When cross-connected, pulling the red valve exhausts the service circuit (connected to the supply gladhand) instead of the supply circuit. The supply line retains pressure because it is connected to the service gladhand and does not receive the exhaust command. The spring brakes do not apply because the supply line (which must lose pressure to trigger spring brake application) remains pressurized through the incorrect connection.

32. A — The right front caliper's slide mechanism (slide pins, guide bolts, or slider rails) must allow the caliper body to float freely so that both the inner and outer pads apply evenly against the rotor. Seized, corroded, or contaminated slide pins prevent the caliper from floating, and only the piston-side (inner) pad applies force to the rotor. The floating-side (outer) pad cannot be pushed against the rotor because the caliper body cannot move. The left caliper's functional slides allow even application, producing the force difference.

33. C — A bleeder screw that cannot stop the fluid leak despite being fully tightened has lost its thread engagement in the caliper body. The original thread material in the caliper bore has stripped, and the screw threads pass through without compressing against a sealing surface. The caliper body must be replaced because the stripped bleeder bore cannot be reliably repaired — any attempt to re-tap the bore or use an oversize bleeder risks creating a leak under the high pressures of brake system operation.

34. B — Brake fade during sustained hill descent is caused by thermal degradation of the braking system. The repeated brake applications generate more heat than the drums can dissipate. The overheated drums expand thermally, increasing the drum's inside diameter and moving the friction surface away from the shoes. Simultaneously, the brake lining material undergoes thermal changes that reduce its coefficient of friction. Both effects combine to produce the progressive loss of braking force that characterizes brake fade.

35. D — At −30°C, any moisture in the air brake system's lines, valves, or chambers can freeze. The spring brake hold-off air line carries pressurized air from the relay valve to the spring brake chambers. If moisture has accumulated in a low point of this line or inside a chamber, it freezes into an ice plug that

physically blocks the airflow. The air system has pressure (confirmed by the gauges), but the ice prevents the air from reaching the spring brake pistons to compress the springs.

36. A — New brake shoes have a surface finish from the manufacturing process that does not precisely match the curvature and surface profile of the used drum. During the first 100 km, the brake shoes bed into the drums through normal friction contact — the high spots on the shoe surface wear down and the contact area gradually increases to match the drum's surface. Once bedded, the uniform contact eliminates the pulsation that was caused by the initial uneven contact.

37. C — The progressive weakening over 4 hours matches a heat-dependent failure. The trailer's relay valve is the component that cycles most frequently and generates internal heat from repeated operation. As the valve heats, its internal components expand thermally. A marginal seal that functions at lower temperatures begins to bypass as the thermal expansion changes the internal clearances. Application air leaks past the worn seal and exhausts through the valve's exhaust port instead of reaching the brake chambers.

38. B — The quick release valve's internal seal or diaphragm separates the inlet port from the exhaust port. When the brakes are released, this seal must close completely to prevent system air from escaping through the exhaust. A failed seal allows continuous air loss that the compressor must compensate for, increasing duty cycle and fuel consumption. More critically, during rapid repeated brake applications, the leak rate may exceed the supply rate to the front brakes, reducing the pressure available for the next application.

39. D — ABS activation during normal dry-pavement stops at low speed indicates the module perceives a wheel lockup condition that does not actually exist. At low wheel speeds, the wheel speed sensors produce their weakest signals (the voltage output is proportional to wheel speed). If one sensor has an excessive air gap, a damaged reluctor ring, or a deteriorating sensor element, its signal may drop below the module's detection threshold at low speeds. The module interprets the disappearing signal as a sudden wheel deceleration and intervenes.

40. A — The compressor's discharge temperature directly affects the desiccant's service life. An inadequately cooled compressor produces discharge air at temperatures that may exceed the desiccant's rated maximum operating temperature (typically 150-175°F/65-80°C for standard desiccants). Sustained exposure to temperatures above the rating thermally degrades the desiccant beads — they crack, lose their moisture-absorbing capacity, and break down into powder. The accelerated degradation requires more frequent cartridge replacement.

41. C — Compounding occurs when the service brakes are applied with the spring brakes already engaged. The service air pushes the service diaphragm, which pushes the pushrod further out because the service force adds to the spring force through the same mechanical linkage. The additional pushrod travel during compounding is normal and expected — it represents the service brake's additional contribution on top of the spring brake's holding force. The total stroke during compounding must remain within the chamber's maximum specification.

42. B — The trailer ABS lamp illuminating immediately upon connection and remaining on continuously indicates the ABS ECU completed its power-up self-test and detected a fault. A normal self-test illuminates the lamp for 3-5 seconds, then extinguishes if no faults are found. A continuous lamp means the ECU found a problem — it could be a sensor fault, modulator fault, power supply issue, or internal ECU fault. The scan tool must be connected to the trailer's diagnostic connector to retrieve the specific fault code.

43. A — A glowing red brake drum represents a temperature exceeding 500°C and is an immediate fire hazard — the tire, wheel seal grease, and surrounding components can ignite. The technician must clear the area and allow the drum to cool naturally. Spraying water on a red-hot cast iron drum risks thermal shock that can shatter the drum explosively. Once cooled, the brake must be thoroughly inspected to identify the cause of the severe drag — seized S-cam, broken return spring, stuck anchor pin, or failed automatic slack adjuster.

44. A — Zero pedal free play means the foot valve's input rod is constantly in contact with the internal piston, holding it slightly off its home (fully released) position. In this position, the valve may maintain a slight residual output pressure to all brake circuits. This residual pressure partially applies all brakes continuously — creating drag that generates heat, accelerates wear on all friction surfaces, reduces fuel economy, and can lead to brake fade from the sustained heat buildup.

45. C — Oil contamination at this severity level has affected every component in the air system. The compressor is the contamination source and must be repaired or replaced to stop the oil. The air dryer desiccant is saturated with oil and must be replaced. All tanks must be drained and flushed. Every valve, relay valve, quick release valve, and brake chamber must be inspected because the petroleum oil degrades rubber components — diaphragms swell, seals lose their sealing ability, and O-rings deteriorate. Residual contamination continues damaging components if not thoroughly removed.

46. B — A normal brake application consumes a specific volume of air from the circuit's reservoir, and the gauge drops proportionally. The primary gauge remains stable, confirming its circuit has normal air consumption. The secondary gauge drops more than expected during each application and returns to normal after release — this pattern indicates the secondary circuit has a leak that opens only when the

application pressure acts on a marginal seal. The leak consumes additional air during each application, causing the extra pressure drop.

47. D — The alternator requires sufficient field current through the exciter circuit to initiate and maintain charging. A high-resistance connection in the field circuit reduces this current below the self-excitation threshold at low RPM. At higher RPM, the alternator generates enough internal voltage to overcome the resistance and establish the field current needed for charging. Cleaning or repairing the corroded connector, damaged wire, or poor connection in the exciter circuit restores normal low-RPM charging.

48. A — The replacement BCM exhibits the same intermittent reboot, proving the fault is external to the module. The BCM requires stable, uninterrupted power and ground to operate. An intermittent open in the power supply wire, a corroded fuse contact, a loose connector pin, or an intermittent ground connection causes a momentary power loss that forces the BCM to reboot. Each of these connection points must be inspected, cleaned, and verified for secure contact.

49. C — The alternator may be producing 14.4V at its output terminal, but by the time the charging current travels through the output cable, fusible link, battery cable, and their connections to reach the battery and subsequently the headlight circuit, 1.6V has been consumed by resistance. The headlight connector should read near 14V with the engine running. A reading of only 12.8V confirms significant resistance in the charging circuit that must be located and corrected through voltage drop testing.

50. B — The BCM shows no fault for the left turn output, confirming the BCM is generating the correct signal at its output pin. The fault is downstream — between the BCM's output and the trailer lamp. Check for voltage at the correct J560 pin while the left turn is activated. If voltage is present, the fault is in the trailer wiring. If no voltage is present at the J560 pin, the fault is in the tractor's wiring between the BCM and the connector.

51. D — Battery voltage of 10.2V during cranking is within specification, confirming the batteries can deliver adequate voltage under load. The slow cranking must be caused by the starter motor itself — worn brushes that make inconsistent contact with the commutator, a contaminated commutator surface, or a partially shorted armature winding all reduce the motor's ability to convert electrical energy to mechanical torque. The motor draws current but wastes more of it as heat rather than producing rotational force.

52. A — The CAN bus functions (communication exists) but the data rate is abnormally slow. A high bus load from an aftermarket device flooding the bus with messages, a failing module transmitting at an

abnormally high rate, or a misconfigured module broadcasting excessive data can saturate the bus's bandwidth. The standard J1939 bus operates at 250 kbps with defined message priorities. When the bus is congested, lower-priority messages (including scan tool requests) are delayed, producing the slow update rate.

53. C — Both connectors measure identical voltage (13.8V), ruling out a circuit voltage drop difference. The brightness difference with equal voltage means one bulb draws less current than the other. A partially broken filament has higher resistance, draws less current at the same voltage (Ohm's Law), and produces less light. The voltage appears equal because the reduced current also eliminates the voltage drop that a healthy, higher-current bulb would create in its circuit.

54. B — Progressive derate escalation over a multi-day period is characteristic of an emission-related fault code with a regulatory-mandated derate timer. Environmental regulations require that certain emission system faults trigger an escalating power reduction to compel repair within a specific timeframe. The derate typically progresses from a mild 5-25% reduction to a 100% derate (idle only) over a period of engine-operating hours. This compels the operator to repair the emission system rather than continuing to operate indefinitely with elevated emissions.

55. D — The analog gauges (stepper motor driven) function correctly while the LCD displays are garbled. Both receive their data from the same CAN bus, so the data source is functional. The fault is in the cluster's internal LCD driver circuit or the LCD panel itself. These are separate electronic subsystems within the cluster — the stepper motor drivers and the LCD drivers use different internal components, and one can fail while the other continues to function.

56. B — With the battery cables disconnected and all switches off, the meter reads the combined parallel resistance of every electrical device permanently connected between the positive and negative power rails. Each module, relay coil, sensor, and electronic device has an internal resistance, and all of these in parallel produce a finite resistance reading. A significantly lower reading would suggest a short circuit, and an infinite reading would suggest a completely open main circuit.

57. C — The alarm still sounds but at reduced volume, indicating the alarm unit is functional but receiving less energy than required for full output. A resistance in the power supply circuit — from corroded wiring connections, a deteriorated ground, or a partially damaged wire — drops the voltage and limits the current reaching the alarm. The alarm converts less electrical energy to acoustic energy, producing a quieter output. Cleaning and repairing the circuit connections restores full voltage and volume.

58. A — The clock loses its settings while other devices retain theirs, indicating separate keep-alive circuits. Most electronic devices share a common memory-keep-alive power circuit that maintains their settings through ignition cycles. If the clock has its own dedicated keep-alive circuit (separate fuse, separate wire), a blown fuse or open wire in that specific circuit causes only the clock to lose power during ignition-off. The other devices retain settings because their shared keep-alive circuit is unaffected.

59. D — The wiring has been inspected and appears intact, but the fault is intermittent and occurs during driving. A modulator valve's internal coil is wound from fine wire that can develop a break from vibration fatigue. The broken wire ends may touch when the coil is at rest (producing a normal resistance reading during a static test) but separate during the vibration of driving. This intermittent internal break produces the open-circuit fault code only during dynamic conditions.

60. B — The throttle position sensor producing a constant 0% signal regardless of actual pedal position means the ECM receives no throttle input from the driver. The ECM interprets 0% as the pedal being fully released and commands idle speed. The sensor has either failed internally (producing no output change with pedal movement), its connector has become disconnected (providing no signal), or its wiring has an open that prevents the signal from reaching the ECM.

61. A — The alternator produces 14.2V at its output terminal, confirming the alternator is functioning correctly. The battery receives only 13.0V — a 1.2V drop in the charging circuit between the alternator and the battery. This 1.2V exceeds the maximum allowable (typically 0.5V) and indicates excessive resistance in the output cable, fusible link, battery cable, or their connections. The resistance wastes the alternator's output as heat and prevents effective battery charging.

62. C — The oil pressure sensor converts physical oil pressure into an electrical signal. Over time, the sensor's internal components (typically a piezoresistive element or a variable resistor) can drift from their original calibration. This drift shifts the sensor's output signal to a value that corresponds to a higher pressure than actually exists. The ECM or cluster faithfully displays the incorrect signal. The discrepancy is confirmed by comparing the sensor's reading to a known-accurate mechanical gauge.

63. B — A complete electrical failure with 12.6V at the battery posts indicates the battery has adequate charge but the vehicle cannot access it. The single point that connects the battery to every vehicle system is the main fusible link or the battery cable connection to the power distribution system. A blown fusible link or a completely failed battery cable terminal creates a single-point open that disconnects the charged battery from every circuit simultaneously.

64. D — A module's ground pin should read near 0V relative to battery negative because the ground connection provides a low-resistance return path to the battery. A reading of 12.4V at the ground pin means the pin is not connected to ground — instead, the voltmeter is reading battery voltage that passes through the module's internal circuitry from the power input to the ungrounded output. The module cannot function because current cannot flow without a complete circuit through the ground return.

65. A — The ELD uses the vehicle speed signal to determine driving status. If the speed signal contains noise spikes — from electromagnetic interference, a deteriorating vehicle speed sensor, or a noisy CAN bus message — the ELD may interpret these brief spikes as vehicle movement above the driving threshold. Each spike registers as a driving event even though the vehicle is stationary. Adjusting the ELD's speed threshold or filtering the speed signal input resolves the false events.

66. C — Heated windshields use embedded heating wires that connect to bus bars (conductive strips) at the edges of the glass. The bus bars distribute current from the power supply to all heating wires in their zone. If a bus bar connection on the left side breaks or corrodes, current cannot reach the heating wires on the left half. The right half continues to function because its bus bar connection is intact. Repairing the connection or replacing the windshield restores heating to both zones.

67. A — The starter solenoid contains an internal thermal protection device (on some designs) or the solenoid coil's resistance increases significantly when hot. After the first start, the solenoid retains heat from the heavy current it carried. If the thermal protector opens or the coil resistance rises too high, the solenoid cannot energize on the immediate restart attempt. After 10 minutes of cooling, the thermal protector resets or the resistance drops, and the solenoid functions again.

68. B — The ABS module calculates wheel speed based on the number of reluctor ring teeth and the tire's rolling circumference. Wide-base single tires have a different rolling circumference than the dual tire configuration the module was programmed for. The module interprets the different signal frequency as an invalid wheel speed that does not match its programmed configuration. Reprogramming the module with the correct tire size parameters for the wide-base tires resolves the configuration error.

69. D — The 7th-to-6th downshift requires a range shift from high to low under the dynamic conditions of a moving vehicle. The range synchronizer must overcome a larger speed differential during a downshift than during the corresponding upshift. If the range cylinder has marginal air pressure, a slow-acting valve, or a weakened synchronizer, it may complete the easier upshift but lack the force or time to match speeds for the more demanding downshift. The range air circuit and synchronizer must be inspected.

70. C — The lockup clutch's friction material controls the engagement transition from the unlocked (fluid coupling) state to the locked (mechanical coupling) state. Contaminated or glazed friction material has an inconsistent coefficient of friction — it alternately grips and slips during the progressive engagement, producing the shudder. Once the clutch is fully clamped and the slip stops, the friction surface holds steadily and the shudder disappears. The torque converter must be replaced.

71. A — DOT 3 brake fluid is glycol-based (synthetic), and the rubber seals in the master cylinder and slave cylinder are designed for glycol-based fluids. Power steering fluid (ATF) is petroleum-based and is chemically incompatible with glycol-rated rubber seals. The petroleum base causes the seals to swell, soften, and lose their sealing properties. The entire hydraulic system must be drained, all rubber components replaced (seals, cups, hoses), and the system refilled with the correct DOT 3 fluid.

72. D — The AMT's clutch learn parameters (kiss point, engagement position, release point) are stored in volatile memory that requires continuous power (keep-alive voltage) to retain. If the keep-alive power circuit has failed — from a blown fuse, a corroded connector, or an open wire — the stored parameters are erased every time the ignition is turned off. The TCU must relearn the clutch on every startup, producing rough engagement for the first few shifts until the learn cycle completes.

73. B — Dynamic balancing corrects mass distribution but does not verify phasing. Phasing refers to the angular alignment of the yoke ears at each end of the driveshaft. If the new yoke was welded at an incorrect clock position relative to the existing yoke at the other end, the U-joints operate out of phase. Out-of-phase U-joints produce a vibration at twice per revolution because the speed cancellation between the two joints is disrupted. The weld must be corrected to restore the proper phasing relationship.

74. A — Engaging the inter-axle lock eliminates the differential action — the gears stop rotating relative to each other. If the noise source were the differential gears, the noise would change or stop when the lock is engaged. Since the noise does not change, the source must be a component that rotates identically whether the lock is engaged or not — the power divider input gears, the drive pinion bearing, or other components upstream of the differential that are always rotating at the same speed regardless of lock status.

75. C — The countershaft bearing supports the countershaft — a heavily loaded shaft that carries all the gear forces inside the transmission. A worn bearing allows the countershaft to wobble slightly at its rotational frequency. This wobble produces a vibration that is transmitted through the transmission case to the shift tower and up through the shift lever to the driver's hand. The vibration correlates with driveshaft speed because the countershaft speed is directly proportional to output speed.

76. D — The cooler was recently serviced, and the temperature problem began after the service. Reversing the cooler's inlet and outlet connections routes the transmission fluid through the cooler in the opposite direction from the designed flow path. Some coolers have internal baffles or flow directors that work correctly only in one direction — reversing the flow bypasses these features, reducing the effective heat exchange surface area and the cooler's heat rejection capability.

77. A — A clutch pedal that slowly drops under sustained pressure but returns normally when released has a classic master cylinder internal seal leak. The primary piston seal holds momentarily when the pedal is pressed but cannot maintain the seal under sustained pressure — fluid slowly bypasses the worn seal, and the piston advances as the hydraulic volume ahead of it leaks back past the seal. Releasing the pedal allows the return spring to push the piston back, and the seal re-seats for the next application.

78. C — A contact pattern on the heel (outer edge) of the ring gear teeth means the ring gear is too close to the pinion. Decreasing the backlash by moving the ring gear closer to the pinion shifts the contact pattern from the heel toward the toe, centering it on the tooth face. This adjustment changes the lateral position of the contact pattern. The pinion depth (shim thickness behind the pinion) controls the vertical position of the pattern.

79. A — The driveshaft slip yoke connects the driveshaft to the transmission output through a splined engagement. Worn splines develop free play between the male and female spline teeth. Under acceleration, the torque loads the splines in one direction, and the worn clearance creates a vibration as the splines oscillate within their free play under the pulsating engine torque. During cruising and deceleration, the splines load differently and the worn clearance is not excited.

80. C — The center carrier bearing mount positions the bearing at a specific height and alignment that determines the operating angles of both driveshaft sections. With the rubber isolator completely separated, the bearing housing drops from its designed position, changing the angles of both shaft sections. The altered angles create vibration from the disrupted U-joint cancellation geometry. The unsupported bearing may contact the frame or other components, and the driveshaft could separate if the misalignment becomes severe.

81. A — New ring and pinion gear sets produce fine metallic particles during their initial break-in period as the gear teeth's microscopic surface irregularities wear smooth and the contact pattern establishes itself. This is normal break-in debris. The oil should be changed at the manufacturer's recommended break-in interval (typically 3,000-8,000 km) to remove the break-in particles. Subsequent oil changes should show progressively less metallic content as the gears seat.

82. A — A new clutch disc is significantly thicker than the worn disc it replaced. The increased thickness pushes the pressure plate further from the flywheel when the clutch is engaged. This moves the release bearing further from the pressure plate fingers, creating a larger gap that the pedal must travel through before the release bearing contacts the fingers. The result is more free play at the pedal — which is the correct condition for a new, full-thickness disc.

83. C — Every driveshaft installed on this vehicle vibrates, and all other common vibration sources have been replaced. The constant in every installation is the flanges the driveshaft bolts to — the transmission output flange and the rear axle pinion flange. If either flange has excessive runout, every driveshaft installed on the vehicle will vibrate because the flange itself imparts a wobble at the connection point. Measuring flange runout with a dial indicator identifies the source.

84. A — The PTO gear meshes with the transmission's PTO drive gear through the mounting gasket thickness and shim stack. If the mesh is too tight (the PTO gear engages too deeply with the drive gear), the gear teeth are over-engaged and produce excessive contact pressure. The resulting whine increases with RPM because the contact forces increase with rotational speed. Adjusting the shimming or gasket thickness to achieve the correct gear mesh depth eliminates the whine.

85. A — Limited-slip differentials use clutch packs to bias torque between the drive wheels. The friction modifier additive in the gear oil controls the engagement characteristics of these clutch packs. Without the additive (or with depleted additive), the clutch packs engage and disengage abruptly during the slight speed differential required for tight turns. This abrupt engage-release cycle produces the chattering noise. Adding the correct friction modifier or replacing the oil with the specified limited-slip gear oil resolves the chatter.

86. B — The steering damper absorbs road shock that would otherwise be transmitted through the steering linkage to the steering gear and steering wheel. A seized damper cannot absorb this energy — it transmits the full bump force directly to the steering system. The power steering pump must momentarily overcome this sudden input force, and the momentary overload makes the steering feel heavy during the bump event. Between bumps, the steering operates normally because there is no shock input to absorb.

87. D — The over-center adjustment (sector shaft lash adjustment) controls the mesh tightness between the sector shaft teeth and the ball nut's rack teeth specifically at the center (straight-ahead) position. On a recirculating ball gear, the sector shaft teeth are tapered — tightest at center and looser off-center. Adjusting the sector shaft moves it closer to (or further from) the ball nut, changing the center mesh clearance. Tightening this adjustment reduces the free play at center without affecting the off-center steering.

88. A — All alignment measurements are within specification, and the pull is to the right — which is the low side of a crowned road. Most public roads are crowned (higher in the center, sloping to both edges) to drain water. The crown's slope creates a gravitational component that biases the vehicle toward the lower edge. In right-hand-traffic countries, the right edge is lower, and the vehicle drifts right. This is a road characteristic, not a vehicle fault.

89. C — Both springs are the same part number and were installed simultaneously, but one has lost more arch than the other. Leaf springs lose their arch over time from metal fatigue, repeated loading cycles, and overloading events. The rate of arch loss varies between individual springs — one spring may have experienced more severe loading (from uneven cargo distribution) or may have had a marginally different heat treatment from manufacturing. The sagged spring must be replaced or re-arched to restore level ride height.

90. B — A metallic scraping noise during wheel rotation that stops when the brakes are applied indicates a component is contacting the rotor only when the brakes are released. A pad installed backward (metal backing plate facing the rotor), a shifted anti-rattle clip, or a displaced pad retaining spring can all contact the rotor during normal rotation but be pushed flush against the rotor surface when the brake application force presses the pad against the rotor.

91. D — Air springs have a natural bounce frequency that the shock absorbers must control. Functional shock absorbers arrest the bounce within 1-2 cycles by converting the kinetic energy to heat. When the shock absorbers lose their damping ability (from worn internal components or lost fluid), the air springs bounce freely at their natural frequency. The energy from the bridge joint disturbance persists through 4-5 cycles because the only damping comes from air system friction and internal losses rather than the designed shock absorber resistance.

92. A — Flat spots on tires develop when a tire sits in one position for an extended period, especially in cold weather. The section of tread in contact with the road surface flattens from the sustained load and cold-stiffened rubber. Each revolution, the flattened section contacts the road and produces a thump. At low speeds, the thumps are too slow and too quiet to be noticeable. At highway speed, the frequency becomes audible. Flat spots typically disappear after driving warms the rubber and it recovers its shape.

93. C — Worn jaw faces allow the king pin to sit loosely in the fifth wheel coupling. During acceleration, the trailer resists and the king pin loads against one jaw face. During braking, the trailer pushes forward and the king pin loads the opposite jaw face. The clunking noise is the king pin shifting from one worn face to the other during each load reversal. In extreme cases, the worn jaws may not retain the king pin securely, risking trailer separation.

94. B — Hub-piloted aluminum wheels crack at the bolt holes from cyclic fatigue — each wheel revolution applies a bending load to the bolt holes from the tire's contact patch forces. The mounting procedure is the most common cause of premature fatigue: impact wrenches can apply instantaneous torque spikes exceeding the aluminum's fatigue limit, and using the wrong nut style (stud-piloted flange nuts on hub-piloted wheels) creates a bending moment at the bolt hole that the correct nut type would avoid.

95. D — The self-steering mechanism uses linkage, pivot points, centering springs, and steering stops on both sides. If a component on the left-steer side has failed — a seized pivot, a broken steering link, a jammed stop, or a corroded steering cylinder — the axle cannot rotate in the left direction. The right-steer components remain functional, allowing normal steering during right turns. Inspecting the left-side steering mechanism components identifies the specific failed component.

96. A — A frame crack at the upper flange-to-web radius is a fatigue crack initiated by the stress concentration at the radius where the flange transitions to the web. The immediate action is stop-drilling the crack tip — drilling a small hole at the crack's leading edge removes the sharp stress concentration and arrests the crack's propagation. The vehicle should then be evaluated for the approved repair procedure, which may include welded doubler plates, bolted reinforcement, or section replacement.

97. D — Intermittent loss of power steering assist has multiple potential causes in the pump, belt, and fluid delivery system. A loose belt slips under heavy steering load, a failing pump intermittently bypasses internally, a kinked hose restricts flow at certain steering positions, and a clogged filter screen starves the pump. Each of these conditions produces intermittent assist loss followed by a return to normal. A systematic diagnosis of the entire power steering system identifies the specific source.

98. C — Both tires wear evenly (ruling out alignment and inflation), but one wears faster. With identical tires on the same axle, the only remaining variable is the load carried by each side. An asymmetric weight distribution on the steer axle — from an off-center engine, a laterally offset fifth wheel, or a frame twist — places more load on one side. The heavier-loaded tire operates under greater contact pressure and wears proportionally faster.

99. D — A vibration that peaks at a specific speed and diminishes both above and below that speed is characteristic of a resonance condition. The driveshaft has a critical speed — the RPM where its natural bending frequency matches its rotational frequency. At this speed, any imbalance or runout is amplified by resonance, producing severe vibration. Above and below the critical speed, the vibration exists but is not amplified. The driveshaft specification must be verified for compatibility with the vehicle's operating speed range.

100. A — The manufacturer specifies 2 mm of toe-in to compensate for the steer axle's natural tendency to toe-out under driving forces (road resistance, suspension compliance, steering linkage deflection). With zero static toe, the dynamic toe during driving becomes slightly toe-out as these forces act on the wheels. The toe-out causes the inside edges of both steer tires to scrub against the road, producing the characteristic inside-edge wear pattern.

101. C — The venting continued after replacing the air spring, eliminating the spring as the leak source. The air supply fitting at the spring's base — the component that connects the air line to the spring piston — may have a crack that was mistaken for a spring base leak. The fitting remains in place when the spring is changed, and its crack continues to leak with the new spring installed. Inspecting the fitting itself and replacing it if cracked resolves the persistent leak.

102. D — Worn engine or transmission mounts allow the powertrain assembly to shift position under the forces of acceleration and braking. Under acceleration, engine torque reaction twists the assembly in one direction, shifting the driveshaft angles and the frame geometry in a way that steers the vehicle to the right. Under braking, deceleration forces shift the assembly in the opposite direction, changing the effective geometry and producing a left pull. Replacing the worn mounts stabilizes the powertrain position and eliminates the directional changes.

103. D — All four drums overheating simultaneously with correct adjustment and no individual drag indicates the entire tandem axle braking system was subjected to excessive heat demand. Sustained heavy braking — from a long descent, an overloaded trailer, or a driver who rides the brakes — generates more heat across all drum positions than the brakes can dissipate. The simultaneous nature confirms a systemic operating condition rather than an individual component failure.

104. A — The HVAC recirculation door controls whether the system draws fresh outside air or recirculates cab air. If stuck in recirculate mode, the system continuously cycles the same moisture-laden cab air. The A/C dehumidifies the air, but in recirculate mode, new moisture from the driver's respiration, wet clothing, and outside humidity carried in by the passengers accumulates faster than the A/C can remove it. The cold windshield provides a condensation surface, and the excess moisture deposits as fog.

105. C — The front steps heat normally, confirming the control circuit, breaker, and power supply are functional. The fault is isolated to the rear step's dedicated circuit. Checking for voltage at the rear heater connector determines whether the supply wiring has an open (no voltage) or the heater element itself has failed (voltage present but no heat). This systematic approach divides the diagnosis in half at one test point.

106. A — The physical latch is engaged (confirmed manually), but the dashboard indicator shows it is not. The latch position switch or sensor reports the latch status to the dashboard. If the switch is misadjusted (not aligned with the latch's engaged position), damaged (internal failure), or has a wiring fault (open wire), it cannot detect the latched condition and the indicator remains active. The switch alignment, continuity, and wiring must be inspected.

107. A — The left mirror adjusts in all four directions, confirming the power supply, ground, control module, and adjustment motor circuits are all functional. The heater is a separate element within the mirror assembly with its own circuit. An open heating element (broken resistance wire) prevents current flow through the heater circuit specifically, while the adjustment circuits operate independently. Measuring the heater element's resistance confirms whether it is open.

108. D — The door bounces open because the latch cannot fully capture the striker. The striker plate's position (set by its mounting screws) determines where it sits relative to the latch's engagement fork. If the striker has shifted from loosened screws, or the striker is worn and its profile no longer matches the latch fork's capture geometry, the latch cannot close fully around the striker. The weather seal's pressure pushes the door back open because the latch's incomplete engagement cannot overcome the seal's resistance.

109. D — Construction equipment tracks concentrate enormous point loads on the deck boards. Standard lumber may not have adequate strength for these concentrated loads. The replacement boards must be rated for the specific load conditions — hardwood (oak or similar) or engineered composite boards with verified load ratings. The boards must be properly fastened to the crossmembers to distribute the track loads to the trailer's structural frame.

110. A — Air pressure at the gladhand is correct, confirming the tractor is supplying adequate pressure. The weak brakes must be caused by the trailer's internal components. The relay valve may have a high crack pressure that reduces delivered pressure. The air lines between the relay valve and the chambers may be kinked or restricted. The brake adjustment on any or all wheel positions may be incorrect (excessive stroke). The linings may be worn thin or contaminated. Each of these conditions reduces the trailer's braking force independently of the air supply.

111. C — Frost on the exterior skin in rectangular patches maps directly to the insulation panels behind the skin. Intact insulation prevents interior cold from reaching the exterior surface — the insulation's thermal resistance keeps the outer skin near ambient temperature. Where the insulation has failed, deteriorated, or is missing, the interior cold penetrates directly through the uninsulated wall section. The frost forms on the exterior skin at these locations because the surface temperature drops below the ambient dew point.

112. B — The supply (emergency) gladhand maintains the air supply to the trailer's spring brake system. A leaking seal at this gladhand continuously drains air from the supply circuit. If the leak rate exceeds the compressor's ability to maintain pressure in the supply circuit, the tractor protection valve detects the dropping pressure and closes at approximately 40-45 psi, simultaneously exhausting the trailer supply line and applying the trailer's spring brakes.

113. B — The internal leg tube extends and retracts inside the outer tube. An impact that bends the inner tube — from hitting a loading dock, scraping a curb, or contacting an obstruction — shortens the tube's effective extended length. The leg cannot extend to its original length because the bent section limits the travel. The other leg, not having been impacted, extends to its full original length.

114. A — A hanging skirt panel is both an aerodynamic concern and a road safety hazard. The loose panel can scrape the road surface, break free entirely, and strike following vehicles as a projectile. It can also catch on road infrastructure (curbs, railroad crossings, debris) and cause further damage to the trailer or create a hazard for other traffic. The panel must be secured or removed before the trailer operates.

115. C — Disc brakes have different application characteristics than drum brakes. Disc brakes typically provide more linear response (more proportional relationship between pedal effort and braking force), less brake fade during sustained use, and different initial engagement feel. The driver who is accustomed to drum brakes will notice these differences. The system may also require relay valve or proportioning adjustments to match the disc brakes' different pressure-to-force characteristics.

116. B — An I-beam's bottom flange carries the tensile load when the beam is loaded from above. A crack in the tensile zone under a known impact point indicates the material has been stressed beyond its yield strength by the dropped object. The crack will propagate under normal operating loads because the tensile stress concentration at the crack tip drives continued growth. The repair must follow the manufacturer's approved procedure to restore the flange's tensile load-carrying capacity.

117. D — The evaporator temperature sensor or low-pressure cycling switch normally cycles the compressor off when the evaporator approaches freezing temperature. If either component fails in the closed (run) position, the compressor receives no command to stop. The compressor runs continuously, the evaporator temperature drops below 0°C, and moisture from the airstream freezes on the evaporator fins. The ice blocks airflow, and the frost is visible on the housing.

118. A — The engine reaches operating temperature at idle (confirmed by the gauge), so the coolant is hot. The heater core produces lukewarm air at idle but hot air at elevated RPM, indicating inadequate

coolant flow through the core at idle. A partial internal restriction forces the water pump to work harder to push coolant through the core. At idle, the pump's low output cannot overcome the restriction. At higher RPM, the increased pump output forces adequate flow through the restricted core.

119. C — Normal refrigerant pressures confirm the A/C system is operating correctly — the compressor, condenser, expansion valve, and evaporator are all doing their jobs. The marginal cooling is caused by something mixing warm air with the cooled air after it leaves the evaporator. The most likely cause is a blend door that is partially open to the heater core position, allowing heated air to mix with the cooled evaporator air before it reaches the vents.

120. B — The rear heating duct runs the full length of the bus from the front HVAC unit to the rear passenger area. If a section of this ductwork has collapsed (from age, heat exposure, or physical damage), become disconnected (from vibration), or been blocked (by debris or a displaced floor panel), heated air cannot reach the rear section. The front area heats normally because it receives air before the obstruction.

121. A — The compressor shaft seal relies on a thin film of refrigerant oil on the shaft surface for lubrication. During extended periods of A/C system inactivity (typically winter months), the oil migrates away from the seal and the rubber element dries out, losing its flexibility and ability to conform to the shaft surface. When the system is activated in spring, the hardened seal cannot form an adequate seal against the shaft, and refrigerant leaks past it. Periodic winter operation maintains seal lubrication.

122. A — Applying extremely hot fluid to a cold windshield creates a severe thermal gradient — the heated area expands while the surrounding cold glass resists. This differential expansion generates stress that can exceed the glass's thermal shock tolerance, causing the windshield to crack. The risk is greatest in winter when the windshield is at sub-zero temperatures and the temperature differential between the hot fluid and the cold glass is maximum.

123. C — The clutch plate engages against the pulley face (confirmed by the engagement action), but the compressor shaft does not turn. The connection between the clutch plate and the compressor shaft has failed. The clutch plate hub may have delaminated from the plate, or the hub's spline connection to the compressor shaft may have stripped. The plate spins freely on the pulley surface without transmitting any torque to the compressor's internal mechanism.

124. C — The boom cylinder has internal cushions (deceleration devices) at each end of its stroke that slow the piston before it contacts the end cap. The cap-end cushion has failed — without it, the piston travels at full speed to the end of the stroke and slams into the cap with the full force of the hydraulic

pressure behind it. The rod-end cushion is intact, which is why retraction (where the piston approaches the rod-end cap) does not produce the banging noise.

125. D — The relief valve poppet is chattering — rapidly opening and closing — at its set point pressure. When the system pressure reaches the relief setting, the poppet cracks open. The sudden pressure drop closes the poppet. Pressure immediately rebuilds and opens the poppet again. This rapid open-close cycle occurs at approximately 4 Hz (4 times per second) and produces the visible gauge needle oscillation. A contaminated seat, worn poppet, or incorrect spring tension causes the chattering.

126. A — Air was introduced into the system during the oil change when the reservoir was drained and refilled. The air is mixed with the new oil and is drawn into the pump's suction. The pump compresses the air bubbles along with the fluid, causing cavitation-like noise as the bubbles collapse inside the pump. The system must be operated through all functions at low pressure to circulate the fluid through the reservoir multiple times, allowing the air to separate from the oil at the reservoir's surface.

127. B — The boom extend proportional valve spool is contaminated or has a scored surface that prevents it from modulating smoothly between the closed and open positions. The spool sticks in the closed position until enough pilot pressure builds to overcome the sticking force, then jumps to a fully open position. The result is all-or-nothing control with no intermediate flow positions. The retract spool is a separate component that operates independently and is unaffected.

128. B — A new filter that loads within 30 minutes of installation indicates an active contamination source is generating debris faster than the filter can hold. The system has an ongoing failure — a pump, cylinder, valve, or motor is producing metallic wear particles at an accelerated rate. Alternatively, the system has been contaminated with an external substance (water, wrong fluid, environmental contamination) that overwhelms the filter's capacity. The contamination source must be identified and corrected before the filter can maintain its normal service interval.

129. D — The single-acting dump cylinder has only one hydraulic port. The body's weight provides the lowering force by pushing the piston down, forcing fluid out of the cap end through the return line to the reservoir. A flow control or metering valve in this return path restricts how quickly the fluid can exit, controlling the descent speed. If this valve is set too restrictively or has become partially clogged, the restricted flow limits the descent rate and the body lowers too slowly.

130. A — Visible vibration in the suction line indicates the pump is struggling to draw fluid — the line is alternating between partial vacuum (as the pump tries to draw fluid through the restriction) and atmospheric pressure (as the vacuum bubble collapses). This oscillation physically moves the line. The

restriction could be a clogged suction strainer, a kinked suction line, a collapsed hose, or an undersized line that cannot supply adequate flow at the pump's demand rate.

131. C — The pilot-operated check valve must seal completely to hold the load in position. Even a microscopic contamination particle on the poppet's seat creates a leak path that allows fluid to slowly bypass the check valve under the load's constant pressure. The drift is slow because the leak path is tiny, but it is continuous because the load applies constant pressure. Cleaning the valve seat or replacing the valve restores the seal.

132. D — The regenerative braking force is generated by the traction motor operating as a generator. A phase winding fault — an intermittent open in one of the motor's three-phase windings — reduces the motor's generating capacity when the connection opens. The regenerative force drops abruptly as one phase is lost, then returns to full strength when the connection re-establishes. The intermittent nature produces the variable braking force during a single deceleration event.

133. B — A drop from 95% to 78% SOH in 6 months (17% degradation versus the expected 1-1.5% for that period) indicates dramatically accelerated cell chemistry degradation. The battery thermal management system is responsible for maintaining the cells within their optimal operating temperature range. Without functional thermal management, cells operate at temperatures that accelerate chemical degradation — elevated temperatures cause electrolyte decomposition and SEI layer growth, while cold temperatures cause lithium plating during charging.

134. A — The high-voltage battery cooling circuit is physically close to high-voltage components and connections. A coolant leak in this circuit could allow fluid to contact high-voltage terminals, busbars, or conductors. Standard automotive coolant contains dissolved ions from its corrosion inhibitor package that make it electrically conductive. If conductive coolant contacts a high-voltage surface and a grounded component simultaneously, it creates a current path that presents a lethal shock hazard. Dielectric coolant does not conduct electricity and eliminates this risk.

135. C — The two-speed transmission shift requires an electronically controlled actuator and specific conditions verified by the VCU before the shift command is issued. The VCU checks vehicle speed (correct range for the target gear), motor RPM (compatible with the target gear ratio), and commands a momentary torque reduction in the motor to unload the gears during the shift. If the actuator has failed, its signal wire is open, or any shift-enable condition is not met, the VCU will not command the shift to protect the transmission from engagement damage.