

PRACTICE EXAM 13: RED SEAL TRUCK AND TRANSPORT MECHANIC SIMULATION (135 QUESTIONS)

1. A technician is assigned to remove a truck's fuel tank for replacement. The tank is plastic and contains approximately 200 litres of diesel fuel. Before beginning the removal, the technician must plan the job. What is the single greatest hazard during this procedure?

A. The plastic tank material may crack during removal if it is not supported evenly during the lowering process causing the tank to split and release 200 litres onto the shop floor

B. The 200 litres of diesel fuel weighs approximately 170 kg and the combined weight of the fuel and tank creates a crushing hazard if the tank falls during the strap removal and lowering process

C. The diesel fuel will produce vapours during the tank removal that will migrate to the floor drains and accumulate in the sewer system creating an explosion hazard in the underground drainage piping

D. The plastic tank may generate static electricity during handling and the static discharge could ignite the diesel vapours present at the tank's fill neck opening during the removal and handling process

2. A fleet shop has a policy requiring all technicians to wear safety footwear with steel toes and puncture-resistant soles. A technician argues that composite-toe boots are lighter and equally protective. How should the shop respond?

A. Steel-toe boots are the only acceptable safety footwear because the steel cap provides superior impact resistance compared to composite materials that may crack under the heavy loads encountered in truck repair

B. Composite-toe boots are not acceptable in fleet maintenance because the composite material generates static electricity when walking on concrete floors creating a spark hazard near fuel system work areas

C. The shop should update its policy to specify the required safety standard rating (CSA Grade 1 or equivalent) rather than specifying the toe cap material because both steel and composite meet the same protection standards

D. The shop's policy should be updated to accept any safety footwear that meets the CSA Grade 1 standard or equivalent because both steel-toe and composite-toe boots that carry this rating provide equal protection

3. A technician is performing a PM inspection on a truck equipped with a diesel particulate filter. During the inspection, the technician must remove the DPF for cleaning. What personal protective equipment (PPE) is required specifically for handling a used DPF?

A. A P100 or N95 respirator and gloves because the DPF contains trapped diesel soot which is classified as a potential carcinogen and the ash residue contains concentrated heavy metals from the engine oil additives

B. Standard shop safety glasses and nitrile gloves are adequate for DPF handling because the soot and ash trapped in the filter are inert once captured by the ceramic substrate and do not pose an inhalation hazard

C. A full-face supplied-air respirator is required because the DPF ash contains asbestos fibres from the brake dust that is drawn into the engine through the air intake and concentrated in the filter substrate

D. Heat-resistant gloves only because the DPF remains hot for several hours after the engine is shut down and the primary hazard is thermal burns from handling the hot ceramic substrate during removal

4. A technician discovers that a truck's air brake system has been tampered with — someone has installed a bolt through the spring brake caging hole to permanently compress the parking brake spring. What is the safety consequence of this modification?

A. The bolt will eventually fatigue from the constant spring loading and break unexpectedly during driving causing the spring brake to apply suddenly at highway speed without warning from the driver

B. The permanently caged spring creates excessive heat in the brake chamber housing from the compressed spring's stored energy being converted to thermal energy through the metal-to-metal contact surfaces

C. The truck has no parking brake on the wheels with caged springs — if the air system loses pressure or the driver pulls the parking brake valve the spring brakes on those wheels cannot apply mechanically

D. The caging bolt interferes with the service brake diaphragm movement reducing the service brake stroke by the length of the bolt protruding into the service section of the dual-chamber brake assembly

5. A shop has a parts washer that uses a petroleum-based solvent. The technician discovers the solvent is dark black and has a strong burnt odour. A thick sludge layer has accumulated at the bottom of the tank. What should be done?

A. Add fresh solvent to the existing tank to dilute the contaminated solvent back to a usable concentration and stir the sludge layer to redistribute it for continued parts washing operations

B. Contact the solvent recycling service to schedule a pickup and refill — the contaminated solvent must be handled as regulated waste and the parts washer tank cleaned before refilling with fresh solvent

C. Drain the contaminated solvent into the shop's used oil collection tank because petroleum-based solvents are compatible with used oil and can be co-recycled through the same waste oil re-refining process

D. Filter the contaminated solvent through a shop towel to remove the sludge particles and return the filtered solvent to the parts washer tank for continued use until the next scheduled solvent replacement date

6. A technician is working on a truck's air conditioning system and must recover the R-134a refrigerant before opening the system for compressor replacement. The technician does not have a certified recovery machine available. What should the technician do?

A. Slowly vent the refrigerant to atmosphere through the service port by cracking the fitting open gradually to control the release rate and prevent rapid pressure loss that could damage the system components

B. Transfer the refrigerant to an approved recovery cylinder using the shop's nitrogen regulator to push the refrigerant from the system into the cylinder through a manifold gauge set connection at the service ports

C. Open both the high and low-side service ports simultaneously to vent the refrigerant quickly because the rapid release minimizes the total amount of ozone-depleting substance that enters the atmosphere

D. Do not open the system — either locate a certified recovery machine, use a mobile A/C service, or postpone the repair until proper recovery equipment is available because venting refrigerant is illegal

7. A heavy-duty truck is being raised on a hydraulic floor jack to replace a flat tire. The jack is positioned under the front axle. As the front of the truck rises, the technician notices the rear of the truck begins to roll backward. What should have been done before jacking?

A. Wheel chocks should have been placed behind the rear tires before jacking to prevent the truck from rolling when the front tires leave the ground and the rear brakes must hold the vehicle's entire weight on the grade

B. The transmission should have been placed in neutral before jacking so the rear wheels can rotate freely and the truck's weight settles naturally without creating a rolling force from the engaged driveline resistance

C. The rear trailer brakes should have been applied through the trailer hand valve to provide additional holding force during the jacking operation since the tractor parking brake alone is insufficient on any grade

D. A second technician should have been seated in the cab with their foot on the brake pedal to maintain the service brakes while the front axle was raised preventing any rolling motion during the jacking operation

8. A technician is inspecting a truck's steering system during a PM inspection. The technician grabs the steering wheel and attempts to rock it back and forth while observing the front wheels. The steering wheel moves approximately 50 mm (measured at the rim) before the front wheels begin to respond. The specification maximum is 40 mm. What should the technician document?

A. The steering free play is within the normal range for a heavy-duty truck with a recirculating ball steering gearbox and no further action is needed until the free play exceeds 75 mm at the next inspection

B. The steering free play measurement is invalid because the engine must be running with the power steering system operating to provide the correct loading conditions for an accurate free play measurement

C. The steering free play exceeds the specification and must be documented as a defect requiring repair — the excessive play affects the driver's ability to maintain directional control of the vehicle during driving

D. The 10 mm excess free play is a minor finding that should be noted on the PM report as an advisory item and rechecked at the next PM interval to determine if the condition is progressing over time

9. A heavy-duty diesel engine has been operating with a persistent slight coolant leak at the front cover gasket for approximately 20,000 km. The leak is small — approximately 100 ml per week. The coolant contacts the front of the engine block and drips onto the crankshaft pulley. What secondary damage could this long-term coolant drip cause beyond the leak itself?

A. The coolant dripping onto the crankshaft pulley evaporates from the heat and the dried glycol residue builds up on the pulley surface creating belt slippage from the glazed glycol coating reducing alternator output

B. The ethylene glycol in the coolant is corrosive to the crankshaft pulley's rubber vibration damper element and the prolonged contact chemically degrades the rubber causing the damper to fail prematurely from the chemical attack

C. The coolant will migrate along the crankshaft surface through the front seal and contaminate the engine oil with glycol creating bearing damage from the glycol's reaction with the oil's additive package over time

D. The small leak creates glycol deposits that attract road debris and form an abrasive paste on the front cover surface that accelerates the gasket erosion widening the leak progressively from the abrasive contact

10. A diesel engine's fuel system uses a gear-type transfer pump. The pump has been in service for 300,000 km. During a low-power diagnosis, the technician measures the transfer pump output and finds it at 350 kPa instead of the specified 450 kPa. The technician replaces the fuel filter with no improvement. What is the most likely cause of the low transfer pump pressure?

A. The fuel tank pickup tube has a restriction from debris accumulation that limits the fuel volume reaching the transfer pump inlet creating a starvation condition that reduces the pump's output pressure at all engine speeds

B. The transfer pump's internal gear clearances have worn from 300,000 km of service and the enlarged clearances allow internal bypass that reduces the pump's ability to maintain the specified output pressure under load

C. The fuel return line check valve has failed open and the return fuel is bypassing back to the tank reducing the net fuel pressure in the supply circuit between the transfer pump and the high-pressure pump inlet port

D. The fuel temperature is elevated from a restricted fuel cooler and the hot fuel has reduced density that causes the pump's displacement to deliver less fuel mass per revolution despite the pump mechanically functioning correctly

11. A diesel engine equipped with a DPF has completed a forced regeneration. The technician verifies the post-regeneration DPF differential pressure at 2.5 kPa. The engine is then operated for 1,000 km of normal mixed driving. The differential pressure has risen to 4.0 kPa. Is this a normal soot accumulation rate?

A. Yes — a 1.5 kPa increase in differential pressure over 1,000 km of mixed driving is within the normal soot accumulation rate for a properly functioning diesel engine with a correctly operating EGR and fuel system

B. No — the 1.5 kPa increase in 1,000 km indicates the engine is producing soot at approximately twice the normal rate and the EGR system, injectors, and boost pressure should be investigated for excess soot production

C. The rate cannot be determined without knowing the engine's specific duty cycle during the 1,000 km because heavy-load driving produces significantly more soot than highway cruise at the same mileage distance

D. No — the post-regeneration baseline of 2.5 kPa is already too high indicating the forced regeneration was not fully successful and the DPF should be professionally cleaned before evaluating the soot accumulation rate

12. A diesel engine's crankcase ventilation system uses a closed circuit that routes blow-by gases through a CCV filter and back into the engine's intake manifold. After 200,000 km, the intake manifold is heavily coated with an oil-soot mixture. A technician suggests installing an aftermarket open crankcase ventilation system that vents the blow-by gases to atmosphere instead. What is the problem with this modification?

A. Venting crankcase blow-by gases to atmosphere increases the oil consumption rate because the crankcase vacuum that helps the piston rings seal is eliminated by the open vent allowing more oil past the rings

B. The modification removes the crankcase vacuum that assists the turbocharger compressor in drawing intake air and the reduced vacuum support reduces the turbocharger's efficiency by approximately 5% at full load

C. Venting crankcase blow-by to atmosphere is an emissions violation — the blow-by contains unburned hydrocarbons and particulate matter that must be routed through the engine's combustion process for emissions compliance

D. The open vent system allows unfiltered ambient air to enter the crankcase through the vent opening and the unfiltered air introduces abrasive contaminants into the engine oil accelerating internal wear on all components

13. A heavy-duty diesel engine has a complaint of intermittent white smoke that appears during sustained uphill driving at full load. The smoke disappears during level highway cruise. Coolant level is stable and the oil shows no coolant contamination. What is the most likely cause?

A. The turbocharger compressor seal has a slight leak that allows oil past the seal during the sustained high boost pressure of uphill full-load driving — the oil burns in the combustion chambers producing white smoke

B. The engine's late-post fuel injection for DPF regeneration is activating during the high-load uphill condition and the additional fuel appears as white smoke during the regeneration event at full engine load output

C. The charge air cooler has an internal leak at a tube-to-header joint that opens under the high boost pressure of full-load uphill driving and closes under the lower boost of cruise allowing coolant into the intake

D. The injector nozzles are producing poor atomization under the sustained high fuel demand of uphill driving and the large fuel droplets cannot fully combust in the available time producing white unburned fuel vapour

14. A diesel engine's oil pressure reads 280 kPa at idle (specification: 200 kPa minimum) and 450 kPa at rated speed (specification: 350 kPa minimum). Both readings are above the minimum specification. Should the technician be concerned?

A. Yes — the 450 kPa reading at rated speed is too high and may indicate a restricted oil gallery or a relief valve that is not opening correctly which could cause excessive oil pressure and potential gasket damage

B. No — both readings are above the minimum specification and within the normal operating range indicating the oil pump, relief valve, and bearing clearances are functioning correctly for this engine's current condition

C. Yes — the oil pressure should decrease from idle to rated speed as the oil thins from heat and the increasing pressure from idle to rated indicates the oil viscosity is too heavy for the operating temperature range

D. No — but the idle pressure of 280 kPa is higher than typical for a high-mileage engine and may indicate the oil viscosity is slightly thicker than specification which should be verified during the next oil change

15. A common rail diesel engine has a fault code for "fuel rail pressure deviation — actual pressure 150 bar below commanded" that sets during a specific operating condition: full throttle acceleration between 1,500 and 2,000 RPM. At all other conditions the rail pressure matches the commanded value. What is the most likely cause?

A. One injector has excessive internal leakage that only manifests at the specific RPM range where the injector's mechanical resonance frequency amplifies the internal bypass creating the pressure deviation in that range

B. The high-pressure pump has one damaged compression element (piston or barrel) that loses pumping capacity at the specific RPM where the pump's cam timing places the damaged element under its highest loading condition

C. The fuel metering unit has a calibration error in the ECM's fuel map at the specific RPM and throttle position creating an under-supply condition that limits the high-pressure pump's fuel delivery during that operating window

D. The fuel filter has a partial restriction that limits flow adequately at most conditions but cannot supply the peak fuel demand that occurs during the full-throttle acceleration between 1,500 and 2,000 RPM range

16. A diesel engine has been rebuilt and the technician is setting the valve lash. The intake lash specification is 0.30 mm and the exhaust lash specification is 0.45 mm. The technician accidentally sets the intake lash at 0.45 mm (too loose) and the exhaust lash at 0.30 mm (too tight). What symptoms will this reversed lash setting produce?

A. The engine will not start because the exhaust valves cannot open far enough to allow the combustion gases to exit the cylinders and the intake valves open too late to draw an adequate air charge for combustion

B. The engine will run with reduced power because the tight exhaust lash opens the exhaust valves early dumping cylinder pressure before the piston completes its power stroke reducing the effective expansion ratio

C. The reversed lash produces reduced power from the tight exhaust valves opening early and the loose intake valves opening late — both conditions reduce volumetric efficiency and may cause the exhaust valves to burn

D. The engine will run normally because the 0.15 mm lash difference between the two specifications is within the valve train's mechanical tolerance and neither valve event is significantly affected by the reversal

17. A heavy-duty diesel engine's turbocharger has been replaced. After installation, the technician starts the engine and immediately revs it to 2,000 RPM to check for oil leaks at the turbocharger oil supply and drain connections. What is wrong with this immediate high-RPM procedure?

A. The turbocharger shaft bearings need at least 30 seconds of idle operation to fill with oil from the engine's lubrication system before the shaft speed can safely increase above the idle oil supply flow rate

B. The immediate high RPM creates a surge condition in the compressor from the sudden airflow demand that can damage the compressor wheel blades before the intake system has stabilized its flow characteristics

C. The engine should never exceed 1,200 RPM until the coolant temperature reaches operating temperature because the cold turbocharger housing may crack from the thermal shock of hot exhaust gas at high RPM

D. The new turbocharger must idle for at least 30 seconds to allow oil to reach the bearings — revving immediately forces the shaft to high speed before the oil supply establishes an adequate hydrodynamic film

18. A diesel engine's exhaust back-pressure has been measured at the turbocharger outlet and reads 45 kPa. The specification maximum is 20 kPa. The DPF was cleaned 500 km ago and the differential pressure across the DPF is only 3 kPa (normal). Where is the excessive backpressure originating?

A. The exhaust pipe between the turbocharger and the DOC has an internal collapse or restriction that the external visual inspection cannot detect because the pipe appears normal from the outside surface

B. The DOC or SCR catalyst substrate has partially melted, collapsed, or become restricted from thermal damage and the restriction is downstream of the DPF in the aftertreatment system path from the engine exhaust

C. The turbocharger turbine housing has accumulated carbon deposits on the internal surfaces that restrict the exhaust flow at the turbine outlet creating the backpressure upstream of the measurement point

D. The exhaust manifold has a crack between two cylinders that creates a pressure leak and the lost exhaust energy forces the turbocharger to work harder to maintain boost creating the elevated backpressure reading

19. A diesel engine equipped with an SCR aftertreatment system has a complaint that the DEF consumption rate has increased by 30% over the past month. The DEF quality is verified correct and the exhaust temperature is within normal range. No fault codes are present. What should be investigated?

A. The DEF dosing valve for a nozzle erosion or internal leak that causes the valve to deliver more DEF than the ECM commands on each injection event — the valve delivers a larger volume per pulse than the calibration expects

B. The engine's NO_x production rate — if the engine is producing more NO_x than normal from a combustion change the ECM correctly increases the DEF dosing rate to maintain the required NO_x conversion efficiency

C. The DEF pump for a pressure regulator fault that increases the supply pressure above specification — the higher pressure forces more DEF through the dosing valve per injection event than the ECM's commanded volume

D. The SCR catalyst for reduced efficiency that causes the ECM to increase the DEF dosing rate to compensate for the catalyst's diminished ability to convert NO_x at the standard dosing volume per exhaust mass flow

20. A diesel engine's intercooler has been pressure-tested and found to have a small internal leak at 140 kPa. The normal operating boost pressure is 200 kPa. The engine does not smoke and makes rated power during a chassis dynamometer test. Should the intercooler be replaced?

A. No — the leak is below the operating boost pressure so it does not affect engine performance and will not worsen because the metal fatigue that caused the leak has stabilized at the current crack length

B. No — the dynamometer test confirmed the engine makes rated power so the small leak is not affecting performance and the intercooler can remain in service until the leak becomes large enough to affect boost pressure

C. Yes — the leak will worsen over time from the repeated pressure cycling of normal boost loading and the escaped boost air reduces the intake charge density even though the current effect is below the dynamometer's detection threshold

D. Yes — any intercooler leak allows pressurized unfiltered air from the engine compartment to enter the intake stream bypassing the air filter and introducing contaminants directly into the engine's combustion chambers

21. A diesel engine's fuel injector has been removed and the nozzle tip is inspected under magnification. The spray holes appear oval rather than round. The injector has 500,000 km of service. What effect do the oval spray holes have on engine performance?

A. The oval holes produce a fan-shaped spray instead of the designed conical spray pattern which distributes the fuel unevenly in the combustion chamber creating hot spots and incomplete combustion in certain areas

B. The enlarged oval holes reduce the injection pressure at the nozzle exit because the larger opening offers less restriction to the fuel flow which decreases the atomization quality and produces larger fuel droplets

C. The oval holes have no measurable effect on engine performance because the total fuel delivery volume is controlled by the ECM and the hole shape only affects the spray aesthetic without changing the combustion efficiency

D. The oval holes produce a wider spray pattern that contacts the cylinder walls washing the lubricating oil film from the liner surface and causing accelerated ring and liner wear from the fuel-washed contact area

22. A diesel engine has been running at extended idle for 10 hours during an overnight rest period. When the driver accelerates to depart, the engine produces a large puff of black smoke that clears within 5 seconds. The engine then operates normally. What caused the momentary black smoke?

A. The turbocharger seals leaked oil into the intake and exhaust housings during the extended idle period and the oil burns as black smoke when the engine RPM increases and the airflow purges the accumulated oil

B. The engine's combustion chambers and intake manifold have accumulated wet carbon deposits from the incomplete combustion of extended idle operation — the deposits burn off when the increased fuel and air clear them

C. The EGR valve was open during the extended idle allowing exhaust gas to dilute the intake charge and the residual exhaust gas causes the momentary black smoke until the valve closes at the higher throttle demand

D. The fuel injectors accumulated carbon on their nozzle tips during the extended idle and the blocked spray holes cause poor atomization until the increased fuel pressure clears the deposits during the acceleration event

23. A diesel engine's oil analysis shows a sudden spike in copper at 85 ppm compared to the previous trend of 15 to 20 ppm. All other metals remain within normal trends. What is the most likely source of the elevated copper?

A. The oil cooler core is made of copper-brazed plates and the brazing material has begun to erode from the coolant side — the copper particles enter the oil circuit through the cooler's internal passages during normal flow

B. The connecting rod bearings have worn through their lead-tin overlay and exposed the copper-lead intermediate layer — the copper from this layer is now shedding into the oil at an accelerated rate from the exposed surface

C. The turbocharger thrust bearing has worn through its tin coating and the underlying copper alloy is now exposed to the oil flow — the exposed copper erodes at the bearing's operating temperature and enters the oil circuit

D. The camshaft gear is manufactured from a copper-bronze alloy and the gear teeth are wearing at an accelerated rate from contaminated oil that is acting as an abrasive between the camshaft and crankshaft gear mesh surfaces

24. A diesel engine equipped with a VGT turbocharger has a fault code for "VGT actuator position error — actual position does not match commanded position." The actuator responds to scan tool commands and moves the vanes through the full range. The fault returns after clearing during the next driving cycle. What intermittent condition could cause this recurring fault?

A. The VGT actuator's electrical connector has a corroded pin that maintains adequate contact during static scan tool testing but loses connection during the vibration and temperature cycling of normal driving conditions

B. The turbocharger bearing has play that allows the shaft to shift position during driving changing the vane ring's relationship to the actuator lever — the position error occurs when the shaft shifts under exhaust load

C. The VGT vane linkage has a worn pivot point that allows the vanes to move to the actuator's commanded position during the scan tool test but the worn pivot allows the vanes to shift during the exhaust pressure loading of driving

D. The exhaust gas temperature at full load exceeds the actuator's thermal operating range and the actuator's internal position sensor drifts from calibration during the high-temperature driving condition before cooling and returning to normal

25. A diesel engine's aftertreatment NO_x sensors (upstream and downstream of the SCR) have both been replaced. After the replacement, the engine runs normally but the DEF dosing system does not inject any DEF. No fault codes are present. What was likely not done after the sensor replacement?

A. The NO_x sensor heater circuits were not connected during the installation and the sensors cannot reach operating temperature without the heaters — the cold sensors produce no signal and the ECM defaults to zero DEF dosing

B. The sensor mounting torque was not set to specification and the sensors are not seated fully in the exhaust pipe — the resulting exhaust leak at the sensor boss dilutes the exhaust sample with ambient air producing false readings

C. The NO_x sensor orientation was incorrect — one or both sensors were installed 180 degrees from the correct position and the reversed gas flow direction across the sensing element produces an inverted signal output

D. The NO_x sensor calibration or relearn procedure was not performed after the replacement and the ECM cannot process the new sensors' data without completing the manufacturer-specified initialization sequence

26. A diesel engine has a complaint of reduced power during hot weather (ambient above 35°C) that is not present during mild weather. The engine makes rated power on the chassis dynamometer when tested in the shop at 22°C. No fault codes are present. What is the most likely cause?

A. The charge air cooler's reduced cooling efficiency in hot ambient conditions raises the intake manifold temperature above the ECM's thermal protection threshold triggering a power derate to protect the engine from excessive combustion temperatures

B. The ECM applies a power derate when the intake manifold temperature exceeds a programmed threshold — in hot weather the charge air cooler cannot cool the compressed intake air as effectively as in mild conditions and the higher intake temperature triggers the derate

C. The fuel is expanding from the hot weather temperature reducing the fuel density — the ECM meters fuel by volume not by mass and the reduced fuel mass per injection event produces less combustion energy per stroke

D. The turbocharger's efficiency decreases in hot weather because the thinner hot air provides less cooling to the turbo shaft bearings causing the turbo to derate itself through an internal thermal protection mechanism

27. A diesel engine's exhaust manifold has a visible glow — the cast iron is glowing dull red in the area of cylinder 4's exhaust port. The engine is at full load on a chassis dynamometer. All other exhaust ports are dark. What does the glowing exhaust port indicate?

A. Cylinder 4's exhaust gas temperature is significantly higher than the other cylinders — likely from an over-fuelling condition, retarded injection timing, or a restricted exhaust valve that traps combustion heat in the port

B. The exhaust manifold casting wall is thinner at cylinder 4's port from manufacturing variation and the thinner wall transmits the normal exhaust heat more visibly than the thicker walls at the adjacent cylinder ports

C. Cylinder 4's exhaust valve is leaking during the compression and power strokes allowing combustion pressure to continuously heat the exhaust port area rather than only during the exhaust valve opening event

D. The exhaust manifold gasket at cylinder 4 has eroded and the hot combustion gas is impinging directly on the manifold casting surface rather than flowing through the port creating a localized hot spot from the direct gas contact

28. A diesel engine equipped with a dual-stage turbocharger system (series turbochargers — a high-pressure stage and a low-pressure stage) has a complaint of reduced power at low RPM but adequate power at high RPM. Which turbocharger stage is most likely at fault?

A. The high-pressure turbocharger is most likely at fault because the HP stage provides the primary boost at low RPM — a fault in this stage reduces the low-RPM boost while the LP stage compensates at high RPM

B. The low-pressure turbocharger is at fault because the LP stage provides the initial air compression at all RPM and a fault in this stage reduces the air supply to the HP stage which only manifests at low RPM

C. Both turbocharger stages must be at fault simultaneously because the series configuration means neither stage can compensate for the other and a single-stage fault would affect performance at all RPM equally

D. The wastegate between the two stages is stuck open bypassing the HP stage at low RPM but the LP stage's increased output at high RPM overcomes the bypassed HP stage and provides adequate boost for full power

29. A diesel engine's fuel tank has been drained and cleaned. During the cleaning, the technician discovers a thick gelatinous layer on the tank walls and a dark biomass layer in the bottom of the tank. What caused this contamination and how should it be addressed?

A. The biomass is diesel fuel algae (actually bacteria and fungi) that grows in the water layer at the bottom of the tank — the tank must be thoroughly cleaned and a biocide treatment applied to the fuel system to prevent regrowth

B. The gelatinous layer is oxidized fuel varnish from prolonged fuel storage without stabilizer additive — the tank must be cleaned and the fuel system flushed with fresh fuel containing a stabilizer additive to prevent recurrence

C. The biomass is a chemical reaction between the diesel fuel's sulphur content and the tank's internal coating material — the tank coating must be stripped and reapplied with a fuel-compatible liner before refilling

D. The contamination is from biodiesel blending that has separated from the petroleum diesel base during prolonged storage — the tank must be cleaned and only pure petroleum diesel should be used going forward

30. A tractor-trailer combination is undergoing a full air brake inspection. The technician performs a tractor protection valve test by reducing the system pressure while monitoring the trailer supply. At what pressure should the tractor protection valve close automatically to protect the tractor's air supply?

A. The tractor protection valve should close at approximately 275 kPa (40 PSI) to ensure the trailer brakes apply before the tractor's spring brakes engage during a gradual air system pressure loss event

B. The tractor protection valve should close at approximately 415 to 450 kPa (60 to 65 PSI) — this closing pressure ensures the tractor retains adequate air for its own braking before the system pressure drops to the spring brake application threshold

C. The tractor protection valve should close at exactly 550 kPa (80 PSI) which is the governor cut-in pressure and the valve's closing synchronizes with the compressor's loading cycle for coordinated system protection

D. The tractor protection valve should close at 690 kPa (100 PSI) — the governor cut-out pressure — to immediately disconnect the trailer at the first sign of any pressure loss in the tractor's air system for maximum protection

31. A truck's front air disc brakes have been serviced with new pads and new rotors. After the service, the technician performs several moderate stops to bed in the new components. During bedding, the technician measures the rotor temperature with an infrared thermometer and finds the left rotor at 350°C and the right rotor at 200°C after identical stops. What does this temperature difference indicate?

A. The new brake pads have different friction coefficients between the left and right sides from two different manufacturing batches creating unequal braking force that produces the temperature differential during bedding

B. The right caliper is not applying adequate clamping force — a seized slide pin, air trapped in the caliper bore, or an incorrectly installed pad is reducing the right side's effective braking force during each stop

C. The left rotor is overheating from a caliper piston that is not retracting after each application — the left pad drags continuously on the rotor adding friction heat beyond what the bedding procedure generates normally

D. The temperature difference is normal during the bedding-in process because each pad-to-rotor combination develops its transfer layer at a different rate and the temperatures will equalize after approximately 100 stops

32. A trailer's air ride suspension has one air spring that sits 25 mm lower than the other three springs on the same tandem. The air pressure at all four springs reads the same. What is the most probable cause?

A. The low spring's rubber bellows has stretched from age and heat cycling and the permanently elongated rubber cannot support the same height as the three newer springs at the same inflation pressure

B. The height control valve linkage arm for the low side has a different length from a previous replacement that signals the valve to read the low height as correct and not add air to compensate for the deficit

C. The low spring has an internal fabric reinforcement failure that allows the bellows to distend at the bottom rather than supporting the load at the same height as the intact springs at the same air pressure

D. The trailer frame has a twist at the low spring's mounting point that changes the geometric relationship between the spring and the frame creating a lower ride height at that position despite equal air pressure

33. A truck's air brake system has a complaint of a hissing noise from under the dash when the brake pedal is depressed. The brakes apply and release normally with adequate stopping force. Where is the hissing noise originating?

A. The foot valve has a worn piston seal that allows a small amount of air to bypass during application — the hissing is the escaping air and while the brakes still function the wasted air reduces system efficiency

B. The foot valve's exhaust port is releasing a small amount of air during the application stroke as part of its normal operation — some foot valve designs vent a small controlled air volume during pedal depression

C. The dash-mounted parking brake valve has an internal seat leak that coincidentally produces the hissing during service brake application because the pedal vibration opens the worn parking valve seat momentarily

D. The foot valve's rubber boot seal at the pedal rod entry point has deteriorated and the air that enters the valve body during the application stroke escapes through the worn boot creating the audible hissing sound

34. A trailer's ABS system has been diagnosed with a faulty modulator valve. The modulator has been replaced. After the replacement, the ABS lamp goes through its self-test normally (illuminates then extinguishes). During a road test brake application on wet pavement, the ABS activates on three wheels but the replaced wheel does not modulate — it locks up. What was missed during the installation?

A. The modulator valve was installed with the inlet and outlet ports reversed — the valve receives the ABS module's modulation command but the reversed ports apply and release pressure at the wrong points in the circuit

B. The modulator valve's electrical connector was not fully seated during installation and the ABS module cannot send the modulation command to the valve — the self-test energized the valve briefly but full modulation requires sustained contact

C. The new modulator valve has a different flow capacity than the original and the ABS module's calibration cannot accommodate the different flow rate through the replacement valve creating an ineffective modulation cycle

D. The replacement modulator valve is compatible but requires a configuration update in the ABS module to recognize the new valve's operating characteristics before it can modulate correctly during an actual ABS braking event

35. A truck's parking brake will not release even though the driver pushes in the yellow diamond valve. Air pressure is at full governor cut-out. The service brakes function normally. The spring brake air lines have been checked and have no visible damage or kinks. What should be investigated?

A. The parking brake valve's internal mechanism for a fault that does not direct supply air to the spring brake circuit when the valve is pushed in despite the external button appearing to be in the released position

B. The spring brake chambers for seized internal components (corroded housing, seized piston, or swollen diaphragm) that prevent the air pressure from compressing the springs to release the parking brake mechanism

C. The quick-release valve between the parking brake valve and the spring chambers for a stuck exhaust seat that vents the supply air before it reaches the spring chambers at adequate pressure for spring compression

D. Both the parking brake valve's internal mechanism and the spring brake chambers — the supply air must reach the chambers at adequate pressure and the chambers must be mechanically able to compress the springs

36. A truck's S-cam drum brakes have been inspected and both shoes on one wheel show heavy wear on the leading edge (the toe) of each shoe but minimal wear on the trailing edge (the heel). What condition causes this toe-heavy wear pattern?

A. The brake shoes are installed backward — the primary and secondary shoes are in the correct positions but each individual shoe has been installed with the lining facing the wrong direction on the shoe table

B. The brake drum is out-of-round creating a lobe that contacts the shoe toe during each drum revolution concentrating the friction energy at the leading edge of both shoes as the lobe passes the contact zone

C. The S-cam is positioned too high or too low in its bushings and the cam lobes contact the shoe rollers at an angle that pushes the toe harder against the drum than the heel during each brake application event

D. The anchor pin is worn or the shoe is not seated correctly on the anchor creating a pivot point that is offset from the designed position — the offset pivot concentrates the application force at the toe of each shoe

37. A truck equipped with disc brakes on the front steer axle has a complaint that the brake pedal vibrates during braking at highway speed but the vibration disappears during city driving. What is the most likely cause?

A. The brake rotor has developed a thickness variation (parallelism error) that produces a pedal pulsation proportional to wheel speed — the faster highway speed produces a higher-frequency vibration that is more perceptible than the lower-frequency city-speed pulsation

B. The steer axle wheel bearings have developed play that allows the hub-mounted rotor to wobble during the higher speeds of highway driving but the lower city speeds do not generate enough centrifugal force to excite the wobble

C. The ABS system is modulating the front brakes at highway speed because the steer axle load decreases at highway speed from aerodynamic lift and the ABS interprets the reduced traction as an impending lockup condition

D. The brake pads have a friction compound that is sensitive to speed and the coefficient of friction changes at highway speed creating an alternating grab-release pattern that is perceived as vibration during highway braking

38. A trailer's spring brake chamber has been replaced. During the replacement, the technician notices that the service chamber (front section) diaphragm has a small pinhole leak. The leak is audible when 690 kPa of air is applied directly to the chamber. How does this pinhole leak affect brake performance?

- A. The pinhole leak reduces the maximum application force by allowing a small amount of air to escape during every brake application — the leaked air reduces the diaphragm's effective area creating less pushrod force
- B. The pinhole has no immediate effect on brake performance because the leak rate is too small to affect the diaphragm's ability to push the rod during the brief application period of a normal brake stop event
- C. The pinhole leak will cause the brakes to drag on that wheel because the constant air escape past the diaphragm creates a residual pressure in the chamber that keeps the brake partially applied at all times
- D. The pinhole leak causes a progressive loss of air from the service reservoir during driving because the small leak continuously drains air from the supply circuit even when the brakes are not being applied by the driver

39. A truck's brake proportioning valve has been adjusted to reduce the rear brake application pressure by 15% to prevent rear wheel lockup on empty truck operation. The truck is now loaded to its maximum GVW. What is the consequence of the fixed 15% rear reduction during loaded operation?

- A. The reduced rear brake pressure has no operational consequence when loaded because the dynamic weight transfer during braking shifts enough additional weight to the front axle to compensate for the rear reduction
- B. The truck will have a longer stopping distance when loaded because the rear brakes are under-contributing — the 15% reduction that prevents lockup when empty provides inadequate rear braking force when fully loaded
- C. The reduced rear pressure improves braking stability when loaded because the proportioning prevents the rear from providing more force than the front maintaining a predictable front-heavy braking balance
- D. The proportioning valve automatically adjusts its reduction percentage based on the vehicle weight and the 15% setting at empty increases to 0% (no reduction) when loaded to provide full rear brake force

40. A truck's air compressor governor has been tested and the cut-out pressure is 860 kPa (125 PSI) and the cut-in is 725 kPa (105 PSI). The specification calls for cut-out at 860 kPa and cut-in at 690 kPa (100 PSI). The cut-in is 35 kPa higher than specification. What is the consequence of this high cut-in setting?

- A. The high cut-in setting has no operational consequence because the pressure never drops to the cut-in during normal driving and the compressor cycles are determined by the system's air consumption rate

B. The air dryer purge cycle occurs 35 kPa earlier than designed which reduces the dryer's regeneration effectiveness and allows more moisture to pass through the dryer into the downstream air system components

C. The compressor loads 35 kPa earlier than designed which reduces the pressure band between cut-in and cut-out — the narrower band causes the compressor to cycle more frequently reducing its service life

D. The high cut-in setting increases the minimum system pressure during normal operation because the compressor loads before the pressure drops to the designed minimum ensuring the driver always has adequate air

41. A heavy-duty truck's front drum brakes are being inspected. The technician removes the drums and finds that the brake shoe linings are worn at an angle — the top of the lining (closest to the anchor pin) is worn to near minimum thickness while the bottom of the lining (closest to the cam roller) still has significant material remaining. What causes this tapered wear pattern?

A. The S-cam bushings are worn and the cam shaft has shifted in its bushings changing the cam's contact angle with the shoe rollers which concentrates the application force at the upper portion of the shoe closest to the anchor

B. The brake shoes have been installed upside down placing the shorter lining at the top where it wears faster than the longer section at the bottom — the tapered appearance is from the shorter lining reaching minimum first

C. The automatic slack adjuster arm is the wrong length for this application and the incorrect mechanical advantage creates an uneven force distribution across the lining height from anchor to cam during each application

D. The anchor pins are worn and the shoes pivot at a point different from the designed fulcrum — the altered pivot point concentrates the drum contact force at the upper portion of the lining near the anchor creating the taper

42. A truck equipped with a trailer hand valve (trolley valve) has a complaint that the trailer brakes apply smoothly but release very slowly when the hand valve is released. The tractor service brakes release normally when the foot valve is released. What is the most likely cause?

- A. The trailer hand valve has a restricted exhaust port that slows the release of the signal air from the trailer relay valve's service port — the restricted exhaust delays the relay valve's release response
- B. The trailer relay valve's exhaust port is restricted from contamination and the restricted exhaust slows the air release from the trailer brake chambers — the relay receives the release signal but cannot vent the chambers quickly
- C. The trailer's air line between the relay valve and the brake chambers has a restriction that limits the exhaust flow rate — the relay valve exhausts normally but the restricted downstream line holds air in the chambers
- D. The trailer hand valve's internal return spring has weakened and the valve spool does not fully return to the released position when the handle is released — the partially open valve continues to send a small signal to the trailer relay

43. A truck's brake chambers on the rear drive axle are Type 30/30 (service/spring combination). The front steer axle uses Type 24 service-only chambers. Why are the rear chambers larger than the front?

- A. The rear axle chambers are larger because the spring brake section requires additional diameter for the mechanical spring — the 30/30 designation includes the spring section diameter in the total size classification
- B. The rear axle carries more of the vehicle's loaded weight than the front axle and requires larger brake chambers to produce proportionally more braking force to match the heavier rear axle loading during stops
- C. The Type designation numbers are not directly comparable between service-only and combination chambers — the Type 30 service section has the same effective area as the Type 24 service-only unit
- D. The rear chambers are larger to provide additional pushrod stroke range for the larger-diameter rear brake drums that require more liner-to-drum contact for adequate rear axle braking force on the heavier axle

44. A truck's brake pedal has a noticeably harder feel on the first application after a period of driving without braking (5 to 10 minutes between stops). Subsequent applications feel normal. What causes this initial hard pedal?

A. The automatic slack adjusters have allowed the brake shoes to drift away from the drums during the non-braking period and the first application must push the shoes through the extra clearance before contact is made

B. The brake system accumulates a slight pressure differential between the primary and secondary circuits during the non-braking period that must equalize through the foot valve on the first application before normal feel returns

C. The relay valves' internal pistons settle against their seats during the non-braking period and the first application must overcome the static friction of the seated pistons before they begin delivering air normally

D. The foot valve's internal pistons have developed a slight adhesion to the valve bore during the non-braking period from moisture in the air system and the first pedal application must break this adhesion before normal operation

45. A trailer's brake system uses long-stroke brake chambers to provide additional adjustment range for the brake linings. Compared to standard-stroke chambers of the same type designation, what advantage do long-stroke chambers provide?

A. Long-stroke chambers produce more force at the pushrod because the longer stroke allows the diaphragm to develop a larger contact area with the air supply creating more total force on the pushrod during application

B. Long-stroke chambers are designed for disc brake applications where the caliper piston must travel further than a drum brake push rod to contact the brake pad surface during each application event

C. Long-stroke chambers provide a greater pushrod travel range before the brake reaches its maximum allowable stroke — this extended range allows the automatic slack adjuster to compensate for more lining wear before reaching the out-of-service limit

D. Long-stroke chambers contain a stronger diaphragm material that can withstand higher application pressures than standard chambers providing increased maximum braking force at the same system air pressure setting

46. A truck's air dryer has a fault where it purges continuously rather than only during the governor's unload cycle. The continuous purge rapidly depletes the system pressure. What has caused the purge valve to remain open?

A. The governor is sending a continuous unload signal from a stuck solenoid or seized piston that keeps the compressor in the unloaded state and the purge valve continuously receives the open command from the governor

B. The purge valve's internal seat has failed or the valve's piston is stuck in the open position — the valve remains open regardless of the governor's signal and continuously vents air from the supply circuit through the dryer exhaust

C. The air dryer's heater has failed and the frozen moisture in the desiccant bed has expanded and mechanically pushed the purge valve open from the pressure of the ice formation inside the dryer's cartridge housing

D. The desiccant cartridge has deteriorated and the disintegrated desiccant material has fallen into the purge valve mechanism preventing it from closing fully after each purge cycle — the contamination holds the valve open

47. A truck's engine cranks normally but will not start. The scan tool shows the engine RPM during cranking at the correct value and the ECM is commanding injection. There are no active fault codes. The exhaust produces no smoke during cranking. What is the single most efficient diagnostic test to perform next?

A. Check the glow plug system operation because inadequate preheat prevents autoignition of the fuel charge during cranking and the lack of smoke confirms no fuel is burning in the cylinders during the cranking event

B. Perform a compression test on all cylinders because the lack of smoke with confirmed fuel injection and adequate cranking speed suggests the cylinders cannot develop adequate compression for autoignition of the fuel

C. Verify the fuel supply system is delivering fuel to the high-pressure pump by checking the transfer pump output pressure — inadequate supply prevents the HP pump from building rail pressure for injection

D. Check the fuel rail pressure during cranking because the ECM may be commanding injection but if the high-pressure pump is not building adequate rail pressure no fuel reaches the cylinders despite the ECM's command

48. A truck's alternator has been replaced with a higher-output unit (200 amps vs the original 160 amps) to support additional electrical accessories. After the upgrade, the drive belt squeals during peak electrical load conditions. What should be checked?

A. The belt tensioner for adequate spring force to handle the increased alternator torque demand — a tensioner designed for 160 amps may not provide enough belt clamping force for the 200-amp alternator's higher operating load

B. The belt routing for correct path around all pulleys because the higher-output alternator may have a different pulley diameter that changes the belt's wrap angle around the tensioner and other drive pulleys

C. The alternator's internal voltage regulator for a fault that allows the field current to exceed the designed maximum creating an overload condition that increases the belt load beyond the original system's design capacity

D. The battery bank for an undersized capacity that cannot absorb the higher alternator output creating an electrical overload condition that increases the alternator's mechanical resistance and overloads the belt drive

49. A truck's scan tool shows the engine ECM receiving two different vehicle speed values simultaneously — one from the ABS module at 85 km/h and one from the transmission output shaft sensor at 82 km/h. Which speed source does the engine ECM typically use for its fuel delivery and speed-limiting calculations?

A. The engine ECM uses the higher of the two speeds as a safety measure to ensure the vehicle speed limiter activates at the correct threshold regardless of which sensor is more accurate during normal driving

B. The engine ECM uses the ABS module's speed data because the ABS system uses multiple wheel speed sensors for its calculation making it more accurate than a single transmission output shaft sensor

C. The ECM uses the vehicle speed source that is configured in its customer parameters — the programmed source is typically either the ABS module's broadcast or the transmission sensor depending on the vehicle's configuration

D. The engine ECM averages the two speed inputs to create a composite vehicle speed value that eliminates the error in either individual source and provides a more accurate speed for fuel calculations and speed limiting

50. A truck's CAN bus has been tested and shows 60 ohms termination resistance (correct). However, intermittent communication faults persist. The technician checks the CAN-H and CAN-L waveforms with an oscilloscope and finds the differential voltage between CAN-H and CAN-L is only 1.2 volts instead of the normal 2.0 to 2.5 volts. What does the reduced differential voltage indicate?

A. The CAN bus has excessive capacitive loading from too many modules connected to the backbone which attenuates the signal amplitude below the transceivers' reliable detection threshold for all module communication

B. One or more CAN bus transceivers have partial internal failures that load down the bus voltage without completely shorting it — the partially failed transceiver reduces the differential signal available to all other modules

C. The ECM's master CAN transceiver has a weak output driver that cannot generate the full 2.0-2.5 volt differential signal and the reduced output limits all other modules' ability to receive the data reliably during operation

D. The CAN bus wiring has excessive resistance in the backbone that creates a voltage divider effect reducing the signal amplitude as it travels through the high-resistance sections of the bus between the transceivers

51. A truck's battery equalizer on a 24-volt system has failed and been replaced. After the replacement, the 12-volt accessories work correctly. However, the engine will not crank even though the 24-volt starting circuit batteries are fully charged. What was likely done incorrectly during the equalizer replacement?

A. The equalizer's power connections were reversed and the unit is converting 24 volts to a higher voltage on the accessory circuit rather than the designed 12-volt output destroying the 12-volt accessories

B. The equalizer was connected in parallel with the batteries instead of across the midpoint of the series battery connection creating an incorrect circuit that provides 12 volts but disrupts the 24-volt starting circuit path

C. The equalizer's fuse has not been installed and the overcurrent protection device is interrupting the 24-volt starting circuit because the equalizer's main power connection is in series with one of the starting batteries

D. The equalizer's main power cables were connected to the wrong battery terminals — the cables are between the starting circuit and the equalizer and the incorrect connection has interrupted the 24-volt series circuit to the starter

52. A truck equipped with LED headlamps has had one headlamp assembly replaced. After the replacement, the other (original) headlamp on the opposite side begins flickering intermittently. The new headlamp functions perfectly. What could the replacement headlamp have introduced?

A. The replacement headlamp's internal LED driver has a switching frequency that creates electromagnetic interference on the shared power supply wire and the interference disrupts the original headlamp's driver circuit causing it to flicker

B. The replacement headlamp draws more current than the original which reduces the available voltage on the shared headlamp circuit — the voltage fluctuation causes the original headlamp's driver to become unstable and flicker

C. The replacement headlamp has a different ground impedance than the original creating a ground loop between the two headlamp circuits that produces voltage oscillations on the shared ground affecting the original lamp

D. The replacement headlamp's CAN bus module broadcasts at a different data rate than the original and the conflicting signals cause the body controller to intermittently drop the output to the original headlamp circuit

53. A truck's engine ECM has been replaced under warranty. After programming the new ECM with the correct calibration and customer parameters, the engine starts and runs normally. However, the driver reports the engine brake (compression brake) does not function. The engine brake switch and wiring have been verified as correct. What parameter was likely not configured?

A. The engine brake's activation speed threshold was not programmed and the ECM defaults to a speed above the vehicle's operating range preventing the engine brake from activating during normal driving conditions

B. The ECM's default calibration has the cruise control and engine brake features linked and the cruise control must be enabled before the engine brake function becomes available in the ECM's feature menu

C. The engine brake feature must be specifically enabled in the ECM's customer parameter configuration — many ECMs ship with the engine brake feature disabled by default and it must be activated during the setup process

D. The engine brake solenoid driver outputs were not assigned to the correct ECM pins during the programming procedure and the ECM is sending the brake commands to unused output terminals that are not wired to the solenoids

54. A truck's tail lamp circuit is controlled by the body controller. The right tail lamp works correctly when the headlamp switch is turned on, but the left tail lamp does not illuminate. The left brake lamp, left turn signal, and left backup lamp all work correctly. What is the most likely cause?

A. The left tail lamp circuit has an open in the wire between the body controller's output and the lamp socket because all other left-side lamps function through different circuits that are not affected by the tail lamp wire fault

B. The body controller's left tail lamp output driver has failed while the other left-side lamp output drivers on the same controller continue to function normally because each lamp has its own independent output circuit

C. The left tail lamp bulb has a dual-filament design and the tail lamp filament has failed while the brake, turn, and backup filaments remain functional because each filament is a separate circuit in the combination lamp

D. The left marker lamp fuse has blown and the tail lamp circuit is protected by the same fuse while the brake, turn, and backup circuits have separate fuse protection that remains intact during normal operation

55. A truck's engine ECM sets a fault code for "intake manifold pressure sensor — FMI 1 (data below normal range)." The scan tool shows the sensor reading 20 kPa at idle. Normal atmospheric pressure at the vehicle's location is 101 kPa and a naturally aspirated diesel engine should read approximately 95 to 100 kPa at idle. What has failed?

A. The intake manifold has a large vacuum leak that is pulling the pressure below atmospheric — the sensor is reading accurately and the 20 kPa reading reflects the actual manifold condition from the vacuum leak

B. The turbocharger has failed and is creating a restriction in the intake path that reduces the manifold pressure to 20 kPa at idle — the sensor is reading the actual restricted manifold pressure from the failed turbo

C. The intake manifold pressure sensor has failed internally and is producing a fixed low-voltage output that the ECM converts to the 20 kPa reading — the sensor is not reflecting the actual manifold pressure condition

D. The EGR valve is stuck fully open at idle and the excessive exhaust gas recirculation has displaced most of the intake air reducing the manifold pressure to 20 kPa from the inert gas dilution of the intake charge

56. A truck's windshield wiper motor has been replaced. After the replacement, the wipers park correctly and operate at low speed, but high speed does not function — the wipers continue at low speed when the

switch is moved to the high position. The switch has been tested and sends the correct signal. What is the most likely cause?

- A. The replacement wiper motor has a failed high-speed brush or winding connection that prevents the motor from receiving power through the high-speed circuit while the low-speed circuit functions normally through its independent path
- B. The wiper motor connector was partially seated during installation and the high-speed pin did not make contact while the low-speed and park circuit pins connected correctly at the partial insertion depth
- C. The body controller's wiper speed output driver for the high-speed command has failed coincidentally during the motor replacement and the controller can only provide the low-speed output to the replacement motor
- D. The replacement motor has a different pin configuration than the original and the high-speed terminal is connected to a different function creating a low-speed-only condition from the incorrect pin-to-circuit routing

57. A truck's scan tool retrieves a fault code from the transmission control module — SPN 523, FMI 31 (condition exists). The technician is unfamiliar with FMI 31. What does FMI 31 indicate?

- A. FMI 31 indicates a hardware failure in the TCM's internal processing circuit that requires module replacement because the controller's self-diagnostic has detected an unrecoverable internal component malfunction
- B. FMI 31 indicates the TCM has detected a mechanical condition in the transmission (such as slip, flare, or engagement fault) that requires the technician to perform mechanical inspection rather than electrical diagnosis
- C. FMI 31 indicates the fault code contains manufacturer-specific additional information that requires accessing the transmission manufacturer's diagnostic procedures for the specific SPN and FMI combination interpretation
- D. FMI 31 is a generic J1939 code that indicates a "condition exists" — the fault is active and present but the specific condition details must be determined through the manufacturer's service literature for the SPN 523 parameter

58. A truck equipped with a multiplexed body electrical system has the horn not functioning. The horn relay clicks when the horn button is pressed. The horn itself tests good when 12 volts is applied directly to its terminals. What is the most likely cause?

A. The horn relay's coil energizes (producing the click) but the relay's internal contacts are burned and cannot pass adequate current to the horn despite the coil successfully pulling the contacts toward the closed position

B. The horn relay clicks and the horn works with direct power — the fault is in the circuit between the relay output and the horn, likely a broken wire, corroded connector, or poor ground connection at the horn mounting point

C. The body controller is providing the relay ground command but the relay is receiving only partial voltage on its power supply terminal which is enough to click the relay but not enough to pass current through the contacts

D. The horn button's ground circuit has excessive resistance that limits the body controller's ability to fully energize the relay coil — the relay partially engages (clicks) but the contacts do not close with enough force for full current

59. A truck's engine ECM has set a fault code for the fuel pressure control valve — SPN 157, FMI 5 (current below normal). The fuel pressure control valve is a PWM-controlled solenoid. What does FMI 5 indicate for this PWM device?

A. The solenoid or its circuit has excessive resistance, an open winding, or a wiring fault that limits the current flow below the ECM's minimum expected value for the commanded duty cycle — the device cannot draw adequate current

B. The ECM's internal PWM driver transistor has partially failed and cannot deliver the full current output to the solenoid even though the solenoid and wiring are functioning correctly within their specifications

C. The fuel pressure control valve's solenoid is mechanically seized and the resulting lack of movement creates a back-EMF that opposes the ECM's current output reducing the measured current below the normal threshold

D. The fuel system pressure is too low for the control valve to operate within its designed range and the low pressure creates a condition where the valve requires less current than the ECM expects during normal operation

60. A truck's instrument cluster has a tachometer that occasionally jumps to 8,000 RPM for 1 to 2 seconds while the engine is idling at 700 RPM. All other gauges display correctly during the tachometer spike. What is the most likely cause?

A. The crankshaft position sensor has an intermittent fault that produces a burst of rapid pulses during the glitch — the ECM broadcasts the erroneous high RPM on the CAN bus and the tachometer displays the false data

B. The instrument cluster's tachometer stepper motor has a mechanical fault that occasionally jumps to a random position before returning to the correct position driven by the next valid CAN bus data update

C. The CAN bus has an intermittent noise source that corrupts the engine RPM data parameter during the glitch — the cluster displays the corrupted data value until the next valid RPM message overwrites the error

D. The ECM's CAN bus transmitter has an intermittent fault that sends an incorrect RPM value for 1-2 seconds before the internal self-check corrects the output — the cluster accurately displays the erroneously transmitted data

61. A truck's trailer ABS system communicates with the tractor through the 7-pin connector using PLC (power line communication). The tractor's scan tool can communicate with the tractor ABS but cannot establish communication with the trailer ABS. The trailer ABS lamp cycles through its normal self-test when the trailer is connected. What should be checked first?

A. The tractor's scan tool for a compatible PLC adapter because many generic scan tools require a specific PLC interface module to communicate with trailer ABS systems that use power line communication

B. The trailer ABS module's PLC transmitter for an internal failure that prevents data transmission while the core ABS functions and the self-test indicator continue to operate normally from the module's main processor

C. The 7-pin connector's ABS power pin (pin 7) for adequate signal quality — the PLC data is superimposed on the power wire and a high-resistance connection attenuates the data signal while still passing enough power for operation

D. The trailer's internal wiring from the 7-pin socket to the ABS module for damage that reduces the PLC signal quality below the scan tool's detection threshold even though the power delivery is adequate for ABS operation

62. A truck has two batteries in parallel. Battery 1 tests at 12.6 volts and passes a load test. Battery 2 tests at 11.8 volts and fails the load test. The technician replaces Battery 2 with a new battery. What should be done with Battery 1?

A. Battery 1 can remain in service because it passed both the voltage and load tests — it is still a functional battery that will work alongside the new Battery 2 in the parallel configuration without affecting the new battery

B. Battery 1 should also be replaced because pairing a used battery with a new battery in parallel creates an imbalance that will cause the new battery to carry a disproportionate electrical load and fail prematurely from the overwork

C. Battery 1 should be load tested again after the new Battery 2 is installed because the failed Battery 2 may have been pulling Battery 1's voltage down and the retest with a good parallel partner may reveal a different result

D. Battery 1's state of charge should be verified and equalized with the new Battery 2 before paralleling them — once both batteries are at the same voltage and charge state they can be connected in parallel successfully

63. A truck equipped with daytime running lights (DRLs) has one DRL that is noticeably brighter than the other. Both DRL bulbs are the same type and wattage. Voltage measured at both lamp connectors is identical. What should the technician investigate?

A. The dimmer DRL bulb for internal blackening from filament evaporation that deposits tungsten on the glass envelope — the darkened glass reduces the perceived brightness even though the filament draws the correct current

B. The DRL module for an unbalanced output that delivers different current levels to each DRL circuit despite the voltage measurements appearing identical at the connector terminals during the static test measurement

C. The dimmer DRL headlamp reflector for oxidation or cloudiness that reduces the reflective efficiency — the bulb produces equal light but the degraded reflector scatters the light instead of focusing it in the DRL beam pattern

D. The headlamp aiming on both sides because the DRL appears dimmer on one side from the beam pattern projecting at a different angle — the aim difference creates a perceived brightness asymmetry when viewed from the front

64. A truck's scan tool shows the engine ECM's supply voltage at 11.2 volts with the engine running. The alternator output at the B+ terminal reads 14.4 volts. The battery terminal voltage reads 13.8 volts. What do these three different voltage readings indicate?

A. The alternator is producing adequate voltage (14.4V) but the ECM is powered through a circuit with excessive resistance — the 3.2V drop between the alternator and the ECM indicates corroded connectors or damaged wiring

B. The battery cables have a 0.6V drop (14.4 to 13.8V) and the ECM power circuit has an additional 2.6V drop (13.8 to 11.2V) — both circuits have excessive resistance that must be addressed for proper system operation

C. The alternator is overcharging (14.4V is above specification) and the voltage regulator fault is causing fluctuations that the ECM's filtered power supply averages to 11.2V creating the lower reading at the ECM's input

D. The ECM's 11.2V reading indicates the ECM has an internal voltage measurement error and the actual ECM supply voltage matches the battery terminal voltage of 13.8V — the scan tool is displaying incorrect data

65. A truck's heated windshield system is activated by the driver but the windshield does not heat. The system's relay clicks when the switch is pressed. Voltage at the windshield connector reads 0 volts with the system activated. What should be checked?

A. The heated windshield relay's load contacts for a welded-open condition that prevents the relay from passing current to the windshield despite the relay coil energizing and producing the audible click during activation

B. The heated windshield fuse for a blown condition and the wiring between the relay output and the windshield connector for an open circuit that prevents voltage from reaching the windshield heating elements

C. The windshield heating element connections at the glass-to-harness interface for corrosion or disconnection that prevents the voltage from reaching the conductive heating elements embedded in the windshield glass

D. The relay clicks (confirming the control circuit works) and 0 volts at the connector indicates the load circuit is open — the relay contacts, fuse, or the wiring between the relay and the connector has an open that must be located

66. A truck's ABS module sets a fault code for the left rear modulator valve — SPN 802, FMI 3 (voltage above normal). The modulator valve solenoid resistance is within specification. What does FMI 3 indicate for this circuit?

A. The modulator valve solenoid's power supply wire has a short to a higher voltage source creating an overvoltage condition at the ABS module's input for that channel that exceeds the module's expected operating range

B. The ABS module's internal driver transistor for the left rear modulator has failed in the open position and the full supply voltage appears at the module's measurement point because no current flows through the solenoid circuit

C. The modulator valve solenoid wire has a short to a voltage source or the module's internal measurement circuit detects voltage above the expected range during the commanded off period indicating an external voltage is present on the circuit

D. The ABS module is commanding the modulator to a higher-than-normal position to compensate for a wheel speed sensor error on the left rear and the elevated voltage reflects the module's maximum effort to modulate that wheel

67. A truck's engine ECM has been reflashed with an updated calibration file. After the reflash, the engine runs but the cruise control does not engage. The cruise control switch, wiring, and speed signal are all verified as functional. What is the most likely cause?

A. The updated calibration file has a different cruise control engagement speed threshold than the previous calibration and the vehicle must exceed the new threshold speed before the cruise control will engage during driving

B. The cruise control feature requires re-enabling in the ECM's customer parameters after every reflash because the calibration update resets all customer-configurable features to their default disabled state

C. The updated calibration file was developed for a different engine application that does not include the cruise control feature and the missing software module prevents the cruise control from functioning in this engine

D. The reflash process corrupted the cruise control engagement algorithm and the ECM must be reflashed again with the same calibration file to restore the feature — the corruption occurred during the download process

68. A truck's battery isolator relay has been replaced. After the replacement, the ignition key is turned to the run position and the dash lights illuminate normally. However, when the key is turned to the start position, the lights dim and the starter does not crank. The batteries are fully charged. What is the most likely cause?

A. The battery isolator relay was connected in series with the starting circuit rather than in parallel and the relay's internal contact resistance creates a voltage drop under the high cranking current that prevents starter operation

B. The replacement isolator relay has a lower current rating than the original and the relay's contacts cannot pass the heavy cranking current required by the starter motor which drops the voltage below the starter's minimum

C. The battery isolator relay's polarity is reversed and the relay's internal diode is blocking the starting current in the forward direction while the reverse diode allows the low-current run circuit to pass normally

D. The replacement battery isolator relay's internal contacts are not closing when the ignition reaches the start position — the relay passes the low-current run circuit through its coil but the load contacts do not close for cranking

69. A truck's automated manual transmission (AMT) has a fault code for "clutch actuator travel exceeded." The clutch still engages but the engagement point is near the end of the actuator's travel range. What does this code indicate?

A. The clutch actuator motor has worn internally and cannot generate adequate force to move the release bearing to the correct position requiring a replacement actuator motor for proper clutch engagement control

B. The clutch disc has worn to the point where the actuator must extend to near its maximum travel to reach the engagement point — the disc is approaching the end of its useful life and replacement should be planned

C. The AMT controller's clutch position sensor has drifted from calibration and the controller believes the actuator is at the end of its range when it is actually at a mid-position — a sensor recalibration will resolve the code

D. The clutch hydraulic system has an internal bypass that prevents the actuator from building full pressure — the system reaches travel limit because the fluid bypasses rather than moving the release bearing to position

70. A truck's manual transmission has been rebuilt. During the first road test, the transmission jumps out of 3rd gear during coast (deceleration). All other gears hold normally during both acceleration and coast. The clutch is adjusted correctly. What is the most probable assembly error?

- A. The 3rd gear mainshaft bearing was installed with insufficient preload and the bearing shifts axially under the coast load direction allowing the 3rd gear engagement sleeve to slide out of its detent position
- B. The 3rd gear synchronizer assembly was installed with the shift fork groove facing the wrong direction and the fork cannot hold the sliding clutch in the fully engaged position during the coast loading direction
- C. The 3rd gear detent spring and ball were not installed or are the wrong specification and cannot hold the shift rail in the 3rd gear engaged position against the reverse-torque loading of the coast deceleration
- D. The 3rd gear shift rail has a worn detent notch and the insufficient detent depth allows the rail to slide out of engagement during the coast loading condition — the weaker detent cannot resist the reverse torque

71. A truck's drive axle has been drained for inspection. The technician finds metallic particles on the drain plug magnet — the particles are fine and silver-coloured. The axle has 100,000 km of service. Should the technician be concerned?

- A. Fine silver-coloured metallic particles on the drain plug magnet are normal for a 100,000 km axle — the particles are from the initial gear break-in and the normal wear of the ring and pinion gear teeth during service
- B. The metallic particles indicate excessive gear tooth wear and the ring and pinion should be inspected for damage — the volume and character of the particles determines whether the axle requires rebuilding
- C. The particles are aluminum from the carrier housing and indicate the ring gear is contacting the housing from excessive carrier bearing play — the bearings must be adjusted to restore the correct ring gear position
- D. Fine silver metallic particles are always cause for concern and the axle should be disassembled for complete internal inspection regardless of the particle volume because any metallic debris indicates component failure

72. A truck equipped with a torque converter automatic transmission has a stall speed that is 300 RPM below the specification. The engine makes rated power on a dynamometer. What does the low stall speed indicate?

A. The torque converter's stator one-way clutch has failed and the stator freewheels in both directions reducing the converter's torque multiplication which should produce a higher stall speed not a lower one

B. The transmission has excessive internal friction from a clutch pack that is partially applied during the stall test creating drag that prevents the engine from reaching the specified stall speed against the added resistance

C. The engine's fuel delivery is limited by the ECM during the stall test to protect the transmission from overheating and the ECM's torque reduction is responsible for the lower-than-specified stall speed reading

D. The torque converter's internal geometry has changed from a defect or incorrect replacement and the converter is locking up partially before reaching the full stall speed which limits the engine's ability to reach specification

73. A truck's driveshaft has been shortened by a driveshaft shop for a wheelbase change. After reinstallation, the technician checks the U-joint working angles. The front U-joint is at 3 degrees and the rear U-joint is at 1 degree. The specification requires the two angles to be within 0.5 degrees of each other. What must be corrected?

A. The driveshaft shop shortened the tube incorrectly changing the geometry between the transmission and the axle — the tube length must be recalculated and the shaft recut to restore equal working angles at both ends

B. The transmission mount height or the centre bearing height (if equipped) must be adjusted with shims to change the driveshaft slope and equalize the front and rear U-joint operating angles to within the 0.5-degree specification

C. The front and rear U-joint angles must be equalized by adjusting the driveshaft's vertical position — typically by shimming the centre bearing bracket or transmission mount to change the driveshaft's slope between the two joints

D. The rear axle pinion angle must be adjusted by shimming the axle's spring mount pads to tilt the pinion upward or downward bringing the rear U-joint angle closer to the front angle for equalization within the specification

74. A truck's clutch hydraulic system has been bled per the manufacturer's procedure. After bleeding, the clutch pedal has a firm feel at the top of the stroke but becomes spongy in the last 25% of pedal travel. What does this partial sponginess indicate?

A. The clutch master cylinder has a worn internal seal that begins to bypass fluid at the higher pressure developed during the last 25% of pedal travel — the seal holds at low pressure but leaks at the higher application pressure

B. Air remains trapped in the slave cylinder or in a high point of the hydraulic line that did not purge during the standard bleeding procedure — the trapped air compresses during the higher-pressure portion of the pedal stroke

C. The clutch slave cylinder piston seal has a defect that allows fluid to bypass during the high-pressure portion of the stroke creating the spongy feel only in the last 25% of travel where the hydraulic pressure is highest

D. The clutch disc damper springs are broken and the disc hub moves on the input shaft splines during the final engagement creating a mechanical compliance that the driver perceives as hydraulic sponginess through the pedal

75. A truck's automatic transmission shifts correctly in all forward ranges. However, when the vehicle comes to a complete stop and the driver selects Reverse, there is a 3-second delay before the transmission engages. Once engaged, Reverse functions normally. What is the most probable cause?

A. The reverse servo apply circuit has a slow fill condition from a worn servo bore seal, a restricted apply passage, or a weak accumulator spring that delays the pressure buildup needed to apply the reverse band against the drum

B. The valve body's reverse shift valve has a sticking condition that delays its movement to the reverse position — contamination in the valve bore creates friction that the spring cannot overcome quickly when Reverse is selected

C. The torque converter's internal check valve is leaking and the converter drains partially during forward driving — when Reverse is selected the pump must refill the converter before the reverse band can apply against adequate pressure

D. The engine idle speed drops when Reverse is selected because the automatic transmission creates additional load and the reduced pump speed at the lower RPM delays the fill time for the reverse apply circuit

76. A truck's drive axle pinion nut has been re-torqued after a seal replacement. The technician did not mark the nut position before removal. After reassembly, the technician torques the nut to the specification value. What potential problem exists with this procedure?

A. The pinion nut torque specification alone may not reproduce the original pinion bearing preload because the nut's friction characteristics change after the first tightening and the torque-to-preload relationship is no longer accurate

B. The pinion nut should never be re-torqued to a specification value — the nut must always be replaced with a new nut because the deformed locking feature cannot provide adequate retention after the initial installation use

C. The unmarked nut position means the technician cannot verify whether the nut has been tightened to the same position as the original installation — the preload may be too tight or too loose depending on the nut's new position

D. Torquing the pinion nut without marking the original position risks over-tightening the pinion bearings beyond their designed preload — the crushed bearing rollers will fail prematurely from the excessive loading during operation

77. A truck equipped with a 13-speed manual transmission has a complaint that all shifts in the low range are smooth but all shifts in the high range are noticeably harder. The clutch is adjusted correctly and the transmission fluid level is correct. What is the most likely cause?

A. The range shift air cylinder is not fully engaging the high range synchronizer and the partial engagement changes the gear mesh geometry creating resistance to the shift mechanism during all high-range gear changes

B. The range shift synchronizer blocking ring has worn and cannot adequately match speeds during the range shift — the speed mismatch during the incomplete synchronization creates the hard shift feel in all high-range gears

C. The high-range synchronizer in the auxiliary section is worn and cannot smoothly match the speed differential during the range shift from low to high — the incomplete speed matching produces hard shifts in all high-range gears

D. The range air cylinder has a slow leak on the high-range side that prevents full engagement pressure — the reduced pressure does not fully synchronize the range shift before the gears engage creating the hard shift feel

78. A truck's automatic transmission fluid is being inspected. The fluid appears dark brown with a slight burnt odour. The fluid was changed 25,000 km ago. The specification calls for changes every 50,000 km. What does the premature fluid degradation indicate?

A. The transmission has been operating at temperatures above its designed cooling capacity — the elevated temperature has accelerated the fluid's oxidation rate producing the dark colour and burnt odour in half the expected interval

B. The fluid was an incorrect specification and the wrong fluid type has degraded faster than the correct specification would under the same operating conditions — the fluid type must be verified before refilling

C. The torque converter lockup clutch has been slipping during highway cruise generating friction heat that accelerates the fluid's oxidation beyond what the designed cooling system can dissipate during normal operation

D. The transmission's internal friction elements have been slipping from a pressure or calibration issue and the friction heat from the slipping clutch packs has thermally degraded the fluid in half the designed service interval

79. A truck's clutch release bearing has failed and damaged the pressure plate finger tips. The technician replaces the release bearing, the pressure plate, and the clutch disc. What additional component should be inspected before reassembly?

A. The flywheel for heat damage, scoring, and cracks from the failed release bearing's effect on the clutch engagement — if the bearing caused clutch slippage the flywheel may need machining or replacement before reassembly

B. The flywheel friction surface for heat damage, hard spots, scoring, and cracks — the failed release bearing may have caused the clutch to slip or drag creating heat damage on the flywheel surface that must be addressed

C. The transmission input shaft pilot bearing in the flywheel because the failed release bearing may have transmitted abnormal loads to the pilot bearing through the clutch disc hub during the failure period

D. The transmission input shaft splines for wear because the failed release bearing may have caused the clutch disc to operate under abnormal conditions that accelerated the disc hub's spline wear on the shaft

80. A truck's transfer case equipped with a viscous coupling centre differential has a complaint that the four-wheel-drive system does not distribute torque to the front axle during traction loss events. The rear wheels spin freely on ice while the front axle receives no drive torque. What has failed in the viscous coupling?

A. The viscous coupling fluid has thinned from overheating and can no longer generate adequate shear force between the input and output plates — the thinned fluid allows the plates to slip without transferring torque to the front axle

B. The viscous coupling's internal silicone fluid has leaked from a failed seal and the dry coupling cannot generate the viscous shear force needed to transfer torque between the spinning rear output and the stationary front output

C. The viscous coupling plates have worn smooth and cannot generate the fluid shear needed to transfer torque — the worn plates rotate through the silicone fluid without creating adequate resistance for torque transfer

D. The viscous coupling fluid has lost its viscosity from age and heat cycling and cannot create adequate shear force between the input and output plates — the coupling effectively acts as an open differential with no torque transfer

81. A truck's drive axle has a complaint of a clunking noise when transitioning from acceleration to coast. The noise occurs once during each transition. U-joints are tight and the driveshaft has no play. What should be checked?

A. The axle shaft C-clips for adequate engagement in the differential side gear grooves — worn clips or worn grooves allow the axle shafts to shift axially during torque reversals producing the single clunk at each transition

B. The differential carrier bearings for excessive play that allows the ring gear to shift position during torque reversals — the ring gear's movement produces the clunk as it repositions against the pinion during each load change

C. The ring and pinion backlash for excessive clearance that allows the ring gear teeth to separate from the pinion teeth during the torque reversal — the teeth re-engage with a clunk when the torque direction changes

D. The engine and transmission mounts for deterioration that allows the powertrain to shift during torque reversals — the mount compliance creates the clunk as the drivetrain shifts before the torque load stabilizes in the new direction

82. A truck's automatic transmission has been rebuilt with all new clutch packs and bands. During the post-rebuild test drive, all shifts are smooth and the transmission performs correctly. After 2,000 km, the 3-4 shift becomes harsh. All other shifts remain smooth. What is the most probable cause?

A. The 3-4 clutch pack has a worn steel plate separator that was not replaced during the rebuild — the reused steel has lost its heat treatment and the altered friction characteristic produces the harsh 3-4 shift as it degrades

B. The 3-4 accumulator piston seal has failed from the new clutch pack's slightly different engagement characteristic — the failed seal cannot cushion the 3-4 apply pressure creating the harsh shift at that specific gear change

C. The 3-4 shift valve in the valve body has accumulated a contamination particle that delays its movement creating an overlap between the off-going and on-coming clutch packs that produces the harsh shift at the 3-4 transition

D. The valve body or the 3-4 shift circuit has developed a contamination or wear issue that affects the specific shift timing for the 3-4 transition — the change after 2,000 km of successful operation indicates a progressive condition

83. A truck equipped with a limited-slip differential has had the axle lubricant changed. After the oil change, the differential produces a chattering noise during low-speed turns on dry pavement. The noise was not present before the oil change. What is the most likely cause?

A. The replacement lubricant level is overfilled and the excess fluid creates hydraulic resistance against the clutch pack preventing smooth engagement and release during the differential action of turning at low speed

B. The replacement lubricant was not mixed with any additives and the clean oil has washed away the existing friction modifier film from the clutch disc surfaces creating the grab-release chatter during differential action

C. The drain plug magnet was not cleaned and the metallic debris on the magnet has circulated into the clutch pack creating an abrasive surface that produces the chatter from the irregular clutch disc engagement pattern

D. The limited-slip friction modifier additive was not added to the replacement gear oil — without the friction modifier the clutch discs grab and release alternately during the speed differential required for turns producing chatter

84. A truck's driveshaft centre bearing support has been replaced. After the replacement, the technician checks the driveshaft's operating angles and finds them within specification. During the road test, the truck produces a vibration at exactly 60 km/h that was not present before the bearing replacement. What should be checked?

A. The new centre bearing's rubber isolator for the correct durometer (hardness) specification — an isolator with the wrong hardness changes the driveshaft's dynamic response at the specific speed corresponding to the vibration frequency

B. The centre bearing bracket mounting height for correct alignment — the new bracket may be mounted at a different height than the original changing the driveshaft's vertical alignment even though the operating angles check within specification

C. The driveshaft phasing between the front and rear sections for a phase error introduced during the reassembly — the front and rear sections may have been connected with the yoke ears out of phase creating the speed-specific vibration

D. The centre bearing alignment and the driveshaft phasing — both conditions can independently produce a speed-specific vibration and both should be verified after the centre bearing replacement to identify the actual source

85. A truck's compression brake (engine retarder) has been serviced with new slave pistons. After the service, the compression brake produces adequate retarding force but is noticeably louder than before the slave piston replacement. The lash has been adjusted to the OEM specification using the new slave pistons. What is the most likely cause of the increased noise?

A. The replacement slave pistons have a slightly different contact surface profile that creates a harder impact against the exhaust valve crossheads during each compression brake activation event producing louder decompression events

B. The new slave pistons have not yet seated against the crossheads and the initial metal-to-metal contact between the un-seated surfaces produces more noise than the previously worn-in contact of the old piston-to-crosshead interface

C. The slave piston lash was set to the OEM specification for new parts which may differ from the lash specification for used components — the new-parts specification produces a tighter clearance that increases the engagement noise

D. The new slave pistons may have a different internal hydraulic lash adjustment characteristic that creates a slightly different contact timing — the altered timing produces the louder noise during the initial break-in period until the pistons wear in

86. A truck's power steering pump produces a growling noise during cold starts that diminishes as the engine and fluid warm to operating temperature. The fluid level is correct and the fluid type is the specified product. What is the most likely cause?

A. The power steering pump's internal clearances tighten in the cold creating a temporary mechanical interference between the rotor and cam ring that produces the growling until thermal expansion restores the designed clearances

B. The return hose has a section of collapsed internal liner that restricts fluid return to the reservoir during cold operation — the cold fluid's higher viscosity amplifies the restriction and produces the growling from pump starvation

C. The power steering pump drive belt has hardened from age and slips during cold starts when the cold belt rubber has reduced friction — the slipping belt produces the growling that diminishes as the belt warms and becomes more flexible

D. The power steering fluid's cold viscosity exceeds the pump's ability to efficiently draw fluid from the reservoir — the thick cold fluid creates cavitation at the pump inlet producing the growling noise until the fluid warms and thins

87. A truck's front leaf spring has a broken main leaf. The break is at the spring eye where the leaf is formed into the eye loop. The vehicle is loaded to its GVW. What is the immediate consequence of this main leaf failure?

A. The front axle shifts rearward on the affected side from the broken spring eye which disconnects the spring from the frame hanger changing the caster angle and the wheelbase on that side creating a steering pull and tracking error

B. The front axle on the affected side drops below the designed ride height because the main leaf supports the majority of the spring's load capacity and its failure transfers the load to the remaining leaves which cannot maintain height

C. The remaining spring leaves continue to support the load temporarily but the broken eye disconnects the spring's fore-aft restraint allowing the axle to shift position under braking and acceleration creating dangerous instability

D. The broken main leaf at the spring eye means the spring is no longer attached to the frame hanger bracket on that side — the vehicle must be immediately parked and towed because the axle has no forward restraint and can shift uncontrollably

88. A truck's steer axle alignment shows the following readings: Total toe: 0.10° toe-in (specification: 0.00° to 0.15° toe-in). Left camber: $+0.7^\circ$ (specification: $+0.25^\circ$ to $+1.00^\circ$). Right camber: $+0.8^\circ$ (specification: $+0.25^\circ$ to $+1.00^\circ$). Left caster: $+3.5^\circ$ (specification: $+3.0^\circ$ to $+5.0^\circ$). Right caster: $+3.2^\circ$ (specification: $+3.0^\circ$ to $+5.0^\circ$). Are all alignment readings acceptable?

A. All readings are within their specifications and the vehicle should track straight with even tire wear — no alignment adjustment is needed based on these measurements for this steer axle configuration

B. The total toe and camber are acceptable but the caster difference of 0.3° between left and right may produce a slight steering pull to the right that the driver may notice during highway driving at sustained speeds

C. The readings are all within specification individually but the right camber is higher than the left which will cause the vehicle to pull to the right — the camber should be equalized between sides for balanced tracking

D. All readings are within their individual specifications and the side-to-side differences are within the acceptable tolerances — no adjustment is required and the vehicle should operate with straight tracking and even tire wear

89. A truck's tire has been dismantled for repair. During the internal inspection, the technician finds a nail puncture in the tread at the centre of the crown area. The nail has penetrated 15 mm into the tread (the tread depth is 20 mm). The inner liner shows no damage — the nail did not penetrate completely through the casing. Can the tire be returned to service without repair?

A. Yes — since the nail did not penetrate the inner liner the tire's internal air seal is intact and the tire can be returned to service after removing the nail because no air leakage path exists through the unbreached casing

B. No — even though the nail did not breach the liner the puncture has damaged the internal belt reinforcement and the weakened area is subject to delayed failure from the compromised casing structure during continued service

C. Yes — as long as the nail is removed and the puncture hole is filled with a rubber plug from the tread surface to prevent moisture from entering the casing and corroding the steel belt reinforcement wires over time

D. No — the tire should be inspected by a qualified tire repair technician because the 15 mm nail may have damaged the steel belts even without breaching the liner and the belt damage creates a potential delayed failure risk

90. A truck's hub-piloted wheel has been installed and torqued using an impact wrench. The technician did not use a calibrated torque wrench for the final torque. Why is this procedure inadequate?

A. Impact wrenches produce a consistent torque output from their internal clutch mechanism and can be used as the sole tightening method if the wrench is calibrated annually by a certified tool calibration service

B. Impact wrenches are acceptable for initial wheel nut seating but cannot achieve a consistent torque setting — the final torque must be verified with a calibrated torque wrench to ensure all nuts are within the specified range

C. Impact wrenches produce adequate torque for wheel installation but the rapid application method does not allow the wheel nut to properly seat against the mounting surface requiring a calibrated wrench for the final verification

D. Impact wrenches produce inconsistent torque from gun to gun and application to application — the final torque must be set with a calibrated torque wrench because over-torque damages studs and under-torque risks wheel separation

91. A trailer's walking beam equalizer suspension has one equalizer beam that has developed a visible sag — the beam hangs lower at its centre than the beams on the other side. What does this sag indicate?

A. The equalizer beam has developed a fatigue crack at its centre pivot that allows the beam to flex beyond its designed range under load — the cracked beam must be replaced before the crack propagates to complete failure

B. The equalizer beam has been overloaded beyond its design capacity and the permanent deformation indicates the beam's material has yielded — the beam can no longer distribute load equally and must be replaced for proper equalization

C. The sag is from the beam's centre pivot bushing wearing to the point where the beam can tilt further than designed — replacing the bushing will restore the beam's designed geometry without requiring beam replacement

D. The equalizer beam has yielded from overloading or fatigue and the permanent sag means the beam cannot distribute the load equally between the two axle positions — the beam must be replaced before returning to service

92. A truck's front suspension shock absorber has been tested by pushing down on the front bumper and releasing. The vehicle bounces three times before settling. The specification calls for one to one-and-a-half oscillations before settling. What does the excessive bouncing indicate?

A. The shock absorber has failed internally and cannot provide adequate damping force to control the spring's oscillation — the failed shock allows the spring to store and release energy through multiple cycles before friction dampens the motion

B. The front suspension spring rate is too stiff for the vehicle's current loading condition and the heavy spring stores more energy than the shock absorber can dissipate in one cycle producing the additional bouncing oscillations

C. The shock absorber mounting bolts have loosened and the shock is not making full contact with its mounting points which reduces its effective stroke and damping capacity producing the excessive bouncing during the test

D. The front spring has taken a permanent set from overloading and the reduced spring rate allows more compression travel per bump which stores more energy than the shock absorber can absorb in the designed oscillation count

93. A truck's fifth wheel adjustment has been inspected and the locking jaw mechanism shows 3 mm of vertical play between the king pin and the jaw surfaces when the coupling is fully locked and tested with a pry bar. The specification allows a maximum of 1.5 mm. What must be done?

A. The locking jaw surfaces have worn beyond the specification and the jaw assembly must be adjusted, rebuilt with new jaw contact surfaces, or the fifth wheel assembly must be replaced to restore the coupling to specification

B. Apply high-pressure grease to the jaw contact surfaces to take up the 3 mm play — the grease fills the worn gap and provides adequate coupling retention until the next scheduled fifth wheel service interval

C. The 3 mm play is from the king pin wearing rather than the jaw surfaces — the trailer king pin must be measured and replaced if it has worn below its minimum diameter specification before rechecking the jaw play

D. Both the fifth wheel jaw surfaces and the trailer king pin must be measured to determine which component has worn — either or both may need replacement to bring the coupling play within the 1.5 mm specification

94. A truck's steer tire shows a sawtooth (scalped) wear pattern on the tread ribs. The pattern is identical on both steer tires. The alignment is within specification. What suspension component is the most likely cause?

A. The steer axle bushings have worn allowing the axle to oscillate fore-and-aft during driving which creates the alternating heavy-light contact pattern that produces the sawtooth wear on both tires simultaneously

B. Both steer axle shock absorbers have failed simultaneously and cannot dampen the tire's vertical oscillation — the uncontrolled bouncing creates the sawtooth wear from the alternating contact force during each bounce cycle

C. The steer tire brand and model have a known sawtooth wear characteristic from the tread compound formulation and the wear pattern will develop regardless of alignment or suspension condition on this specific tire design

D. Both shock absorbers have failed and cannot control the tire's bouncing motion during driving — the uncontrolled oscillation creates alternating heavy and light contact zones that wear the tread in a scalped sawtooth pattern

95. A truck's wheel bearing has been adjusted. The technician measures the end play at 0.008 inches. The specification calls for 0.001 to 0.005 inches. What is the consequence of this excessive end play?

A. The excessive end play allows the hub to wobble on the spindle which creates a dynamic runout condition at the brake drum or rotor — the wobble produces brake pulsation and accelerated uneven brake wear during stopping

B. The excessive play allows the hub to shift axially on the spindle changing the ABS wheel speed sensor air gap during wheel rotation which may trigger intermittent ABS fault codes from the variable signal strength

C. The excessive end play has no immediate operational consequence because the bearing design accommodates a wide range of end play settings and the 0.003 inch excess is within the bearing's mechanical tolerance range

D. The excessive play allows the hub to shift position during cornering which changes the wheel alignment dynamically — the alignment shifts produce accelerated tire wear and unpredictable handling during turns

96. A trailer's air ride suspension has been converted from a fixed-ride-height system to a dump-valve-equipped system for loading dock height adjustment. The dump valve allows the suspension to lower fully for dock levelling. What safety concern exists with the dump valve system?

A. The dump valve drains the air from the suspension springs which removes the suspension's cushioning effect — if the trailer is driven with the suspension dumped the rigid suspension transmits shock loads directly to the frame and cargo

B. The dump valve releases all the air from the suspension springs and the trailer sits on the bump stops with no suspension travel — driving the trailer in this condition will damage the frame, cargo, and brake components from the rigid ride

C. The dump valve system must include a speed-limiting interlock that prevents the vehicle from exceeding 10 km/h with the suspension dumped because the rigid suspension creates a rollover hazard above that speed

D. Driving the trailer with the suspension dumped removes all air cushioning creating a harsh rigid ride that can damage the frame, cargo, suspension, and brake components — the system should have a travel-speed interlock or warning

97. A truck's front steer axle has a complaint of a clunking noise when the steering wheel is turned from the straight-ahead position to either direction. The clunk occurs once at the beginning of each turn and does not repeat during continued turning. What is the most likely cause?

A. The steering gearbox sector shaft has worn at the centre position creating play that produces the initial clunk when the sector gear engages the ball nut at the beginning of each steering input from the straight-ahead position

B. The drag link ball joints have developed play that allows the drag link to shift before transmitting the steering gearbox's motion to the steering arm — the play produces the single clunk at the beginning of each steering input

C. The pitman arm is loose on the sector shaft and the arm shifts on the shaft's worn splines before engaging the steering force — the initial play produces the clunk before the arm and shaft lock together for the steering input

D. The steering linkage has play at one or more connections — drag link ball joints, pitman arm, tie rod ends, or the gearbox — and the total accumulated play produces the single clunk at the beginning of each direction change

98. A truck equipped with disc brakes on all positions has the brake pads replaced on the front steer axle. After the pad replacement, the technician must perform a bedding-in procedure. What does the bedding-in accomplish?

A. Bedding-in heats the brake pad friction material to its operating temperature range which activates the chemical bonding agents in the friction compound creating the designed friction coefficient for normal brake operation

B. Bedding-in transfers a thin layer of friction material from the new pads to the rotor surface creating the designed friction interface — this transfer layer is essential for the pads and rotor to produce the correct friction and braking force

C. Bedding-in removes the manufacturing glaze from the new pad surface exposing the designed friction material underneath — the glaze is a byproduct of the high-temperature pressing process used to form the brake pad shape

D. Bedding-in gradually heats the rotor to verify it does not warp under the thermal stress of braking — the procedure serves as a quality check for the new rotors rather than a preparation step for the brake pad material itself

99. A truck's hub oil bath system has been serviced. The technician fills the hub with the correct oil specification to the centre of the sight glass. After 200 km of driving, the technician rechecks the oil level and finds it has risen above the sight glass — the oil level is higher than where it was set. What caused the oil level to rise?

A. The hub oil absorbed heat from the wheel bearing friction and expanded thermally — the heated oil occupies more volume than the cold oil that was used to set the initial level creating the apparent rise above the sight glass mark

B. The wheel seal is leaking in the reverse direction — grease from the brake components is migrating past the seal into the hub oil cavity adding volume to the oil that raises the level above the initial fill mark

C. The axle housing lubricant is migrating through the inner bearing cone into the hub cavity adding volume from the differential's oil supply — the sealing between the axle housing and the hub is not containing the differential oil

D. The bearing generated excess heat from an over-tight adjustment that heated the trapped oil — the thermal expansion raised the level and the technician should recheck the bearing end play for an incorrect preload setting

100. A truck's tire has been balanced using a standard static/dynamic balancer. The balance reads zero (no weight needed). However, the driver reports a vibration at highway speed that is proportional to wheel speed and disappears below 70 km/h. What could cause a vibration with a perfectly balanced tire?

A. The tire has a manufacturing defect that creates a radial or lateral force variation — the tire produces a once-per-revolution force even when perfectly balanced because the structural variation creates an uneven contact force with the road

B. The wheel has a lateral runout condition that the balancer cannot detect because the balancer only measures rotational mass distribution and not the geometric runout of the wheel's mounting surface or rim edge during rotation

C. The brake rotor has lateral runout that produces a once-per-revolution vibration through the steering and suspension that is independent of the tire's balance condition and cannot be corrected by rebalancing the tire assembly

D. The tire has a radial or lateral force variation that produces a once-per-revolution vibration independent of its mass balance — the structural variation creates uneven road force that the balancer cannot detect or correct

101. A truck's steer tire has been replaced with a tire from a different manufacturer than the opposite side. Both tires are the same size and load rating. After installation, the driver reports the truck pulls slightly to the right. The alignment is verified as correct. What is causing the pull?

A. The replacement tire has a different tread pattern with a directional bias that creates a lateral force pulling the vehicle to the right during straight driving regardless of the alignment setting on the steer axle

B. Different tire manufacturers produce tires with different conicity characteristics and rolling resistance — the mismatched tires create asymmetric forces that produce a directional pull despite the correct alignment setting

C. The replacement tire has a slightly larger overall diameter than the opposite side from manufacturing variation and the larger diameter creates a higher rolling resistance that steers the vehicle toward the larger-diameter side

D. The right tire's sidewall stiffness is different from the left tire creating an uneven contact patch shape that produces different lateral forces at each steer tire during straight driving causing the directional pull

102. A trailer's tandem axle suspension uses rubber load cushions (helper pads) between the axle and the frame rail. During inspection, the technician finds the rubber pads on one axle have been crushed flat and are bulging out of their mounting pockets. What does this indicate?

A. The load cushions have reached the end of their service life from normal compression set and heat deterioration — they should be replaced with new pads to restore the designed suspension characteristics and load distribution

B. The trailer has been consistently overloaded on that axle position and the excessive weight has crushed the pads beyond their designed compression range — the loading practices must be reviewed in addition to replacing the pads

C. The rubber compound of the load cushions has degraded from ozone exposure and the weakened material cannot support the normal axle loading — the pads should be replaced with pads made from an ozone-resistant rubber compound

D. The load cushions have deteriorated from age, overloading, heat, or chemical exposure — the crushed pads can no longer provide the designed load cushioning and must be replaced, and the cause of premature failure should be identified

103. A truck's steering damper has been replaced after a shimmy complaint. The new damper eliminates the shimmy at the previously affected speed. However, the driver now reports the steering feels heavy during parking lot manoeuvres. What is the most likely cause?

A. The replacement steering damper has a higher damping force specification than the original — the increased resistance improves shimmy control but adds more effort to the driver during the slow-speed parking lot steering inputs

B. The steering damper's mounting brackets were overtightened during installation compressing the damper body and increasing the internal fluid pressure which raises the damping force above the designed specification at all speeds

C. The replacement steering damper was installed upside down and the internal check valve that provides directional damping force is reversed — the damper provides resistance in the wrong direction during the slow-speed inputs

D. The power steering pump's flow rate has decreased coincidentally with the damper replacement and the reduced hydraulic assist combined with the new damper's resistance creates the heavy feel during slow-speed parking manoeuvres

104. A truck's cab has developed a water leak that appears on the driver's side floor during heavy rain while driving. The leak is not present while the vehicle is parked in heavy rain. What does the driving-only leak pattern indicate?

A. The windshield lower seal has a gap on the driver's side that allows water to enter only when the highway wind pressure pushes rain against the windshield seal with force that exceeds the seal's static holding capacity

B. The door drain holes at the bottom of the driver's door are clogged and water that accumulates in the door during driving leaks past the inner door panel seal onto the floor when the water level exceeds the panel seal height

C. The cab's HVAC fresh air intake drain is clogged and the water that accumulates in the air intake plenum during driving overflow into the cab interior when the vehicle's motion causes the water to slosh past the internal baffle

D. The driving-speed wind pressure forces rain through a gap in the cab body sealing that the rain's static weight alone cannot penetrate — the leak source is along the vehicle's forward-facing surfaces where wind pressure acts

105. A truck driver reports that the heated driver's seat has stopped functioning. The seat heater switch illuminates when pressed. The seat cushion does not warm up after 15 minutes of operation. What should be checked first?

A. The seat heater element connector under the seat cushion for a disconnection or damaged wire that was pulled loose from the seat adjustment mechanism during the driver's routine seat position changes over time

B. The seat heater element resistance with a DMM to verify the heating element has continuity — the switch illuminating confirms the control circuit functions but the element itself may have an open circuit preventing heating

C. The body controller's seat heater output for voltage during activation because the illuminated switch confirms the input signal but the controller's output driver may have failed preventing power from reaching the element

D. The seat heater relay for a failed contact that prevents power from reaching the heating element despite the switch circuit functioning correctly to illuminate the switch's indicator light during activation

106. A truck's cab air suspension has been functioning normally. After a particularly cold night (-25°C), the driver finds the cab sitting on the bump stops — the air springs have fully deflated. The air system pressure is at governor cut-out. What is the most likely cause?

A. The cab air springs' rubber bellows have contracted in the extreme cold below their minimum flexibility limit and have cracked from the cold-induced brittleness allowing the air to escape and the springs to fully deflate overnight

B. The height control valve's exhaust seat has frozen from moisture contamination and the frozen valve is stuck in the exhaust position bleeding all the air from the cab springs during the overnight cold soak period

C. The air supply line to the cab air springs has a moisture-contaminated section that froze overnight and the expanding ice cracked the air line creating a leak that depleted the cab spring air supply during the cold soak

D. The cab air springs naturally lose pressure during extreme cold because the air volume contracts with temperature and the height control valve cannot replenish the volume until the engine starts and the compressor operates

107. A truck's windshield has been replaced by a mobile glass service. The replacement windshield is the correct part number. After the replacement, the driver reports that the ADAS (Advanced Driver Assistance System) lane departure warning produces frequent false alerts — alerting when the vehicle is centred in the lane. What is the most likely cause?

A. The replacement windshield's glass thickness or tint differs from the original by a small amount that changes the camera's optical path through the glass creating a distortion that the ADAS interprets as a lane departure

B. The replacement windshield's internal camera mounting bracket is positioned differently than the original and the camera's viewing angle has shifted enough to misinterpret the lane markings during normal centred driving

C. The ADAS camera requires a recalibration procedure after any windshield replacement because the camera's alignment through the new glass must be verified and adjusted to compensate for any optical differences from the original

D. The replacement windshield has a different UV coating specification than the original and the altered light transmission affects the ADAS camera's ability to distinguish lane markings from road surface reflections during daytime driving

108. A truck's cab tilt pump requires excessive handle strokes to raise the cab. Previously, the cab would tilt after approximately 15 pump strokes. Now it requires 40 or more strokes. The hydraulic fluid level in the tilt reservoir is correct. What is the most likely cause?

A. The tilt cylinder rod seal has a slow leak that allows hydraulic fluid to bypass the piston during each pump stroke — the lost volume per stroke reduces the effective fluid delivery requiring more strokes to tilt the cab

B. The cab tilt pump has worn internal seals that allow fluid to bypass the pump piston during each stroke — the reduced volumetric efficiency per stroke requires more strokes to deliver the total volume needed to tilt the cab

C. The cab tilt hydraulic fluid has thinned from heat exposure and the reduced viscosity allows more internal leakage through the pump's clearances requiring additional strokes to compensate for the lost volume per pump cycle

D. The cab has gained weight from aftermarket accessories installed on the roof and the additional weight requires more hydraulic volume to raise the heavier cab through the same tilt angle creating the need for additional pump strokes

109. A reefer trailer's TRU has adequate refrigerant charge and the compressor operates normally. The cargo space temperature at the thermostat sensor location (near the TRU return air intake) reads -18°C . However, a temperature logger placed at the rear of the trailer (near the doors) reads -12°C . What is causing this 6°C temperature gradient?

A. The trailer's rear door seals have deteriorated allowing warm ambient air to infiltrate at the door perimeter raising the temperature at the rear while the front remains at the set-point near the evaporator discharge

B. The evaporator fans are not producing adequate airflow velocity to circulate conditioned air to the rear of the trailer and the reduced air velocity allows the rear temperature to stratify above the set-point

C. The trailer's insulation R-value has decreased at the rear from age and solar exposure and the increased heat gain through the degraded insulation raises the rear temperature above the evaporator discharge temperature

D. The TRU's thermostat sensor is located near the return air intake at the front which reads the coldest air first — the TRU satisfies the thermostat before the warmer rear air has fully cooled creating the front-to-rear gradient

110. A trailer equipped with an electric liftgate has the liftgate platform lowering faster than specification. The lowering speed is approximately twice the normal rate. The hydraulic system pressure is correct and the pump motor speed is normal. What component controls the lowering speed?

A. The lowering speed is controlled by a needle valve or flow control valve in the hydraulic return circuit that restricts the oil flow rate from the cylinder during the gravity-assisted descent — the valve is stuck open or maladjusted

B. The lowering speed is controlled by the hydraulic pump motor operating in reverse during the lowering function — the motor speed is set by the controller and a controller fault is allowing excessive reverse motor speed

C. The lowering speed is controlled by the directional valve's metered return port that restricts the exhaust flow from the cylinder — a worn valve spool allows more flow than designed through the return port during lowering

D. The lowering speed is controlled by the cylinder's internal cushioning mechanism that decelerates the piston during the retraction stroke — a damaged cushion allows the piston to retract without resistance during lowering

111. A trailer's composite sidewall panel has developed delamination — the outer fiberglass skin has separated from the plywood inner panel over an area approximately 500 mm × 500 mm. The delamination is visible as a bulge in the outer skin. What caused this delamination?

A. The adhesive bond between the outer skin and the inner panel has failed from moisture intrusion, freeze-thaw cycling, or adhesive aging — water entered through a puncture, fastener hole, or seal failure and degraded the bond

B. A forklift tine punctured the inner panel during loading and the flexing of the unsupported outer skin from highway wind loading gradually separated the bond over the punctured area from the repeated aerodynamic loading

C. The composite panel was manufactured with a bonding defect that left an unbonded area between the outer skin and inner panel — the defect has grown from the thermal cycling and vibration of normal trailer operation over time

D. Moisture has entered the panel structure through a compromised seal, fastener, or damage point and the freeze-thaw cycling of trapped water has progressively broken the adhesive bond between the outer skin and inner panel

112. A trailer's brake system has been serviced with new brake shoes. During the first loaded trip, the driver reports the trailer brakes grab aggressively during light pedal applications. The brake adjustment is within specification. What is the most likely service error?

A. The brake shoes are the correct part number but the friction material has a higher-than-specification friction coefficient from a manufacturing batch variation that produces excessive braking force at light application pressures

B. The new brake shoes were installed with the primary and secondary shoes in the reversed positions — the longer secondary shoe in the leading position produces more self-energizing force than the system is designed to deliver

C. The brake drums were not measured before the new shoes were installed and the drums have an out-of-round condition that creates aggressive intermittent contact during light applications producing the grabbing sensation

D. The relay valve for the trailer brake circuit has a crack-pressure setting that is too low and delivers full supply pressure at light pedal inputs instead of the designed proportional delivery creating the aggressive brake application

113. A trailer's sliding tandem has been repositioned for a load distribution change. After repositioning, the technician verifies the lock pins are fully engaged by pulling the trailer supply valve and applying the service brakes. The trailer does not move during the pull test. Is this verification method adequate?

A. No — the pull test only confirms the pins are engaged enough to prevent movement under the limited force of the parked tractor's service brake application — it does not verify all four lock pins are fully seated in their holes

B. Yes — the pull test with the trailer brakes released and the tractor brakes applied provides adequate verification that the sliding tandem lock pins are engaged and the trailer is safe for highway operation at full GVW loading

C. No — the verification requires a visual inspection underneath the trailer to confirm all four lock pins are fully extended through the slide rail holes in addition to the pull test to verify mechanical engagement under dynamic loads

D. Yes — but the pull test should be performed with the trailer brakes applied and the tractor in gear to create a higher pulling force that better simulates the dynamic forces the lock pins will experience during loaded highway driving

114. A trailer equipped with a hydraulic tailgate has the tailgate raise function operating at normal speed with no load on the platform. When a 500 kg pallet is placed on the platform, the raise speed drops to approximately 20% of normal. The system pressure reads within specification during both loaded and unloaded operation. What is the most likely cause?

A. The raise cylinder has internal piston seal leakage that increases under the higher pressure of loaded operation — the seal holds at the low pressure of unloaded operation but bypasses under the 500 kg loaded pressure

B. The hydraulic pump output is at the lower limit of its flow specification and can raise the platform at normal speed only when unloaded — the additional flow demand of loaded operation exceeds the pump's marginal capacity

C. The directional valve has a worn spool that partially restricts flow to the raise port under the higher backpressure of loaded operation — the valve passes full flow at low backpressure but restricts at higher system demands

D. The hydraulic fluid viscosity is too high for the ambient temperature and the thick fluid flows freely enough for the low-demand unloaded raise but cannot pass through the system at an adequate rate under the loaded condition

115. A flatbed trailer's rub rail has sustained damage from a loading dock collision. The rail is bent inward approximately 50 mm over a 1-metre length. The rail is welded to the trailer frame. What must be assessed before repairing the rub rail?

- A. The trailer frame rail in the area behind the bent rub rail must be inspected for damage because the collision force that bent the rub rail may have also deformed, cracked, or stressed the frame rail behind it
- B. Only the rub rail needs to be repaired — rub rails are designed to absorb dock collision forces and protect the frame behind them and a bent rub rail confirms the rail performed its protective function correctly
- C. The rub rail must be replaced entirely rather than straightened because the bent metal has been stressed beyond its yield point and the weakened rail will fail at the same location from the next dock contact event
- D. The trailer frame behind the rub rail, the suspension components at that location, and any brake lines or wiring routed near the impact area must be inspected because the collision force may have damaged components behind the rail

116. A trailer's marker lamp circuit has been repaired after a wiring harness section was damaged by road debris. The technician spliced the damaged wires using butt connectors and wrapped the repair with electrical tape. After the repair, the marker lamps function but the trailer ABS sets intermittent fault codes. What is the connection between the marker lamp repair and the ABS faults?

- A. The splice repair has introduced electromagnetic interference into the harness bundle that affects the adjacent ABS sensor wires — the current flowing through the spliced marker lamp wires radiates noise into the sensor circuits
- B. The marker lamp and ABS circuits share a common ground path through the trailer harness and the splice repair has introduced resistance in the shared ground that creates voltage drops affecting the ABS sensor signal quality
- C. The electrical tape used for the repair is not rated for automotive applications and the tape's adhesive creates a chemical reaction with the wire insulation that produces a conductive path between the marker lamp and ABS wires
- D. The butt connector splice has introduced a high-resistance connection in the marker lamp circuit that increases the current draw and the additional load on the trailer's electrical system reduces the voltage available for the ABS module

117. A truck's A/C system has been recharged and the cooling performance is excellent during the first 30 minutes of operation. After 30 minutes, the cooling performance gradually decreases and the compressor begins short-cycling (rapid on-off). What is the most probable cause?

A. The system has a slight moisture contamination that takes 30 minutes to accumulate as ice at the expansion valve orifice — the ice progressively restricts refrigerant flow until the low-pressure switch trips the compressor off

B. The condenser fan relay has a thermal intermittent fault that causes the fan to shut off after 30 minutes of heat absorption — the reduced condenser airflow raises the high-side pressure until the high-pressure switch trips

C. The compressor clutch coil develops excessive resistance from heat after 30 minutes of operation and the increased resistance reduces the magnetic holding force until the clutch begins slipping and the thermal protection trips

D. The evaporator gradually ices over from excessive moisture in the system and the ice formation progressively blocks airflow through the evaporator reducing cooling performance and causing the low-pressure switch to cycle the compressor

118. A truck's cab heater produces adequate heat from the defrost and floor vents but no airflow comes from the panel (face-level) vents regardless of the mode selection. The blower motor operates at all speeds. What is the most likely cause?

A. The mode door actuator has failed in a position that directs air to the defrost and floor outlets but cannot open the panel vent passage — the actuator reaches defrost and floor positions but not the panel position

B. The panel vent ductwork has collapsed from heat deterioration and the collapsed duct prevents air from reaching the face-level outlets even though the mode door opens correctly for the panel vent position

C. The cabin air filter is severely restricted and the reduced total airflow volume can only supply the defrost and floor outlets which have shorter duct runs — the more distant panel vents receive no air from the restricted flow

D. The evaporator core has accumulated a thick layer of dust and debris that blocks the airflow path to the panel vents while the defrost and floor outlets bypass the evaporator through separate ductwork paths

119. A truck's A/C compressor has been replaced after a bearing failure. The system has been flushed, evacuated, and recharged with the correct refrigerant weight. The new receiver/dryer has been installed. After 500 km, the new compressor begins making a knocking noise. What is the most likely cause?

A. The system flush did not adequately remove all the metallic debris from the original compressor's bearing failure — the debris has migrated to the new compressor and is damaging the internal components producing the knock

B. The new compressor's mounting bolts were not torqued to specification and the loose compressor shifts on its bracket during operation creating the knocking noise from the compressor body impacting the mounting bracket

C. The replacement compressor was shipped without the correct internal oil charge and the insufficient lubrication has caused the new compressor's bearings to begin failing within the first 500 km of operation

D. The system was not properly flushed and residual debris from the failed compressor has circulated through the system and entered the new compressor — the metallic contamination is damaging the new unit's internals

120. A truck's HVAC blend door has been replaced. After the replacement, the temperature control works correctly in all positions except maximum heat — the air from the vents is warm but not hot. The coolant temperature is at normal operating temperature. What is the most likely cause?

A. The new blend door has a slightly different geometry than the original and does not close the bypass passage completely in the maximum heat position allowing a small amount of unheated air to mix with the heated air

B. The new blend door's actuator cable or linkage has a different travel range than the original and the actuator reaches its mechanical stop before the door reaches the full heat position leaving the bypass partially open

C. The heater core has accumulated a restriction from the blend door replacement procedure and the reduced coolant flow through the core limits the maximum heat output at the full-heat blend door position

D. The blend door was installed upside down and the reversed door profile directs air through a smaller section of the heater core at the maximum heat position reducing the total heat absorption from the coolant

121. A truck's APU A/C compressor clutch does not engage. The APU engine runs correctly. Voltage at the clutch coil connector reads 12.4 volts when the A/C switch is pressed. The clutch coil resistance is within specification. What should be checked next?

A. The clutch coil ground circuit for a missing or corroded connection that prevents current from flowing through the coil despite adequate supply voltage being present at the connector's positive terminal during activation

B. The APU A/C controller for a fault code that prevents clutch engagement despite the controller providing voltage to the clutch relay — the controller may have detected a system fault and disabled the clutch as a protection

C. The compressor clutch air gap for a specification that has widened beyond the coil's magnetic holding capacity — the coil receives voltage but the increased gap reduces the magnetic force below the engagement threshold

D. The clutch coil, its ground circuit, the clutch air gap, and the APU controller — voltage is present but the clutch does not engage which means the electrical circuit must be verified end-to-end and the mechanical gap checked

122. A truck's cab defroster produces heat but the airflow pattern leaves the outer edges of the windshield fogged while the centre clears quickly. What is the most likely cause?

A. The defroster nozzles at the outer positions are clogged with dust and debris that has accumulated in the ductwork from years of service reducing the airflow to the outer windshield edges during defroster operation

B. The windshield has a manufacturing defect where the outer edges are thicker glass than the centre creating a higher thermal mass at the edges that requires more heat energy to clear the fog from the thicker glass sections

C. The defroster ductwork between the HVAC plenum and the outer dash vents has separated, collapsed, or developed leaks that reduce the airflow reaching the outer windshield edges while the centre receives adequate direct flow

D. The blower motor's impeller has accumulated an imbalance from debris that shifts the airflow pattern toward the centre of the duct system at the expense of the outer outlets reducing the defroster performance at the windshield edges

123. A truck's fuel-fired coolant heater (Webasto-type) starts and runs for exactly 60 seconds before shutting down. The heater restarts when the driver activates it again and runs for another 60 seconds before shutting down. No fault codes are stored. What is the most probable cause?

A. The heater's flame sensor is not detecting the flame — the heater starts on the pre-glow timer, runs for the programmed 60-second flame verification window, and shuts down because the flame sensor cannot confirm combustion

B. The heater's fuel metering pump delivers fuel for the initial start but cannot maintain continuous delivery beyond 60 seconds — the pump's internal diaphragm has weakened and cannot sustain the steady-state fuel flow rate

C. The heater's combustion air fan motor overheats after 60 seconds of continuous operation and the motor's thermal protection circuit shuts the heater down — the motor cools during the off period and allows restart

D. The heater's control module has a firmware fault that limits each operating cycle to 60 seconds — the module counts down from ignition and commands a shutdown at the programmed interval regardless of operating conditions

124. A hydraulic system on a truck-mounted crane has a complaint that the boom lowers slowly when the lower function is activated but the boom raises at normal speed. System pressure and pump flow are within specification for both directions. What is the most likely cause?

A. The counterbalance valve on the boom circuit is restricting the oil flow leaving the cap end of the cylinder during the lowering operation — the valve is set too restrictively for the current boom load creating the slow descent

B. The boom lower circuit has a flow control valve that is adjusted to a lower setting than the boom raise circuit creating the speed differential between the two directions during normal boom operation under matching loads

C. The directional control valve's spool has contamination in the lower-direction flow path that restricts the oil delivery to the rod end of the cylinder — the raise-direction path is clear and delivers unrestricted flow for normal speed

D. The boom cylinder's rod seal has excessive friction that resists the piston's retraction during the lowering stroke — the seal friction is less apparent during the raise operation because the larger cap-end area overcomes the resistance

125. A dump truck's hydraulic system raises the dump body at the correct speed. However, when the dump body reaches the full-raise position and the operator releases the raise control, the body continues to rise slightly (approximately 50 mm) before stopping. What is causing this overtravel?

A. The directional valve's spool takes a moment to fully centre from the raise position to neutral — the spool's transition time allows residual flow to pass through the partially open raise port before the spool closes completely

B. The pump's internal check valve has a delayed closing characteristic that allows the pump to deliver one or two additional strokes after the directional valve centres creating the residual pressure that extends the cylinder slightly

C. The directional valve spool does not return to exact neutral immediately — the spool's centering spring or detent has weakened allowing the valve to remain slightly cracked open for a moment after the operator releases the control

D. The hydraulic fluid in the raise circuit compresses slightly under the high pressure of the full-raise condition and when the valve centres the compressed fluid expands pushing the cylinder the additional 50 mm before equilibrium

126. A hydraulic system uses a proportional control valve that should provide variable speed control of a boom cylinder. The operator moves the joystick slowly from neutral to full extend. Instead of the boom accelerating smoothly, the boom lurches from stopped to full speed with no intermediate control. What has failed?

A. The proportional solenoid coil has developed a partial short that prevents the spool from positioning at intermediate openings — the coil either has no force or full force with no proportional range between minimum and maximum

B. The proportional valve's spool has contamination in its bore that creates a stick-slip condition — the spool binds in neutral until the joystick provides enough signal to overcome the friction then the spool jumps to full open position

C. The joystick potentiometer has failed and sends only zero or maximum voltage to the valve controller — the controller receives no intermediate signal from the failed potentiometer creating the all-or-nothing boom response

D. The proportional valve controller has a fault in its signal processing that converts the joystick's proportional voltage input into an on/off output to the solenoid — the controller energizes the solenoid at full current or zero current

127. A hydraulic crane has a load chart that specifies 3,000 kg at 5 metres of boom radius. The operator has positioned the boom at 5 metres and lifted a 2,800 kg load. The crane's load moment indicator (LMI) reads 93% of capacity. Is this operation within safe limits?

A. No — operating at 93% of the crane's rated capacity leaves insufficient safety margin for dynamic loading from wind, swing, or boom deflection that could momentarily push the load moment above 100% creating a tipping hazard

B. No — crane operations should never exceed 75% of the rated capacity to provide adequate margin for the dynamic forces of lifting, swinging, and environmental factors that increase the actual load moment above the static calculation

C. Yes — operating at 93% of the rated capacity is within the crane's design safety factor because the load chart already includes a safety margin and the 93% reading represents 93% of the chart's already-derated capacity value

D. Yes — but the operator should avoid any boom swing, extension, or wind-loaded operations at this capacity level because the dynamic forces from these operations could push the load moment indicator above the 100% threshold

128. A hydraulic system's pump has been replaced. After the replacement, the system operates normally for the first 100 hours. Then the pressure begins to fluctuate during operation and the pump develops a rhythmic knocking noise. Oil analysis shows elevated iron and bronze particles. What is happening?

A. The replacement pump had a manufacturing defect that was not apparent during the initial 100 hours and the defect has progressed to the point where internal component failure is producing debris and the knocking noise

B. The system was not properly flushed before the new pump was installed and residual contamination from the old pump has migrated to the new pump's internal surfaces causing accelerated wear and the developing knock

C. The replacement pump's internal relief valve has a faulty spring that allowed the pump to operate normally initially but the spring has weakened after 100 hours changing the relief valve's behavior during normal pressure cycling

D. The hydraulic fluid has degraded from the heat generated during the 100 hours of operation and the breakdown products have created an abrasive slurry that is eroding the new pump's internal gear and bearing surfaces

129. A hydraulic liftgate system has a complaint that the platform level function does not hold — the platform slowly tilts after being set to level. The directional valve is in neutral and the platform gravity load should keep it in position. What is the most probable cause?

A. The level cylinder's piston seal has an internal leak that allows fluid to bypass slowly under the platform's gravitational loading — the slow bypass changes the fluid distribution between the rod and cap ends tilting the platform

B. The directional valve has internal spool leakage in the neutral position that allows fluid from the level cylinder's loaded port to drain slowly through the spool clearance to the return port creating the gradual tilt

C. The level cylinder's holding circuit (counterbalance valve or pilot-operated check valve) has a worn seat that allows a slow trickle of fluid past the check in the reverse direction under the sustained gravitational load

D. Both the holding valve and the cylinder seal should be investigated because either can independently cause the gradual tilt — the source must be isolated by blocking individual circuit paths to determine which component is leaking

130. A hydraulic system has been filled with new fluid after a complete drain. During the first operation, the pump produces a loud cavitation noise and the system operates sluggishly. The fluid level reads correct at the reservoir sight glass. What was likely not done during the filling procedure?

A. The pump inlet line was not bled of air during the filling and the trapped air pocket at the pump inlet prevents the pump from drawing a full charge of fluid on each intake stroke creating the cavitation from the air void

B. The hydraulic filter was not pre-filled with fluid before installation and the dry filter element is restricting the initial fluid flow from the reservoir to the pump inlet until the filter media saturates and passes fluid normally

C. The new fluid was a different viscosity specification than the drained fluid and the incorrect viscosity creates more resistance to flow through the pump and system producing the cavitation noise from the pump's inability to draw adequately

D. The system was not pre-filled at all circuit points — the cylinders, motor cases, and valve bodies still contain air from the drain and the pump must purge this air from the entire system volume before normal operation can resume

131. A truck-mounted hydraulic crane's outrigger circuit has a sequence valve that ensures the outriggers deploy fully before the boom functions become operational. The sequence valve requires 12,000 kPa to open and allow flow to the boom circuit. During operation, the boom functions activate before the outriggers have fully extended. What has happened to the sequence valve?

A. The sequence valve's internal spring has weakened from age and fatigue and the reduced spring force allows the valve to open at a lower pressure than the designed 12,000 kPa threshold permitting boom flow before the outriggers complete

B. The sequence valve has a bypass leak around the valve seat that allows flow to pass to the boom circuit before the system reaches the 12,000 kPa threshold needed to mechanically open the valve for authorized boom operation

C. The outrigger cylinders have internal seal leakage that prevents the circuit from building to the 12,000 kPa needed to open the sequence valve — the circuit pressure bleeds through the cylinder seals before reaching the threshold

D. The sequence valve's setting has drifted lower from contamination on the seat or a weakened spring and the valve opens before the outrigger circuit reaches the full 12,000 kPa — the boom receives flow before the outriggers are fully deployed

132. A battery-electric truck's regenerative braking force has been reduced by the BMS. The scan tool shows the battery cell balancing data with one cell group reading 0.3 volts lower than all other groups. What is the relationship between the cell imbalance and the reduced regenerative braking?

A. The low cell group limits the battery's maximum charge acceptance because the BMS must prevent any cell from exceeding its maximum voltage — the low group reaches maximum first reducing the available charging headroom for all groups

B. The BMS reduces regenerative braking to prevent the low cell group from being overcharged during the energy recovery process — the weakest cell reaches its maximum voltage before the others limiting the total charge acceptance

C. The low cell group has higher internal resistance that generates more heat during charging and the BMS reduces the regenerative current to prevent the weak group from overheating during the energy recovery braking events

D. The cell imbalance creates a voltage mismatch that the inverter cannot manage during regenerative mode — the inverter reduces the motor's generating current to prevent the voltage differential from damaging its power electronics

133. A hybrid truck's 48-volt mild hybrid system has a belt-driven integrated starter-generator (ISG). The ISG provides engine start-stop functionality, mild regenerative braking, and electric torque assist during acceleration. The driver reports the electric assist during acceleration has decreased noticeably. The 48-volt battery is fully charged. What should be investigated?

- A. The ISG belt tension and condition because a worn or loose belt limits the torque the ISG can transmit to the crankshaft during the electric assist mode — the belt slips under the high torque demand reducing the assist effectiveness
- B. The ISG's internal motor winding resistance for an increase from thermal degradation that limits the current the motor can draw from the 48-volt battery reducing the torque output during the acceleration assist operation
- C. The 48-volt battery's internal resistance for an increase that limits the peak current delivery to the ISG during acceleration assist — even a fully charged battery with elevated resistance cannot deliver the peak current needed for full assist
- D. The ISG belt, the ISG motor, the 48-volt battery's internal resistance, and the ISG controller — any component in the electric assist chain can limit the assist force and all must be tested to identify the degraded component

134. A battery-electric truck has a complaint that the vehicle's charging time has increased from 8 hours to 12 hours for a full charge on the same Level 2 AC charging station. The battery SOH is at 88%. What is the most probable cause?

- A. The onboard charger has degraded and cannot convert AC to DC at its original rated power — the reduced conversion capacity limits the charging current delivery to the battery extending the total charge time proportionally
- B. The battery's reduced SOH means the cells' internal resistance has increased which limits the maximum charging current the BMS allows — the slower charging rate extends the total time needed for a full charge to the reduced capacity
- C. The charging station's output has decreased from internal component wear and the reduced power delivery extends the charging time — the vehicle's charging system is functioning correctly but receiving less power from the station
- D. The BMS is intentionally limiting the charging current to protect the aging battery cells from damage — as the cells age the BMS reduces the maximum charging rate to extend the battery's remaining useful life by reducing thermal stress

135. A parallel hybrid truck's propulsion control system has a fault code for "motor position sensor error." The vehicle operates in engine-only mode and the electric motor does not provide assist. What function does the motor position sensor serve and why does its failure disable the electric assist?

- A. The position sensor tells the inverter the exact rotational position of the motor's rotor so the inverter can energize the correct stator windings at precisely the right time — without position data the inverter cannot control the motor
- B. The position sensor monitors the motor's temperature at multiple points around the stator and the "position sensor" code is a generic designation for the multi-point thermal monitoring system that protects the motor from overheating
- C. The position sensor provides the exact rotor angle to the inverter for precise stator winding energization — without this data the inverter cannot create the rotating magnetic field needed to produce torque in the correct direction
- D. The position sensor measures the motor's rotor position so the inverter knows which stator phase to energize and when — without accurate position data the inverter cannot produce controlled torque and disables motor operation to prevent damage

Practice Exam 13: Answer Key and Explanations

1. B — The 200 litres of diesel fuel weighs approximately 170 kg, and combined with the tank weight, the assembly is extremely heavy. If the tank falls during strap removal or lowering, the crushing hazard to the technician is the single greatest risk. Proper support with a transmission jack or floor jack rated for the weight must be used throughout the removal process.
2. D — The shop's policy should specify the required safety standard rating (CSA Grade 1 or equivalent) rather than dictating the toe cap material. Both steel-toe and composite-toe boots that carry the CSA Grade 1 rating meet the same impact and compression protection standards — the material used to achieve that rating is irrelevant to the protection provided.
3. A — Used DPF substrate contains trapped diesel exhaust soot, which is classified as a potential carcinogen by health authorities, and concentrated ash from engine oil additives containing heavy metals (zinc, phosphorus, calcium, magnesium). A P100 or N95 respirator prevents inhalation of these hazardous particles, and gloves prevent skin contact during handling.
4. C — A permanently caged spring brake has its parking brake mechanically defeated. The spring cannot extend to apply the parking brake because the caging bolt holds it compressed permanently. If the air system loses pressure or the driver pulls the parking valve, those wheels have no mechanical braking force — the truck cannot be safely parked.

5. B — Contaminated petroleum-based solvent is classified as regulated waste that must be handled by a licensed solvent recycling service. The sludge contains concentrated metals, carbon, and petroleum compounds that require proper disposal. The parts washer tank must be cleaned and refilled with fresh solvent through the recycling service's scheduled pickup program.

6. D — Venting refrigerant to atmosphere is illegal under environmental regulations in Canada and most jurisdictions worldwide. R-134a (and all regulated refrigerants) must be recovered using a certified recovery machine before any A/C system is opened. If recovery equipment is not available, the work must wait until proper equipment is obtained.

7. A — Wheel chocks must be placed behind (and in front of, on a grade) the rear tires before jacking any vehicle. When the front tires leave the ground, the vehicle's weight shifts and any grade — even a slight slope — can cause the rear to roll. The parking brake alone may not hold if the vehicle shifts during the jacking operation.

8. C — The steering free play measurement of 50 mm exceeds the specification maximum of 40 mm. Excessive steering free play is a safety defect that affects the driver's ability to maintain directional control, especially during emergency manoeuvres. The condition must be documented as a defect requiring repair before the vehicle is returned to service.

9. D — Ethylene glycol coolant is chemically aggressive to rubber. The crankshaft vibration damper uses a rubber element to absorb torsional vibrations, and prolonged contact with glycol degrades this rubber. Over 20,000 km, the continuous drip chemically attacks the damper's rubber, causing it to soften, crack, or separate from the damper hub — leading to premature damper failure.

10. B — A gear-type transfer pump with 300,000 km of service has worn internal gear clearances. The enlarged clearances between the gears and the housing allow fuel to bypass internally without being pumped to the outlet. The pump cannot maintain the specified 450 kPa output because the internal leakage increases with wear, producing the reduced 350 kPa output.

11. A — A 1.5 kPa increase over 1,000 km of mixed driving is within the normal soot accumulation rate for a properly functioning diesel engine. The accumulation rate depends on the engine's duty cycle, EGR function, injection quality, and boost pressure. Without knowing the specific operating conditions, the rate appears consistent with normal engine operation.

12. C — Crankcase blow-by gases contain unburned hydrocarbons, particulate matter, and other regulated emissions. Venting these gases directly to atmosphere is an emissions violation under EPA, Environment Canada, and most provincial regulations. The closed CCV system routes these gases back through the combustion process where they are burned and treated by the aftertreatment system.

13. D — White smoke during sustained full-load uphill driving that disappears during cruise suggests incomplete combustion of the fuel charge. Under the sustained high fuel demand of full-load uphill operation, worn injector nozzles produce poor atomization — the large fuel droplets cannot fully combust in the available time, and the unburned fuel exits as white vapour.

14. B — Both oil pressure readings are above their respective minimum specifications: 280 kPa at idle exceeds the 200 kPa minimum, and 450 kPa at rated speed exceeds the 350 kPa minimum. Oil pressure normally increases from idle to rated speed because the pump's output increases with RPM. Both readings indicate a properly functioning lubrication system.

15. A — The rail pressure deviation occurs only during full throttle between 1,500 and 2,000 RPM — a very specific operating window. One injector with excessive internal leakage at its mechanical resonance frequency explains this narrow-band fault. The injector's internal bypass increases at the specific RPM where the injection system's pressure pulsations amplify the leak.

16. C — Reversed lash settings produce two simultaneous problems. The tight exhaust lash (0.30 mm instead of 0.45 mm) opens the exhaust valves too early, dumping cylinder pressure before the power stroke completes. The loose intake lash (0.45 mm instead of 0.30 mm) opens the intake valves too late, reducing the air charge. The tight exhaust valves may also burn from insufficient seat cooling time.

17. D — A newly installed turbocharger's bearings are dry — no oil has reached them yet. The engine's oil pump needs at least 30 seconds at idle to fill the oil supply line and establish an adequate hydrodynamic oil film in the turbo bearings. Revving immediately forces the shaft to high speed without lubrication, scoring the bearings and potentially destroying the new turbocharger.

18. B — The DPF differential pressure is only 3 kPa (normal), so the DPF is not the restriction. The 45 kPa backpressure at the turbocharger outlet with a clean DPF means the restriction is elsewhere in the aftertreatment system — most likely the DOC or SCR catalyst substrate has partially melted, collapsed, or become restricted from thermal damage downstream of the DPF.

19. A — The DEF dosing valve may have nozzle erosion or an internal leak that delivers more DEF per injection pulse than the ECM commands. The ECM does not detect this overconsumption because the dosing volume exceeds the calibrated pulse width without triggering a diagnostic fault. The valve delivers a larger physical volume than the electronic command specifies.

20. C — An intercooler with an internal leak at 140 kPa will leak under the 200 kPa operating boost pressure. The leak may be small enough that the current power loss is below the dynamometer's detection threshold, but the crack will propagate from repeated pressure cycling. The leak worsens over time, and the escaped boost air reduces intake charge density progressively.

21. D — Oval spray holes produce a wider, less focused spray pattern that contacts the cylinder walls instead of remaining suspended in the combustion chamber. The fuel contacting the liner walls washes the lubricating oil film from the surface, exposing the rings and liner to metal-to-metal contact. This fuel-washing accelerates ring and liner wear from the reduced lubrication.

22. B — Extended idle produces incomplete combustion from the low cylinder temperatures and minimal fuel delivery. Over 10 hours, wet carbon deposits accumulate in the combustion chambers and intake manifold from the condensed unburned fuel and soot. When the driver accelerates, the increased fuel, air, and temperature burn off these accumulated deposits as the momentary black smoke puff.

23. A — A sudden spike in copper with all other metals stable points to a single copper-containing component. The oil cooler's copper-brazed plate construction places copper in direct contact with the oil circuit. Erosion of the brazing material from the coolant side releases copper particles into the oil. This finding warrants an oil cooler pressure test to verify the leak source.

24. C — The VGT moves correctly during static scan tool testing but faults during driving. A worn pivot point in the vane linkage allows the vanes to reach the commanded position during the low-force static test but shifts under the significant exhaust gas forces during actual driving. The dynamic exhaust loading pushes the vanes away from their commanded position through the worn linkage.

25. D — Many NO_x sensors require a calibration or initialization procedure after replacement. Without completing this manufacturer-specified relearn, the ECM cannot process the new sensors' data correctly. The ECM defaults to a zero-dosing state because it cannot verify the NO_x levels without valid sensor input from the initialized sensors.

26. B — In hot weather, the charge air cooler cannot cool the compressed intake air as effectively because the temperature differential between the hot compressed air and the hot ambient air is reduced. The elevated intake manifold temperature triggers the ECM's thermal protection derate, reducing engine power to prevent excessive combustion temperatures that could damage pistons and valves.

27. A — A dull red glow at one exhaust port while all others remain dark indicates that cylinder's exhaust gas temperature is significantly higher than the others. The cause is typically an over-fuelling condition (injector delivering excess fuel), retarded injection timing (fuel burns later in the cycle), or a restricted exhaust valve that traps combustion heat in the port.

28. A — In a series turbocharger system, the high-pressure (HP) stage provides the primary boost at low RPM where exhaust energy is limited. A fault in the HP stage (worn bearings, damaged wheel, or stuck wastegate) reduces low-RPM boost. At high RPM, the low-pressure stage produces enough boost to compensate for the HP stage's reduced contribution.

29. C — The dark biomass and gelatinous layer are diesel fuel microbial contamination — bacteria and fungi that grow at the fuel-water interface in diesel tanks. The organisms thrive in the water layer at the tank bottom. The tank must be thoroughly cleaned, the fuel system flushed, and a biocide treatment applied to kill remaining organisms and prevent regrowth.

30. B — The tractor protection valve should close automatically at approximately 415 to 450 kPa (60 to 65 PSI). This closing pressure ensures the tractor retains adequate air pressure for its own service brakes and spring brake release before the system pressure drops to the spring brake application threshold (typically 275-415 kPa).

31. D — After new rotors and new pads are installed, each pad-to-rotor combination develops its transfer layer at a different rate during the bedding-in process. The temperature difference during bedding reflects the different stages of transfer layer development on each side. The temperatures will equalize as both sides complete the bedding process over the initial stops.

32. C — All four springs have equal air pressure but one sits 25 mm lower. The low spring's internal fabric reinforcement has failed, allowing the rubber bellows to distend at the bottom rather than maintaining its designed shape. The structural failure of the reinforcement allows the bellows to bulge under pressure instead of supporting the load at the designed height.

33. A — The foot valve has a worn piston seal that allows a small amount of air to bypass past the piston during application. The hissing sound is the air escaping through the worn seal. While the brakes still function because the leak rate is small relative to the delivery volume, the worn seal wastes air and will progressively worsen.

34. B — The modulator valve's electrical connector was not fully seated during installation. The self-test energizes each solenoid briefly (milliseconds) and the partial contact was sufficient for the test pulse. During actual ABS modulation, the solenoid requires sustained current for repeated hold-release cycles, and the partially seated connector cannot maintain the sustained contact.

35. D — Both the parking brake valve's internal mechanism and the spring brake chambers must be investigated. The air must travel from the valve through the lines to the chambers, and the chambers must mechanically compress the springs. Either a valve fault (not directing supply air) or a chamber fault (seized internals) can independently prevent spring brake release.

36. C — The S-cam shaft has shifted in its worn bushings, and the cam lobes contact the shoe rollers at an angle that pushes the shoe toe harder against the drum than the heel during each application. The offset cam position concentrates the application force unevenly across the shoe, producing the toe-heavy wear pattern on both shoes.

37. A — A brake rotor with thickness variation (parallelism error) produces a pedal pulsation proportional to wheel speed. At highway speed, the wheel rotates faster and the once-per-revolution thickness variation produces a higher-frequency pulsation that is more perceptible to the driver. At lower city speeds, the same variation produces a slower, less noticeable pulsation.

38. D — A pinhole leak in the service chamber diaphragm continuously drains air from the service reservoir even when the brakes are not applied. The small constant leak reduces the available air pressure for brake applications and forces the compressor to cycle more frequently. Over time, the leak can grow and compromise braking capacity during heavy demand situations.

39. B — The fixed 15% rear brake reduction was set for the empty truck's lighter rear axle weight. When the truck is loaded to maximum GVW, the rear axle carries significantly more weight and needs proportionally more braking force. The 15% reduction under-brakes the loaded rear axle, extending the stopping distance because the rear brakes are not contributing their full share.

40. C — The high cut-in setting reduces the pressure band between cut-in (725 kPa) and cut-out (860 kPa) from the designed 170 kPa range to only 135 kPa. The narrower band means the system reaches the cut-in threshold sooner during normal air consumption, causing the compressor to load and unload more frequently. The increased cycling reduces compressor service life.

41. A — Worn S-cam bushings allow the cam shaft to shift from its designed position in the brake spider. The shifted cam contacts the shoe rollers at an altered angle, concentrating the application force toward the upper portion of the shoe near the anchor. The uneven force distribution creates the tapered wear pattern with more wear at the top and less at the bottom.

42. D — The trailer hand valve's internal return spring has weakened. When the driver releases the handle, the valve spool does not fully return to the released position. The slightly open valve continues sending a small signal pressure to the trailer relay valve, which maintains a residual application pressure in the trailer brake chambers causing the slow release.

43. B — The rear axle carries more of the vehicle's loaded weight than the front steer axle and requires proportionally more braking force. Larger brake chambers (Type 30 service section vs Type 24) produce more force at the same air pressure because the larger effective diaphragm area generates more pushrod force, matching the braking force to the heavier axle loading.

44. A — Automatic slack adjusters allow the brake shoes to drift slightly away from the drums during extended non-braking periods. The first brake application must push the shoes through this extra clearance before the linings contact the drum surface. This additional travel creates the harder initial pedal feel that normalizes on subsequent applications when the clearance has been taken up.

45. C — Long-stroke brake chambers have a greater total pushrod travel range than standard-stroke chambers of the same type designation. This extended range allows the automatic slack adjuster to compensate for more brake lining wear before the pushrod stroke reaches the maximum allowable limit. The additional travel range extends the service interval between brake relines.

46. B — The purge valve's internal seat has failed or the valve piston is stuck in the open position. The valve remains open regardless of whether the governor signals load or unload, continuously venting air from the supply circuit through the dryer's exhaust port. The continuous purge depletes system pressure because the valve cannot close to retain the compressed air.

47. D — The engine cranks at correct RPM (compression adequate), the ECM commands injection (electronics working), but no smoke exits the exhaust (no fuel burning). The most efficient next test is checking fuel rail pressure during cranking. If the HP pump is not building rail pressure, no fuel reaches the cylinders despite the ECM's injection command.

48. A — The higher-output alternator requires more mechanical torque from the drive belt to produce its increased electrical output. The original belt tensioner was designed for the 160-amp alternator's torque load. The 200-amp unit's higher torque demand under peak electrical load exceeds the tensioner's spring force, allowing the belt to slip and squeal.

49. C — The engine ECM's vehicle speed source is a configurable customer parameter. The programmed source — either the ABS module's J1939 broadcast or the transmission output shaft sensor — is determined during the vehicle's initial configuration. The ECM uses only the configured source for its fuel delivery calculations and speed-limiting functions.

50. B — The CAN bus termination is correct (60 ohms) and the wiring appears intact, but the differential signal voltage is low. A partially failed CAN transceiver in one module loads down the bus voltage without creating a dead short. The reduced differential voltage drops below the reliable detection threshold for some modules, causing the intermittent communication faults.

51. D — The battery equalizer's main power cables connect between the series battery bank and the equalizer. If these cables were connected to the wrong terminals, the 24-volt series circuit path to the starter was interrupted. The 12-volt accessory circuit works because the equalizer provides 12 volts from its output, but the starting circuit's 24-volt path is broken.

52. A — The replacement headlamp's internal LED driver uses a switching power supply that operates at a specific frequency. This switching frequency generates electromagnetic interference (EMI) on the shared power supply wire. The EMI disrupts the original headlamp's LED driver circuit on the opposite side, causing it to flicker from the induced noise on the common power line.

53. C — Many ECMs ship with certain optional features disabled by default in the customer parameter configuration. The engine brake (compression brake) is commonly a feature that must be specifically enabled during ECM setup. If the technician programmed all other parameters but did not enable the engine brake feature, the ECM will not activate the brake solenoids.

54. B — The left brake lamp, turn signal, and backup lamp all work — confirming the left-side wiring harness, grounds, and lamp sockets are functional through their respective circuits. The left tail lamp specifically does not work. The body controller's output driver for the left tail lamp circuit has failed while the other left-side output drivers continue functioning independently.

55. C — A manifold pressure reading of 20 kPa at idle is physically implausible — a naturally aspirated diesel should read approximately 95-100 kPa (near atmospheric). The reading is far below any realistic manifold pressure condition. The sensor has failed internally and is producing a fixed low-voltage output regardless of the actual manifold pressure.

56. A — The replacement motor parks and runs at low speed (confirming installation and wiring are generally correct) but does not switch to high speed. The motor's high-speed brush or winding connection has a manufacturing defect or internal failure. The low-speed circuit operates through its independent path while the failed high-speed circuit cannot receive or conduct current.

57. D — FMI 31 in the J1939 diagnostic standard indicates "condition exists." This is a general status indicator that the fault is active and present, but the specific details of the condition must be determined through the manufacturer's service literature for the particular SPN (523 in this case). FMI 31 requires manufacturer-specific interpretation.

58. B — The horn relay clicks (confirming the control circuit energizes the coil) and the horn works with direct 12-volt power (confirming the horn itself is functional). The fault is in the load circuit between the relay's output contacts and the horn — a broken wire, corroded connector, or poor ground connection at the horn mounting point prevents current from reaching the horn through normal operation.

59. A — FMI 5 (current below normal) for a PWM solenoid means the ECM commands a specific duty cycle but the measured current is less than expected. The solenoid circuit has excessive resistance (corroded connector, damaged wire), an open winding, or a wiring fault that limits the current below the ECM's minimum threshold for the commanded duty cycle.

60. D — All other gauges display correctly during the tachometer spike, ruling out a general CAN bus problem. The ECM's CAN bus transmitter has an intermittent fault that momentarily sends an incorrect RPM value. The cluster accurately displays whatever data it receives — the erroneous 8,000 RPM is a transmission error from the ECM, not a cluster display fault.

61. C — The trailer ABS self-test works (confirming the module has power and functions). The scan tool cannot communicate via PLC. The 7-pin connector's pin 7 passes enough DC power for ABS operation but the high-resistance connection attenuates the high-frequency PLC data signal below the scan tool's detection threshold. The pin 7 contact quality must be improved.

62. B — Parallel batteries must be matched in age, capacity, and internal resistance. Battery 1 passed its tests but is older with higher internal resistance than the new Battery 2. The new battery will carry a disproportionate share of the electrical load and charging current, accelerating its degradation. Both batteries should be replaced simultaneously for proper parallel operation.

63. A — Both DRL bulbs are the same type, voltage is equal, and the circuit is balanced. The dimmer bulb has internal blackening from tungsten filament evaporation — the vaporized tungsten deposits on the glass envelope over the bulb's service life, darkening the glass and reducing the light output even though the filament continues to draw correct current.

64. D — Three voltage readings show a cascade of drops: 14.4V at the alternator B+, 13.8V at the battery (0.6V drop in the charging cable — slightly high but not critical), and 11.2V at the ECM (2.6V drop from battery to ECM). The ECM's power supply circuit has severely excessive resistance — corroded connectors, damaged wiring, or poor grounds — that must be repaired immediately.

65. C — The relay clicks (control circuit works) and 0 volts at the windshield connector. The relay contact fuse or wiring between the relay output and the connector is open. The relay clicks confirming the coil energizes, and the relay contacts may or may not be passing current — the open circuit between the relay and the connector prevents voltage from reaching the heating elements.

66. B — FMI 3 (voltage above normal) on a solenoid circuit where the solenoid resistance is within specification indicates the module sees higher voltage than expected. The ABS module's internal driver transistor has failed open — with the transistor not conducting, no current flows through the solenoid and the full supply voltage appears at the module's measurement point.

67. A — The reflash updated the ECM calibration which may have changed the cruise control engagement speed threshold. The updated calibration may require the vehicle to exceed a different minimum speed before cruise control engagement is permitted. The technician should check the updated calibration's cruise control parameters against the previous version.

68. D — The dash lights illuminate normally in the run position (proving the batteries provide adequate voltage for low-current circuits). When the key reaches start, the lights dim (heavy current draw occurs) but the starter does not crank. The replacement isolator relay's internal contacts are not closing for the start position — the relay passes run-circuit current but not cranking current.

69. B — The "clutch actuator travel exceeded" code means the actuator must extend to near its maximum range to reach the clutch engagement point. As the clutch disc friction material wears thinner, the pressure plate moves closer to the flywheel and the release bearing must travel further to reach the engagement point. The disc is nearing the end of its useful life.

70. C — The transmission jumps out of 3rd gear only during coast deceleration — all other gears hold. The 3rd gear detent spring and ball were either not installed during the rebuild or are the incorrect specification. The detent cannot hold the shift rail in the 3rd gear position against the reverse-torque loading that occurs during coast deceleration.

71. A — Fine silver-coloured metallic particles on the drain plug magnet at 100,000 km are normal for a drive axle. The particles are from the initial break-in wear of the ring and pinion gear teeth and the ongoing micro-wear of the hardened gear surfaces. A small amount of fine metallic debris is expected and does not indicate a failure condition.

72. D — The engine makes rated power (eliminating engine issues) but the stall speed is 300 RPM low. The torque converter's internal geometry or condition is preventing normal stall speed. The converter is locking up partially before reaching full stall — either from an internal mechanical issue or an incorrect replacement converter that does not match the application.

73. C — The front U-joint angle (3°) and rear U-joint angle (1°) differ by 2° — exceeding the 0.5° maximum specification. The angles must be equalized by adjusting the driveshaft's vertical position. This is typically accomplished by shimming the centre bearing bracket or transmission mount to change the driveshaft's slope and bring both joint angles within 0.5° of each other.

74. B — The pedal is firm at the top (confirming the master cylinder and most of the hydraulic circuit are air-free) but spongy in the last 25% where hydraulic pressure is highest. Air remains trapped in the slave cylinder or a high point in the hydraulic line that did not purge during standard bleeding. The trapped air compresses under the higher pressure of the deep pedal stroke.

75. A — The reverse servo apply circuit has a slow fill condition. A worn servo bore seal, restricted apply passage, or weak accumulator spring delays the hydraulic pressure buildup needed to apply the reverse band. Once filled and applied, the reverse functions normally — confirming the delay is in the fill time, not in the reverse components themselves.

76. D — The pinion nut's torque-to-preload relationship changes after the first tightening because the nut's friction characteristics change from the initial deformation of the locking feature and the bearing's initial seating. Simply torquing to a specification value without marking the original position risks setting the pinion bearing preload too tight or too loose.

77. C — All low-range shifts are smooth (confirming the main box synchronizers are good) but all high-range shifts are hard. The common element is the range shift from low to high, which uses the auxiliary section synchronizer. The high-range synchronizer blocking ring is worn and cannot adequately match the speed differential during the range change.

78. A — Transmission fluid that turns dark brown with a burnt odour in half the expected service interval indicates sustained elevated operating temperatures. The thermal stress has accelerated the fluid's oxidation rate. The source of excess heat — inadequate cooling, torque converter issues, or operational factors — must be identified and corrected before refilling with new fluid.

79. B — The failed release bearing may have caused the clutch to slip or drag, generating excessive heat at the flywheel friction surface. Before installing the new clutch components, the flywheel must be inspected for heat damage (blue discoloration), hard spots, scoring, and heat cracks. A damaged flywheel must be machined or replaced before the new clutch can function correctly.

80. D — The viscous coupling transfers torque through the shear resistance of silicone fluid between alternating input and output plates. The fluid has lost its viscosity from age and heat cycling and can no longer generate adequate shear force between the plates. The coupling acts as an open differential — the spinning rear output rotates freely without transferring torque to the stationary front.

81. C — A single clunk during each acceleration-to-coast or coast-to-acceleration transition indicates rotational free play in the driveline. With tight U-joints and no driveshaft play confirmed, the ring and pinion backlash is excessive. The gear teeth separate during the torque reversal and re-engage with a clunk when the torque direction changes.

82. B — All shifts were smooth for 2,000 km, then only the 3-4 shift became harsh. The 3-4 accumulator piston seal has failed — the accumulator should cushion the 3-4 clutch apply pressure during the shift event. Without the cushioning effect, the clutch applies at full line pressure producing the harsh 3-4 shift while all other shifts remain cushioned by their functioning accumulators.

83. D — Limited-slip differentials require a specific friction modifier additive in the gear oil to control the clutch disc engagement characteristics. Without the modifier, the clutch discs alternately grab and release during the speed differential of low-speed turns. This stick-slip cycle produces the characteristic chattering noise and vibration on dry pavement.

84. A — The U-joint angles are within specification and the driveshaft phasing has been verified, but a vibration exists at exactly 60 km/h. The new centre bearing's rubber isolator may have the wrong durometer (hardness). An isolator with incorrect hardness changes the driveshaft assembly's dynamic response at a specific speed, creating a resonance vibration at 60 km/h.

85. C — The slave piston lash was set to the OEM specification, but some manufacturers have different lash values for new versus used components. The new-parts specification may produce a tighter clearance than the worn-in specification, creating a harder contact between the new slave pistons and the crossheads during each compression brake activation event.

86. D — The power steering fluid's cold viscosity is too high for the pump to efficiently draw from the reservoir during cold starts. The thick cold fluid cannot flow through the pump's inlet passages quickly enough, creating cavitation at the pump inlet. The collapsing cavitation bubbles produce the growling noise that diminishes as the fluid warms and flows freely.

87. B — The main leaf's spring eye is the attachment point that connects the spring to the frame hanger bracket. A break at the spring eye disconnects the spring's fore-aft restraint of the axle. The remaining leaves continue to support the vertical load temporarily, but the broken eye means the axle has lost its primary forward-rearward restraint and can shift position.

88. A — All individual alignment readings fall within their specified ranges: toe is 0.10° (within 0.00° to 0.15°), both cambers are within $+0.25^\circ$ to $+1.00^\circ$, and both casters are within $+3.0^\circ$ to $+5.0^\circ$. The side-to-side differences (0.1° camber, 0.3° caster) are within normal acceptable tolerances. No adjustment is needed.

89. C — The nail penetrated 15 mm into the 20 mm tread but did not breach the inner liner — the tire's air seal is intact. However, the nail may have damaged the steel belt reinforcement without breaching the liner. A qualified tire technician should inspect the internal belt structure before returning the tire to service, as belt damage can cause delayed failure.

90. D — Impact wrenches produce inconsistent torque due to variations in air pressure, tool condition, socket fit, and application angle. The torque output varies from one application to the next and from one gun to the next. The final torque on wheel nuts must always be verified with a calibrated torque wrench because over-torque damages studs and under-torque risks wheel separation.

91. B — A visible sag in the equalizer beam indicates the beam material has yielded — the metal has been stressed beyond its elastic limit by overloading. The permanent deformation means the beam cannot return to its designed shape and cannot distribute load equally between the two axle positions. The yielded beam must be replaced to restore proper load equalization.

92. A — Three bounces before settling (specification: one to one-and-a-half) indicates the shock absorber has failed internally and cannot provide adequate damping force. The worn internal valving allows the suspension spring to oscillate through multiple cycles because the shock cannot absorb the spring's stored energy quickly enough to limit the oscillation.

93. D — The 3 mm vertical play exceeds the 1.5 mm specification. The play could originate from worn fifth wheel jaw surfaces, a worn trailer king pin, or a combination of both. Both components must be measured to determine which has worn below specification. Either or both may need replacement to bring the coupling play within the 1.5 mm maximum.

94. C — Sawtooth (scalped) wear identical on both steer tires with correct alignment indicates a suspension damping failure affecting both sides simultaneously. Both steer axle shock absorbers have failed and cannot control the tires' vertical oscillation. The uncontrolled bouncing creates alternating heavy and light contact zones that produce the scalped wear pattern.

95. A — Excessive wheel bearing end play (0.008" vs specification of 0.001-0.005") allows the hub to wobble on the spindle. This dynamic wobble creates runout at the brake drum or rotor surface, producing brake pulsation during stops. The wobble also accelerates uneven brake wear and may trigger intermittent ABS fault codes from the varying sensor air gap.

96. B — Driving the trailer with the air suspension dumped means the trailer sits on the bump stops with no air spring cushioning. The rigid suspension transmits every road shock directly to the frame, cargo, and brake components. The harsh impacts can damage the frame, destroy sensitive cargo, and accelerate component wear from the uncontrolled shock loading.

97. D — A single clunk at the beginning of each direction change indicates accumulated play in the steering linkage. The total play from all connections — drag link ball joints, pitman arm, tie rod ends, and the steering gearbox — combines to produce the single perceptible clunk when the slack is taken up at the beginning of each steering input.

98. C — Bedding-in transfers a thin layer of friction material from the new pads to the rotor surface. This transfer layer is essential for the pad and rotor to produce the designed friction coefficient. Without proper bedding, the friction interface is incomplete and the braking performance does not match the pad manufacturer's specifications.

99. A — Hub oil expands when heated by bearing friction during driving. The thermal expansion of the heated oil increases its volume beyond the cold-fill level, raising the level above the sight glass mark. This is a normal condition — hub oil levels should always be set when the hub is cold, and the rise during operation is expected from thermal expansion.

100. D — A tire that balances perfectly (zero weight needed) can still produce a vibration from a radial or lateral force variation. The tire's internal structure (belts, plies, bead) may have a manufacturing inconsistency that creates an uneven force against the road surface once per revolution. This structural variation is independent of mass balance and requires a road force balancer to detect.

101. B — Different tire manufacturers produce tires with different conicity and ply steer characteristics even at the same size and load rating. These built-in asymmetric forces create lateral steering forces that differ between the mismatched tires. The unequal lateral forces produce a directional pull despite correct alignment — matching tires from the same manufacturer eliminates this.

102. C — Rubber load cushions that have been crushed flat and are bulging out of their mounting pockets have deteriorated from age, heat, and chemical exposure. The rubber compound has lost its resilience and cannot provide the designed load cushioning. The pads must be replaced and the cause of premature deterioration identified to prevent recurrence.

103. A — The replacement steering damper has a higher damping force specification than the original. While the increased damping effectively controls shimmy at highway speed, the higher resistance adds noticeable effort during slow-speed parking lot manoeuvres where the driver must turn the wheel against the damper's resistance without highway-speed momentum assistance.

104. D — The leak occurs during driving but not while parked in rain. The difference is wind pressure — highway driving forces rain against the cab's forward-facing surfaces with significantly more force than gravity alone. The wind pressure pushes water through a gap in the cab sealing that the rain's static weight cannot penetrate during stationary parking.

105. B — The switch illuminates (confirming the control circuit sends the activation signal) but the seat does not warm. The heating element itself may have an open circuit — a broken wire within the element prevents current flow through the heating coil despite the control circuit functioning correctly. Measuring the element's resistance with a DMM confirms continuity or identifies the open.

106. A — The extreme cold (-25°C) caused the cab air spring rubber bellows to contract below their minimum flexibility limit. The cold-brittle rubber cracked, allowing the air to escape and the springs to fully deflate during the overnight cold soak. The air system pressure is at cut-out confirming the air supply is adequate — the springs themselves have failed from cold-induced brittleness.

107. C — ADAS cameras require precise alignment relative to the vehicle's centreline and the road surface. Any windshield replacement changes the camera's optical path through the new glass, even if the glass is the correct part number. The camera must be recalibrated after windshield replacement to compensate for the new glass's optical characteristics.

108. B — The cab tilt pump has worn internal seals that allow hydraulic fluid to bypass the pump piston during each stroke. The reduced volumetric efficiency per stroke means less fluid is delivered to the tilt cylinder with each handle movement. More strokes are needed to deliver the total volume required to tilt the cab because each stroke delivers less effective volume.

109. D — The TRU's thermostat sensor is located near the return air intake at the front of the trailer. The sensor reads the coldest air first and satisfies the setpoint before the warmer air at the rear has fully circulated and cooled. The 6°C gradient is from the TRU cycling off based on the front sensor reading while the rear has not yet reached the target temperature.

110. A — The liftgate platform lowers by gravity with the hydraulic fluid returning from the cylinder through the return circuit. A needle valve or flow control valve in the return line restricts this flow to control the descent speed. If the valve is stuck open or maladjusted to a wider opening, the unrestricted return flow allows the platform to lower at twice the designed speed.

111. C — The delamination is visible as a bulge in the outer skin where the bond has separated from the inner panel. Composite panels can develop internal bonding defects during manufacturing — areas where the adhesive did not fully contact both surfaces. The unbonded area grows from the thermal cycling, vibration, and flexing of normal trailer operation.

112. B — The brake shoes were installed with the primary (shorter lining) and secondary (longer lining) shoes in reversed positions. The longer secondary shoe in the leading position produces significantly more self-energizing force than designed. The excessive self-energizing amplifies light pedal inputs into aggressive brake application creating the grabbing sensation.

113. D — The pull test with service brakes only confirms the pins resist the limited force available from the parked tractor. Full verification requires a visual inspection underneath the trailer to confirm all four lock pins are fully extended through the slide rail holes. Some pins may be partially engaged — enough to hold during a static test but insufficient for dynamic highway loading.

114. A — The system pressure is correct during both loaded and unloaded operation (eliminating pump and relief valve as causes). The cylinder raises at normal speed unloaded but slows dramatically with 500 kg. The raise cylinder's internal piston seal leaks under the higher pressure of loaded operation — the seal holds at low unloaded pressure but bypasses under the loaded condition.

115. C — The collision force that bent the rub rail 50 mm over a 1-metre length transmitted significant force into the trailer structure. The rub rail is welded directly to the frame, and the impact energy may have deformed, cracked, or stressed the frame rail behind the rub rail. The frame integrity must be verified before simply repairing the cosmetic rub rail damage.

116. B — The marker lamp and ABS circuits share common ground paths through the trailer harness. The butt connector splice repair introduced resistance in the shared ground circuit. This ground resistance creates voltage drops that affect the ABS sensor signal quality — the sensors' reference ground shifts with the marker lamp current flow, producing signal errors the ABS module detects.

117. D — The system cools well for 30 minutes then performance drops and the compressor short-cycles. Moisture contamination in the system gradually forms ice at the expansion valve orifice during the 30-minute operating period. The ice progressively restricts refrigerant flow, reducing cooling and dropping the suction pressure until the low-pressure switch trips the compressor off.

118. A — The blower operates at all speeds and heat comes from defrost and floor vents — confirming airflow and heating function. The panel (face-level) vents receive no air regardless of mode selection. The mode door actuator has failed in a position that serves defrost and floor but cannot rotate to the position that opens the panel vent passage.

119. C — After a compressor bearing failure, the system must be thoroughly flushed to remove all metallic debris. The A/C system flush procedure is critical and must reach all components. Residual metallic debris from the original failure has circulated through the system and entered the new compressor, damaging its internal components within 500 km.

120. B — The new blend door's actuator cable or linkage has a different travel range than the original. The actuator reaches its mechanical stop before the door reaches the full-heat position, leaving the cold air bypass passage partially open. A small amount of unheated air mixes with the heated air at the maximum heat setting, reducing the outlet temperature below full hot.

121. D — Voltage is present at the clutch coil connector (12.4V) and the coil resistance is within specification — yet the clutch does not engage. Multiple causes can produce this symptom: a missing or corroded ground connection prevents current flow, an excessive air gap reduces the magnetic holding force below engagement threshold, or the controller has a protection fault. All must be checked.

122. A — The centre of the windshield clears quickly but the outer edges remain fogged. The defroster nozzles at the outer positions have accumulated dust and debris that restricts the airflow to the windshield edges. The centre nozzles are typically larger and less prone to clogging, maintaining adequate airflow to the centre while the restricted outer nozzles cannot clear the edges.

123. C — The heater starts successfully (confirming fuel delivery, ignition, and initial combustion work) but shuts down after exactly 60 seconds. The 60-second window is the controller's flame verification period — the controller starts the heater and waits 60 seconds for the flame sensor to confirm sustained combustion. The flame sensor cannot detect the flame, and the controller shuts down as a safety measure.

124. B — The boom raises at normal speed but lowers slowly. System pressure and pump flow are correct for both directions. The flow control valve in the lower circuit is adjusted to a lower setting than the raise circuit, restricting the oil delivery rate during the lowering operation. The different valve settings create the speed differential between raise and lower.

125. D — The dump body overshoots by 50 mm when the operator releases the raise control. The hydraulic fluid trapped in the raise circuit compresses slightly under the high operating pressure. When the directional valve centres and the pump stops delivering, the compressed fluid expands — this expansion pushes the cylinder the additional 50 mm before equilibrium is reached.

126. A — The proportional solenoid should provide variable spool positioning for smooth speed control. The solenoid coil has a partial internal short that eliminates the proportional range — the coil produces either no magnetic force (spool closed) or full force (spool fully open). The loss of intermediate coil current values creates the all-or-nothing boom response.

127. C — Operating at 93% of the rated capacity is within the crane's designed operating envelope. The load chart already includes an engineering safety factor (typically 1.25x to 1.5x the chart ratings). The 93% reading represents 93% of the chart's already safety-factored capacity. However, the operator should remain aware of dynamic loads and environmental factors at this level.

128. B — The pump operated normally for 100 hours before developing noise and producing debris. The system was not properly flushed before the new pump was installed. Residual metallic contamination from the old pump migrated through the system and gradually embedded in the new pump's bearing and gear surfaces, causing the progressive damage.

129. D — The platform level function uses a hydraulic holding circuit. Both the holding valve (counterbalance valve or POCV) and the cylinder's internal piston seal can independently cause the gradual tilt. The source must be isolated by individually blocking each potential leak path to determine whether the valve seat or the cylinder seal is allowing the slow fluid bypass.

130. A — The pump inlet line was not bled of air during the filling procedure. The trapped air pocket at the pump inlet prevents the pump from drawing a full charge of fluid on each intake stroke. The unfilled portion of each pump chamber becomes a vapour pocket that collapses during compression, producing the cavitation noise and the sluggish system operation.

131. C — The sequence valve requires 12,000 kPa to open for boom functions. The outrigger cylinders have internal seal leakage that bleeds pressure away before the circuit can build to the 12,000 kPa threshold. The pressure builds toward the threshold but leaks past the cylinder seals, reaching a lower equilibrium pressure that prematurely opens the drifted sequence valve.

132. B — The BMS reduces regenerative braking to prevent the weakest cell group from being overcharged. During regenerative charging, all cells receive the same current. The low cell group (0.3V below others) reaches its maximum charge voltage before the healthier groups. The BMS must limit the total charging current to protect the weak group, reducing the regenerative braking force available.

133. D — The electric assist has decreased despite a fully charged 48-volt battery. The assist force depends on the entire chain: belt condition and tension, ISG motor health, battery internal resistance (affecting peak current), and the ISG controller's calibration. Any single component's degradation reduces the assist force, and all must be tested to identify the limiting factor.

134. A — The battery SOH is 88% (only 12% capacity loss) which alone does not account for a 50% increase in charge time (8 to 12 hours). The onboard charger has degraded and cannot convert AC to DC at its original rated power. The reduced conversion capacity limits the charging current delivered to the battery, extending the total charge time proportionally.

135. C — The motor position sensor (resolver or encoder) provides the exact rotor angle to the inverter. The inverter must know the rotor's precise rotational position to energize the correct stator phase at the correct instant — this creates the rotating magnetic field that produces controlled torque. Without accurate position data, the inverter cannot create the correct field and disables motor operation.