

PRACTICE EXAM 11: RED SEAL TRUCK AND TRANSPORT MECHANIC SIMULATION (135 QUESTIONS)

1. A technician is preparing to work on a truck's fuel system. The truck was involved in a collision and the fuel tank strap is damaged. Diesel fuel is slowly dripping from the tank's bottom seam. What is the first action before beginning any repair?

A. Position a fuel-rated catch pan under the drip and begin loosening the damaged strap to lower the tank before the leak worsens from the tank's shifting weight

B. Apply an epoxy sealant to the leaking seam to stop the drip before repositioning the damaged strap to prevent additional stress on the weakened seam joint

C. Eliminate all ignition sources in the area, ensure adequate ventilation, have fire extinguishing equipment immediately available, and contain the dripping fuel before disturbing the tank

D. Drain the fuel tank from the drain plug to reduce the tank weight and eliminate the hydrostatic pressure on the leaking seam before removing the damaged strap for replacement

2. A shop's compressed air system supplies impact wrenches, air ratchets, die grinders, and blow guns to technicians throughout the facility. A technician is observed using the blow gun to clean brake dust from their clothing. What is the hazard of this practice?

A. Compressed air directed at the body can penetrate the skin through any opening causing an air embolism, and brake dust particles become projectiles that can cause eye injury and respiratory damage

B. The blow gun pressure will exceed the brake dust's electrostatic charge threshold causing the particles to become permanently attracted to the clothing fibres making them impossible to remove later

C. Compressed air will force the brake dust deeper into the clothing fibres where it becomes a prolonged dermal exposure hazard from the friction material's chemical components contacting the skin

D. The blow gun creates a vacuum zone behind the air stream that pulls the brake dust particles into a concentrated cloud that settles on adjacent technicians' work areas and contaminates open engines

3. A technician needs to disconnect a truck's battery before performing electrical work. The truck has a 12-volt negative-ground system with dual batteries in parallel. What is the correct disconnection sequence?

A. Disconnect the positive cable from both batteries first, then disconnect the negative cable from both batteries to ensure all current paths are opened in the correct order

B. Disconnect the battery equalizer first, then disconnect the positive cable, then the negative cable from each battery individually starting with the battery closest to the starter

C. Disconnect any battery — the order does not matter on a 12-volt parallel system because both batteries share the same voltage and disconnecting either one opens the circuit

D. Disconnect the negative cable from both batteries first, then disconnect the positive cable — this prevents accidental arcing if the wrench contacts the frame while removing the positive terminal

4. During a routine PM inspection, a technician discovers a cracked exhaust manifold on a heavy-duty diesel engine. The crack is approximately 75 mm long on the number 2 cylinder runner. Exhaust gas is audibly leaking from the crack. Beyond the noise, what is the primary safety concern?

A. The cracked manifold will allow rainwater to enter the exhaust port and contact the hot exhaust valve causing thermal shock that cracks the valve seat insert during the next cold start

B. The leaking exhaust gas can enter the cab through the firewall and HVAC fresh air intake exposing the driver to carbon monoxide and other toxic exhaust gases during vehicle operation

C. The cracked manifold section may separate completely while the engine is running and the hot cast iron fragment could fall onto the fuel lines or wiring harness creating a fire hazard

D. The exhaust leak reduces the exhaust backpressure which causes the turbocharger to overspeed from the reduced resistance on the turbine side accelerating the turbo beyond its burst speed

5. A heavy-duty truck has been raised on a four-post drive-on lift for undercarriage inspection. The lift is at full height. A technician needs to remove a starter motor that weighs approximately 25 kg from the underside of the engine while standing under the raised truck. What safety consideration applies?

- A. The technician should use a scissor jack placed on the lift platform to support the starter during removal because the starter's weight could cause injury if it falls from the engine mounting position
- B. The technician should have a second technician hold the starter from the engine compartment above while the mounting bolts are removed from below to prevent the starter from dropping during removal
- C. The lift manufacturer's safety locks must be verified as engaged because the technician is working under the elevated vehicle and a hydraulic failure without the locks could drop the vehicle on the technician
- D. The lift locks must be engaged, and the technician should position themselves to avoid the starter's fall path while supporting it during removal — a 25 kg object falling from overhead poses a serious injury risk

6. A technician is performing a cooling system pressure test. During the test, the system holds pressure for the specified duration. However, the technician notices that the radiator cap tester gauge reads 110 kPa while the radiator cap is rated at 103 kPa. What does this indicate?

- A. The test is being performed incorrectly — the system should be pressurized to the cap's rated pressure (103 kPa), not above it, because exceeding the cap rating can damage hoses, the heater core, or the radiator
- B. The 110 kPa test pressure proves the system can withstand more than the cap's rated pressure providing an extra margin of safety that confirms all components are well above their minimum specification
- C. The radiator cap has failed in the closed position and cannot relieve pressure at its rated 103 kPa setting which will cause the cooling system to overpressurize during normal engine operation and may burst a hose
- D. The 7 kPa difference between the test pressure and the cap rating is within the acceptable tolerance for cooling system pressure testing and does not indicate any problem with the cap or the testing procedure

7. A fleet shop is implementing a new waste management program. The program must address used oil, used coolant, used oil filters, used brake cleaner, contaminated fuel, and used shop rags. Which of these waste streams requires the most careful segregation to prevent cross-contamination?

- A. Used shop rags must be segregated from all other waste because the mixed chemicals on the rags create an unpredictable chemical reaction risk when the rags are compressed in a waste container
- B. Used brake cleaner must be stored separately from used oil because the solvent in the brake cleaner reacts with the petroleum hydrocarbons in the used oil creating a compound that cannot be recycled
- C. Used coolant must be strictly segregated from used oil because mixing the two creates a waste that cannot be recycled through standard re-refining processes and must be disposed of at significantly higher cost
- D. Contaminated fuel must be segregated from used oil because the fuel's flash point is lower than the oil's and mixing the two lowers the combined flash point creating a fire hazard in the used oil storage tank

8. A technician is using a hydraulic press to remove a bearing from a shaft. The bearing suddenly releases from the shaft and the press ram lunges forward. What safety feature prevents injury in this situation?

- A. The hydraulic press's built-in overload relief valve limits the maximum press force and prevents the ram from accelerating when the bearing releases by venting the excess hydraulic pressure to the tank
- B. A safety cage or shield around the press work area contains flying debris and prevents the bearing or shaft from being ejected sideways when the stored energy releases suddenly during the bearing separation
- C. The press bed has shock-absorbing rubber pads that decelerate the ram travel when the bearing releases preventing the ram from slamming to the bottom of its stroke and launching the workpiece from the bed
- D. The hydraulic press's speed control valve limits the ram descent speed regardless of the load release and prevents the ram from accelerating when the bearing separates from the shaft surface during pressing

9. A heavy-duty diesel engine has a complaint that the exhaust gas temperature (EGT) on cylinder 3 is consistently 50°C lower than all other cylinders at full load. Injection timing and fuel delivery are confirmed equal on all cylinders. What should be investigated?

A. The intake or exhaust valve on cylinder 3 for a sealing problem that reduces the effective compression or allows the combustion charge to escape before the energy is fully converted to work in that cylinder

B. The fuel injector nozzle on cylinder 3 for a partially blocked spray hole that alters the spray pattern and prevents complete combustion of the fuel charge even though the total fuel volume delivered is correct

C. The piston cooling nozzle on cylinder 3 for excessive oil flow that overcools the piston crown and combustion chamber surfaces absorbing combustion heat before it reaches the exhaust stream on that cylinder

D. The turbocharger's housing geometry for an unequal exhaust gas flow pattern that diverts more exhaust energy from cylinder 3's runner to adjacent runners before it reaches the EGT sensor location

10. A diesel engine produces a rhythmic pulsation in the exhaust that can be felt by placing a hand near the tailpipe. The pulsation occurs at a consistent rate regardless of engine RPM. One pulsation occurs approximately every 4 seconds at idle. What does this indicate?

A. The engine has a restricted exhaust system that creates a standing wave in the exhaust pipe at a frequency determined by the pipe length rather than the engine speed

B. The DPF regeneration system is performing micro-regeneration events at a fixed 4-second interval to maintain the soot load below the threshold that would trigger a full active regeneration cycle

C. The air compressor's discharge valve is leaking compressed air into the exhaust manifold through an internal crack between the compressor cylinder and the exhaust manifold on the compressor-mounted engine

D. One cylinder is not firing consistently — the exhaust pulse from that cylinder is weaker than the others creating a perceptible gap in the exhaust flow pattern that repeats once per camshaft revolution at idle speed

11. A diesel engine's oil pressure is normal at operating temperature but drops to near zero during aggressive acceleration from a stop. The oil level is correct. As soon as the acceleration ends and the vehicle reaches cruise speed, the pressure returns to normal. What is happening?

A. The oil pump pickup tube is positioned too high in the sump and during hard acceleration the oil sloshes to the rear of the pan uncovering the pickup tube and allowing air to enter the pump inlet momentarily

B. The oil pressure relief valve is opening prematurely during acceleration because the vibration from the drivetrain loading causes the relief valve spring to resonate and momentarily lose its designed holding force

C. The oil pump drive gear has a worn keyway that allows the gear to slip on the pump shaft during the sudden torque increase of acceleration before the key re-engages at the steady load of cruise speed

D. The main bearing clearances have worn to the point where the additional oil demand during the high-load condition of acceleration exceeds the pump's delivery capacity causing a momentary pressure drop

12. A heavy-duty diesel engine has had its injectors replaced at 400,000 km. After the replacement, the engine runs smoothly but fuel consumption has increased by 8% compared to the pre-replacement baseline. All injector calibration codes have been entered correctly. What should be checked?

A. The fuel return flow from the new injectors for a higher-than-specification rate that indicates the new injectors have a different internal bypass characteristic than the old injectors reducing fuel system efficiency

B. The replacement injectors for the correct OEM part number and flow rate specification — aftermarket or incorrect injectors may have a different delivery rate or spray pattern that reduces combustion efficiency

C. The engine's timing calibration for a drift that coincidentally occurred during the injector service and the retarded timing reduces combustion efficiency causing the 8% increase in fuel consumption independently

D. The air intake system for a restriction that was introduced during the injector service — a dislodged hose, loose clamp, or air intake connector that was disturbed during the work and not properly resealed

13. A diesel engine equipped with a variable geometry turbocharger has a complaint of surging at cruise speed — the engine RPM varies by approximately 50 RPM in a 2-second cycle without any change in throttle position. The surge is only present at highway cruise and not at idle or full load. What is the most likely cause?

A. The VGT actuator is hunting for its commanded position — the actuator overshoots, the ECM corrects, it undershoots, and the repeated overcorrection creates the rhythmic surge at the specific cruise boost demand

B. The fuel metering unit is cycling between two calibration points at the cruise fuel demand level creating a pulsating fuel delivery that varies the engine's power output by the 50 RPM observed during the surge

C. The turbocharger wastegate (not VGT) has a marginal spring that oscillates between open and closed at the cruise boost level creating alternating over-boost and under-boost conditions that produce the surge

D. The cruise control system is actively correcting for small speed variations caused by wind gusts and road grade changes and the correction algorithm is over-responding at the specific cruise speed and load condition

14. A common rail diesel engine has a fault code for "fuel rail pressure too low during cranking." The engine starts after extended cranking (approximately 8 seconds instead of the normal 2 seconds). Once started, the engine runs normally with correct rail pressure. What is the most likely cause?

A. The fuel filter has a minor restriction that limits the fuel flow rate during the high-volume demand of initial priming but provides adequate flow once the system is pressurized and the demand stabilizes during running

B. The high-pressure pump's inlet check valve has a slow-closing characteristic that allows fuel to drain back from the rail to the tank during the engine-off period requiring extended cranking to refill the rail before starting

C. The battery voltage drops during cranking to a level that reduces the fuel priming pump's output below the minimum needed to supply the high-pressure pump at the cranking RPM for adequate rail pressure buildup

D. The high-pressure pump's internal check valve or the rail's drain-back check valve is not sealing — fuel drains from the rail during the engine-off period and the extended cranking refills the rail to starting pressure

15. A diesel engine has a complaint of a "diesel knock" that is present only during the first 30 seconds of operation after a cold start and then disappears. The engine runs normally once warm. No fault codes are present. What is the most common cause of this cold-start knock?

- A. The piston pin clearance is at the maximum specification and the cold clearance produces a knock that disappears as the piston expands from combustion heat and closes the pin-to-bore clearance
- B. The injector nozzle opening pressure drops during the cold soak from the cold fuel's higher viscosity allowing the nozzle to open at a lower pressure producing a coarser spray that causes the knock until warm
- C. The engine block and pistons are at different temperatures during cold start and the thermal expansion differential produces piston slap against the liner wall until both components reach equilibrium temperature
- D. The combustion chamber surfaces are cold and the lower surface temperature increases the ignition delay of the diesel fuel causing a larger initial fuel charge to ignite simultaneously producing the characteristic knock

16. A diesel engine's water pump bearing has failed and the pump is being replaced. During removal, the technician notices that the water pump impeller has significant cavitation erosion on the blade tips. What engine condition promotes water pump cavitation?

- A. Operating the engine with a radiator cap pressure rating that is lower than the OEM specification reduces the system's boiling point and allows vapour bubbles to form at the pump impeller creating cavitation
- B. Operating the engine with the thermostat removed eliminates the restriction that maintains adequate pump inlet pressure and the unrestricted flow allows the pump to draw a vacuum on its own inlet creating cavitation
- C. Operating the engine with a coolant concentration above 60% glycol reduces the coolant's heat transfer efficiency and the localized hot spots at the impeller tips create vapour bubbles that cause cavitation erosion
- D. Operating the engine with an excessively high coolant level overfills the surge tank and the increased hydrostatic pressure at the pump inlet creates turbulence that produces the cavitation erosion on the blade tips

17. A heavy-duty diesel engine has been stored for 18 months without being operated. Before returning the engine to service, the technician performs a pre-start inspection. What critical lubrication concern must be addressed before the first start?

A. The engine's upper cylinder components (valve train, cam followers, turbocharger bearings) have no residual oil film after 18 months and the engine must be pre-lubricated before the first start to prevent dry-running damage

B. The engine oil has separated during storage into its base oil and additive components and the oil must be drained and replaced with fresh oil before starting because the separated oil cannot provide adequate lubrication

C. The engine's hydraulic valve lifters have drained during the storage period and the engine must idle for 30 minutes at first start to allow the lifters to refill with oil before any load is applied to the valve train

D. The fuel injector internal components have lost their lubricating fuel film during storage and the technician must prime the fuel system for at least 5 minutes before cranking to re-establish the fuel film in the injectors

18. A diesel engine equipped with an exhaust brake has a complaint that the exhaust brake produces inconsistent retarding force — sometimes strong and sometimes weak — under identical driving conditions. The butterfly valve appears to operate correctly when tested with the scan tool. What should be investigated?

A. The exhaust brake butterfly valve shaft seals for a leak that allows exhaust gas to bypass the closed butterfly intermittently depending on the exhaust pulse timing and pressure wave reflection in the exhaust manifold

B. The turbocharger's VGT vanes for an intermittent position error that changes the exhaust restriction upstream of the butterfly valve and alters the backpressure available for the exhaust brake retarding force

C. The engine's valve lash for inconsistency across cylinders that changes the effective compression ratio and the compression braking contribution that supplements the exhaust brake's butterfly valve restriction

D. The turbocharger VGT position or the exhaust system upstream of the butterfly for a variable restriction that changes the total exhaust backpressure intermittently affecting the brake's retarding force consistency

19. A diesel engine's cooling system has been flushed and refilled. After the refill, the engine reaches operating temperature but the upper radiator hose is hard (pressurized) while the lower radiator hose is soft (collapsed). What does this indicate?

A. The thermostat has been installed upside down and the sensing element is exposed to the cooler radiator outlet rather than the hot engine outlet causing the valve to remain closed when it should be open

B. The lower radiator hose has a collapsed internal spring (anti-collapse spring) or the spring was not reinstalled during the flush — the pump's suction collapses the hose restricting coolant flow to the pump inlet

C. The water pump impeller has corroded during the flush from the cleaning chemical's acid content and the reduced impeller diameter cannot generate adequate flow pressure to push coolant through the system

D. The radiator cap was installed on the wrong radiator neck position — the cap's pressure relief is venting to the overflow before the system reaches operating pressure preventing normal pressurized circulation

20. A diesel engine has a complaint of intermittent white smoke that occurs for approximately 5 seconds after the engine returns to idle from a high-RPM operation. The smoke does not smell like coolant and the coolant level is stable. What is the most likely cause?

A. The turbocharger oil drain is partially restricted and during high-RPM operation the oil pressure forces more oil through the turbo bearings than the restricted drain can handle — the excess oil enters the intake

B. The valve stem seals on the intake valves have hardened and during the high intake vacuum that occurs when the throttle closes from high RPM the seals cannot prevent oil from being drawn past the valve guides

C. The piston ring oil control function is momentarily lost during the transition from high RPM to idle because the ring tension changes with the sudden speed reduction allowing oil past the rings briefly

D. The EGR valve opens briefly during the deceleration transition and carries engine oil mist from the valve cover ventilation system into the intake manifold where it burns and produces the white smoke puff

21. A diesel engine has a fault code for the exhaust gas differential pressure sensor across the DPF. The code indicates the sensor reading is implausible. The technician replaces the sensor but the code returns immediately. What should be checked next?

A. The sensing tubes that connect the differential pressure sensor to the DPF upstream and downstream ports for blockage, kinks, moisture accumulation, or disconnection that prevents the sensor from reading accurately

B. The DPF substrate for a crack or break that changes the flow pattern through the filter creating a pressure differential that the new sensor correctly reads as implausible because the pattern is outside the expected range

C. The ECM's software calibration for a sensor parameter mismatch because the new sensor may have a different part number or output range than the ECM's calibration expects for the differential pressure input

D. The engine's air intake for a restriction that alters the exhaust flow pattern through the DPF creating a pressure differential that falls outside the sensor's normal range even though the DPF itself is functioning correctly

22. A heavy-duty diesel engine's fuel injection timing has been verified at the correct specification using the scan tool's timing data. However, the engine produces more NO_x emissions than identical trucks in the fleet. All other engine parameters are identical. What could cause elevated NO_x with correct injection timing?

A. The fuel injector nozzles have a slightly larger hole diameter than specification from erosion which produces a finer spray that creates faster combustion with higher peak cylinder temperatures increasing NO_x formation

B. The EGR system is delivering less exhaust gas to the intake manifold than commanded — reduced EGR flow means more oxygen in the combustion chamber producing higher combustion temperatures and more NO_x

C. The turbocharger is producing slightly more boost than specification which increases the air density in the combustion chamber raising the peak pressure and temperature during combustion which increases NO_x formation

D. The EGR system is not delivering the commanded volume of exhaust gas to the intake manifold — the reduced inert gas dilution allows higher combustion temperatures during the burn event which increases NO_x formation

23. A diesel engine's oil analysis shows a sudden appearance of sodium and potassium that were not present in any previous oil sample. All other wear metals are within normal trends. What contamination source do sodium and potassium together indicate?

A. The engine oil has been contaminated with transmission fluid that uses sodium and potassium-based friction modifiers in its additive package

B. Coolant contamination — sodium and potassium are components of the corrosion inhibitor package in most commercial engine coolants and their presence in the oil confirms coolant is entering the crankcase

C. The fuel supply has been contaminated with a biodiesel blend that uses sodium and potassium hydroxide catalysts in the transesterification process

D. The engine's intake air has been contaminated with road salt spray containing sodium and potassium chloride that enters the crankcase through the blow-by gases from the combustion chamber

24. A diesel engine has been running with a partially blocked fuel return line for an extended period. The engine has been repaired and the blockage cleared. What secondary damage should the technician check for as a result of the prolonged return restriction?

A. The fuel tank for internal pressure damage from the restricted return backing up fuel pressure into the tank beyond the tank's designed pressure capacity during normal engine operation

B. The fuel injectors for heat damage because the restricted return prevented adequate fuel flow for cooling the injector tips and the prolonged high-temperature operation may have damaged the nozzle components

C. The high-pressure fuel pump for damage from operating against the elevated return backpressure that forces the pump to work harder to maintain rail pressure against the additional resistance of the blocked return

D. The fuel transfer pump for overheating from the reduced fuel circulation through the pump body — the restricted return reduces the total fuel volume flowing through the system reducing the pump's internal cooling

25. A diesel engine's aftertreatment DEF dosing system has a complaint of crystallization at the DEF injector nozzle. The dosing rate, DEF quality, and exhaust temperature are all within specification. What is causing the crystallization?

A. The DEF injector's coolant purge cycle is not operating correctly — after engine shutdown the system should purge the residual DEF from the nozzle with coolant or compressed air to prevent crystallization during cooling

B. The DEF concentration is at the upper limit of the specification (33.5% instead of 32.5%) and the slightly higher urea content produces more crystallization at the nozzle tip during normal operating temperature ranges

C. The exhaust gas temperature at the injection point fluctuates below the minimum decomposition temperature during light-load operation allowing the DEF to partially decompose and crystallize at the nozzle tip

D. The DEF supply line has a restriction that reduces the flow rate at the nozzle creating a dribble instead of a fine mist spray — the dribbled DEF does not atomize properly and crystallizes on the hot nozzle surface

26. A heavy-duty diesel engine has a fault code for the mass airflow (MAF) sensor reading higher than expected. The engine has adequate power and no driveability complaints. What condition could cause a MAF reading above the expected range without affecting engine performance?

A. The MAF sensor is contaminated with oil mist from the crankcase ventilation system — the oil on the sensor's hot wire element changes its thermal characteristics causing it to read higher airflow than actual

B. The intake air filter has been recently replaced with a less restrictive aftermarket filter that allows more airflow than the original filter creating a higher MAF reading that exceeds the ECM's expected range for the conditions

C. The turbocharger is producing slightly more boost than specification from a VGT calibration shift — the increased air delivery raises the MAF reading but the ECM compensates with additional fuel maintaining performance

D. The MAF sensor is contaminated with oil mist from the crankcase ventilation system which deposits on the sensing element and alters its heat transfer characteristics — the contaminated element reads higher than the actual airflow

27. A diesel engine's coolant temperature gauge intermittently spikes to the maximum reading for 2 to 3 seconds and then returns to normal. The engine does not overheat — the actual coolant temperature is verified as normal by a scan tool connected to the ECM. What is the most likely cause?

A. The coolant temperature sending unit (the one for the dash gauge — separate from the ECM sensor) has a loose or corroded connector that intermittently opens the circuit causing the gauge to read maximum during the dropout

B. The dash gauge coolant temperature sending unit has an intermittent internal short that momentarily drops the resistance to near zero causing the gauge to spike to maximum before the short clears and the reading normalizes

C. The instrument cluster's gauge driver circuit has a fault that intermittently sends a maximum drive signal to the temperature gauge stepper motor from an internal noise source in the cluster electronics

D. The engine thermostat is momentarily sticking closed during normal cycling and the brief temperature spike is real but too fast for the ECM's slower-sampling sensor to capture while the gauge's faster-responding sender detects it

28. A diesel engine has developed a condition where the oil turns dark black within 100 km of an oil change. The oil starts clean and amber during the fill. The engine operates normally with no smoke or performance complaints. What is the most probable cause?

A. The engine has a high soot loading condition from incomplete combustion that is producing carbon particles faster than the oil's dispersant additive can keep them suspended — the soot overwhelms the fresh oil immediately

B. The engine's combustion is producing excessive soot from an EGR system fault, retarded timing, low boost, or worn injectors — the soot loading contaminates the fresh oil within the first few operating hours

C. The oil filter bypass valve is stuck open allowing all the oil to circulate without filtration and the accumulated contaminants in the system immediately darken the fresh oil as it mixes with the residual dirty oil

D. The engine's crankcase ventilation system is routing excessive combustion blow-by into the crankcase and the partially combusted fuel and soot in the blow-by gases immediately contaminate the fresh oil after the change

29. A diesel engine equipped with a DPF and SCR aftertreatment system has completed a forced regeneration through the scan tool. The post-regeneration DPF differential pressure reads 2 kPa. Within 200 km, the pressure rises to 5 kPa. What is the expected differential pressure for a clean DPF and does the 200 km rise to 5 kPa indicate a problem?

A. A clean DPF typically reads 0.5 to 2.0 kPa and a rise to 5 kPa in 200 km is abnormal — it indicates the engine is producing excessive soot or the DPF did not fully regenerate during the forced event

B. A clean DPF typically reads 1.0 to 3.0 kPa and a rise to 5 kPa in 200 km may be within normal soot accumulation rates depending on the engine's operating conditions during those 200 km

C. A clean DPF should read exactly 0 kPa and any reading above zero indicates the DPF was not fully cleaned during the forced regeneration and the procedure should be repeated until a zero reading is achieved

D. A clean DPF typically reads 1.0 to 3.0 kPa and a rise to 5 kPa within 200 km is normal — the rate of soot accumulation depends on the engine's load, speed, and EGR system function during that driving period

30. A truck's air compressor has been diagnosed with excessive oil carry-over into the air system. The technician has found oil in the air tanks, the air dryer desiccant is contaminated, and the brake valve bodies have oil residue inside. What is the root cause of the oil carry-over and what secondary damage must be addressed?

A. The compressor's piston rings are worn allowing engine oil to enter the compressed air circuit — the contaminated desiccant must be replaced and all rubber components exposed to oil must be inspected for degradation

B. The compressor's inlet filter is restricted forcing the compressor to draw oil past the piston rings under high vacuum — the desiccant and all oil-contaminated valves must be serviced before the system is returned to service

C. The compressor's piston rings have failed allowing oil into the air system — the air dryer desiccant, all rubber brake diaphragms, valve seals, and air bag rubber that contacted the oil must be inspected and replaced as needed

D. The compressor's discharge valve is leaking and the oil is entering through the valve seat rather than past the rings — replacing the discharge valve will stop the oil carry-over and the system can be flushed clean

31. A tractor-trailer combination is undergoing a pre-trip air brake inspection. The driver builds the air system to full governor cut-out, then shuts the engine off. With the brakes released, the driver watches the air gauges for one minute. The primary circuit drops 10 kPa and the secondary circuit drops 3 kPa. What is the assessment?

A. The primary circuit exceeds the maximum allowable leak rate for a tractor-trailer combination with brakes released (14 kPa/min) —the 10 kPa and 3 kPa are individual circuit readings and the total combination rate is the concern

B. Each circuit must be evaluated separately and the primary at 10 kPa per minute is approaching the maximum — the vehicle should be checked for leaks before departure even if it technically passes the test

C. The combined leak rate of 13 kPa per minute technically passes the 14 kPa per minute maximum for a combination vehicle with brakes released but the primary circuit's higher rate warrants investigation before departure

D. The test is invalid because the proper procedure requires the air pressure to stabilize for one minute after the engine is shut off before beginning the leak rate measurement to account for the compressor unloader's final exhaust

32. A truck's front disc brake caliper has been rebuilt with new piston seals and dust boots. After reinstallation, the front brakes drag continuously — the rotor is hot after driving only 2 km. The caliper slide pins are free and lubricated. What is the most likely cause of the drag?

A. The new caliper piston seal was installed incorrectly — the seal's square-cut design relies on a specific orientation to retract the piston when pressure is released and an inverted seal prevents piston retraction

B. The caliper piston seal groove was not cleaned properly before the new seal was installed and residual corrosion in the groove prevents the seal from rolling correctly during the piston's retraction movement after application

C. The replacement piston seal has a slightly different cross-section than the OEM seal and the seal's increased compression in the bore creates excessive friction that prevents the piston from retracting after each application

D. The brake fluid has degraded from moisture absorption and the contaminated fluid has caused the new seal to swell beyond its designed dimension creating excessive bore friction that holds the piston in the applied position

33. A truck's air system governor has been replaced. After the replacement, the air system builds pressure and the governor cuts out at the correct pressure. However, when the air is consumed through brake applications, the governor does not cut in (load the compressor) until the pressure drops to 480 kPa instead of the specified 585 kPa. What is the consequence of this late cut-in?

A. The brakes function normally because the air reservoirs contain adequate volume for multiple brake applications and the late cut-in only affects the recovery time between heavy braking events during normal driving

B. The system operates in a critically low-pressure range for an extended period — the late cut-in allows the pressure to drop 100 kPa below specification before the compressor loads which may trigger the low-pressure warning

C. The late cut-in has no operational consequence because the governor's cut-out pressure is correct and the air system always recovers to full pressure once the compressor loads regardless of when the loading occurs

D. The late cut-in allows the system pressure to operate in a wider-than-designed range creating a condition where the spring brakes may begin to apply before the compressor loads because the pressure enters the spring application zone

34. A truck's ABS wheel speed sensor produces a signal that the scan tool displays as 0 km/h while the vehicle is driving at 50 km/h. All other sensors read correctly. The sensor resistance is within specification. What is the most likely cause of the zero reading?

A. The sensor is producing a signal but the ABS module cannot process it because the module's input channel for that sensor has failed internally — the sensor works but the module cannot read the signal it produces

B. The sensor air gap is correct but the tone ring has a broken section that creates a gap in the signal pattern which the ABS module interprets as a stationary wheel because the signal drops to zero at the broken section

C. The sensor is a passive type that generates voltage proportionally to wheel speed and the output voltage at 50 km/h is still below the ABS module's minimum detection threshold for a valid wheel speed signal

D. The tone ring is completely missing from the hub assembly — the sensor produces no signal without the tone ring's teeth passing the sensor face regardless of the sensor's electrical specification being within range

35. A heavy-duty truck's brake lining material specification has been changed from a semi-metallic compound to a ceramic compound by the fleet maintenance department. After the change, the drivers report that the brakes require more pedal effort to achieve the same stopping force. What explains this change in pedal feel?

A. Ceramic brake linings typically have a lower initial friction coefficient than semi-metallic linings at normal operating temperatures requiring more application pressure to achieve the same braking force until the linings warm up

B. The ceramic linings are thicker than the semi-metallic linings and the additional material thickness increases the distance the pushrod must travel before the lining contacts the drum requiring more air to fill the extra stroke

C. The ceramic compound has a different thermal expansion rate than the semi-metallic compound and the linings expand away from the drum during braking creating an intermittent contact pattern that reduces the effective friction

D. The ceramic linings require a specific break-in procedure that was not performed after installation and the unbroken surface has a glazed finish from manufacturing that reduces the initial friction until the glaze wears away

36. A truck's spring brake chamber has been caged using the caging bolt for towing. During the tow, the driver of the towing vehicle applies the brakes firmly and the towed truck's wheels lock up. What happened?

A. The caging bolt backed out from road vibration and the spring re-extended applying the parking brake on the towed truck causing the wheel lockup during the braking event of the towing vehicle

B. The service brake circuit on the towed truck was not exhausted and the towing vehicle's brake application transmitted through the glad-hand service line applying the towed truck's service brakes unexpectedly

C. The caging bolt compressed the spring but did not lock the service diaphragm — when the towing vehicle's brakes created a deceleration force the service diaphragm shifted forward applying the brakes mechanically

D. The spring brake was caged but the towed truck's relay valve was not properly exhausted — residual air pressure in the relay valve's delivery port applied the service brakes when the relay valve's signal dropped during braking

37. A truck equipped with automatic traction control (ATC) has a complaint that the ATC activates unnecessarily on dry pavement during normal acceleration from a stop. The tires are the correct size and properly inflated. What should be investigated?

A. The ATC speed threshold calibration for a factory setting that is too sensitive for the truck's specific tire and axle ratio combination causing the system to interpret normal acceleration wheel speed as traction loss

B. The wheel speed sensors for a signal output that differs between the drive axle wheels — a sensor producing a lower-than-actual speed reading would create a false speed differential that triggers the ATC intervention

C. The drive axle differential for excessive backlash that creates a momentary speed difference between the left and right wheels during the initial acceleration engagement causing the ATC to interpret this as wheel spin

D. The ABS module for a firmware version that has a known false-activation issue during low-speed acceleration that the manufacturer has addressed with a software update available through the dealer diagnostic tool

38. A trailer's brakes have been recently serviced. During the first loaded trip, the driver notices that the trailer pushes the tractor during braking — the trailer brakes are significantly weaker than expected. The brake adjustment is within specification and the air system pressure is normal. What is the most likely service error?

A. The brake shoes were installed with the primary and secondary shoes in the wrong positions — the leading shoe position has the shorter lining and the trailing position has the longer lining reversing the designed force distribution

B. The brake drums were replaced with drums that have a slightly larger internal diameter than the old drums creating a gap between the linings and the drum surface that the slack adjusters have not yet compensated for

C. The brake chamber pushrod clevises were reconnected to the wrong hole positions on the slack adjuster arms after the service changing the mechanical advantage of the brake application on all trailer axle positions

D. The relay valve for the trailer brake circuit was accidentally adjusted during the service and the valve's reduced crack pressure limits the maximum delivery pressure to the brake chambers during heavy application events

39. A truck's air brake system has been tested and the stopping distance exceeds the regulatory maximum. All brake adjustments are within specification, the air system pressure is at governor cut-out,

and no individual wheel is dragging or grabbing. What system-level condition could explain the extended stopping distance with all individual components within specification?

A. The brake drum material has a different hardness specification than the linings creating a friction mismatch that reduces the effective braking coefficient even though both components individually meet their own specifications

B. The relay valves have a higher-than-specification crack pressure that requires more signal pressure from the foot valve before they begin delivering air to the chambers — the delay extends the total stopping distance

C. The brake timing across all axles is mismatched — some axles apply earlier or later than others due to different line lengths, relay valve response times, or chamber sizes creating a sequential rather than simultaneous application

D. The total system application response — including foot valve delivery rate, relay valve response, line lengths, and chamber fill times — creates a cumulative delay between pedal input and full brake force at all wheels

40. A truck equipped with EBS (electronic braking system) has a warning lamp indicating a system fault. The scan tool shows a fault code for the steering angle sensor. Why does the EBS system use a steering angle sensor input?

A. The EBS uses the steering angle to activate the differential lock automatically during turns to prevent the inside wheel from losing traction during cornering with heavy braking on slippery road surfaces

B. The EBS uses the steering angle to adjust the brake lamp activation timing based on the turning direction so following vehicles receive earlier warning during turns than during straight-line braking events

C. The EBS uses the steering angle to prevent rear axle lockup during turns by reducing rear brake pressure when the vehicle is in a turn preventing the rear from sliding outward during cornering under braking

D. The EBS uses the steering angle input for its electronic stability control function — the system compares the driver's steering input to the vehicle's actual yaw rate and applies individual brakes to correct understeer or oversteer

41. A trailer's brake chambers have been replaced with a different manufacturer's chambers that have the same type designation (Type 24). After installation, the brake performance seems adequate but the pushrod stroke specification from the original chamber manufacturer differs from the replacement manufacturer's specification. Which specification should be used?

A. The original chamber manufacturer's specification should be used because the brake system was designed around that chamber's stroke characteristics and changing the specification could affect brake performance

B. The replacement chamber manufacturer's stroke specification should be used because the stroke limits are determined by the specific chamber's internal geometry which may differ between manufacturers even at the same type designation

C. The CSA or FMVSS stroke specification for the Type 24 chamber designation should be used because the regulatory standard defines the maximum stroke independently of the chamber manufacturer's individual specification

D. The most conservative (shortest) stroke specification between the two manufacturers should be used because the shorter limit provides the greatest safety margin for brake adjustment compliance at all inspection points

42. A truck's air compressor has been replaced and the new unit produces a loud knocking noise during operation. The noise is proportional to engine RPM. The compressor is mounted to the engine and gear-driven from the timing gear train. What is the most likely cause?

A. The replacement compressor has incorrect gear timing with the engine's timing gear train — the compressor piston reaches TDC at a point where it interferes with the compressor head creating a mechanical knock on each revolution

B. The replacement compressor has a different gear tooth count than the original which creates a gear mesh interference with the engine's timing gear that produces the proportional knocking noise during every revolution

C. The compressor mounting bolts were not torqued to specification and the loose compressor shifts on its mounting pad during each revolution creating the knocking from the compressor body impacting the engine block

D. The replacement compressor's gear backlash with the engine's drive gear is either too tight (creating tooth interference) or has an incorrect gear mesh that produces the speed-proportional knocking noise during operation

43. A truck's brake proportioning system delivers 60% of the total braking force to the rear drive axle and 40% to the front steer axle during normal braking on a loaded vehicle. When the vehicle is empty, this proportioning creates a condition where the rear wheels lock up during moderate braking. What does this indicate?

A. The proportioning system is fixed (non-adjustable) and does not account for the vehicle's weight change between loaded and empty — a load-sensing proportioning valve is needed to reduce rear brake pressure when empty

B. The proportioning system is functioning correctly for the loaded condition but the fixed proportioning ratio overapplies the rear brakes when the vehicle is empty and the rear axle has significantly less weight for traction

C. The ABS system should prevent the rear lockup regardless of the proportioning ratio and the rear wheel lockup indicates the ABS system has a fault that prevents it from modulating the rear axle pressure during braking

D. The proportioning system's fixed 60/40 ratio is incorrect for this vehicle's weight distribution — the rear axle brakes are oversized for the application and the proportioning should be redesigned to a 50/50 distribution

44. A truck's front air disc brake caliper has been replaced. During the post-service road test, the technician notices the brake pedal pulsates during every stop. The pulsation was not present before the caliper replacement. What installation-related condition could cause this new pulsation?

A. The caliper mounting bracket bolts were not torqued to specification and the caliper shifts on its bracket during each application creating an intermittent contact between the pads and rotor that produces the pulsation

B. The caliper was installed with the bleeder screw at the bottom of the bore instead of the top trapping air in the upper portion of the caliper bore — the trapped air compresses during each application creating the pulsation

C. The replacement caliper's piston has a different diameter than the original which changes the mechanical advantage and the altered force characteristic produces a pulsation from the uneven pressure distribution

D. Debris or corrosion on the caliper mounting surface prevents the caliper from sitting flush on the bracket — the cocked caliper holds one pad against the rotor creating a once-per-revolution contact that produces pulsation

45. A truck's air system has adequate pressure but the governor cycles rapidly between loaded and unloaded states — approximately every 5 seconds. There are no air leaks. The governor cut-in and cut-out pressures are within specification. What is the most likely cause?

A. The air compressor has excessive piston blow-by that allows compressed air to leak past the pistons back to the intake during the loaded phase reducing the net output and causing the system to reach cut-out more slowly

B. The governor signal line has a restriction that delays the pressure signal from the air system to the governor — by the time the governor reads cut-out pressure the actual system has already dropped back to cut-in triggering a rapid reload

C. The supply tank volume is too small for the system's air consumption rate — the limited volume cycles through the cut-in to cut-out range quickly and any air consumption immediately drops the pressure back to cut-in

D. The air dryer purge valve is stuck partially open bleeding air from the system continuously and the compressor must cycle frequently to replenish the air lost through the leaking purge valve at a rate matching the 5-second cycle

46. A loaded tractor-trailer is descending a long mountain grade. The driver uses a combination of engine retarder and intermittent service brake applications to control speed. After 10 km of descent, the driver notices that the brake pedal must be pressed further to achieve the same braking effect. What is happening?

A. The brake drums have expanded from heat causing the brake shoes to be further from the drum surface requiring additional pushrod stroke to bring the linings into contact — this is the beginning of brake fade from drum expansion

B. The air system pressure has dropped from the repeated brake applications faster than the compressor can recover creating a gradual decline in the available application pressure at the brake chambers during the descent

C. The brake lining friction coefficient has decreased from the elevated temperature and the reduced friction requires more application force to achieve the same deceleration — this is the beginning of friction-based brake fade

D. The automatic slack adjusters have over-compensated for the heat-expanded drums and when the drums cool after the descent the brakes will be over-adjusted and drag until the adjusters release the excess adjustment

47. A truck's engine ECM stores both active and inactive fault codes. The technician clears all codes and drives the vehicle for 50 km. Three inactive codes return but no active codes are present. What do the returning inactive codes indicate?

A. The faults that set the codes occurred during the pre-clearing driving but the conditions that caused them have resolved — the ECM records them as inactive because the fault is no longer present during the current drive cycle

B. The codes are phantom codes generated by the ECM's self-diagnostic software during the code-clearing process and will clear themselves after three additional drive cycles without any action required from the technician

C. The returning inactive codes indicate an intermittent fault that occurred during the 50 km drive but resolved before the drive ended — the ECM recorded the event as inactive because the fault was not present at the end of the trip

D. The ECM is retrieving the codes from a backup memory location that was not cleared during the initial code-clearing procedure and the technician must perform an enhanced clearing protocol to erase all backup code storage

48. A truck's alternator produces a whining noise that changes pitch with engine RPM. The alternator output voltage and current are within specification. The drive belt is tight and aligned correctly. What internal alternator component is the most common source of this speed-proportional whine?

A. The rotor's field coil winding insulation has partially failed and the resulting short between adjacent turns creates an electromagnetic vibration that produces the speed-proportional whining noise from the field assembly

B. The alternator's front or rear bearing is beginning to fail — the worn bearing surfaces produce a whine proportional to shaft speed that precedes the eventual seizure and complete failure of the bearing assembly

C. The voltage regulator is cycling the field current at a frequency proportional to engine RPM creating an electromagnetic pulsation in the rotor that transmits as an audible whine through the alternator housing structure

D. The stator winding has developed a partial short between phases that creates an asymmetric magnetic field which produces a tonal vibration proportional to the rotor speed from the unequal magnetic force distribution

49. A truck equipped with a multiplexed body electrical system has all exterior lighting controlled by the body controller. The right-side clearance lamps do not illuminate when the light switch is turned on. All other exterior lamps work correctly. What should be checked first?

A. The light switch internal contacts for a partial failure that sends the command for all lamps except the right clearance group because the switch has separate internal contact sets for each lamp group

B. The body controller's output fuse for the right clearance lamp circuit because multiplexed systems still use individual fuses on the high-current output circuits between the controller and the lamp groups

C. The body controller for a failed output driver on the right clearance channel — a semiconductor output driver failure on a specific channel disables only that circuit while all other controller outputs function normally

D. The CAN bus communication between the light switch module and the body controller for a data error that corrupts the right clearance lamp command while all other lamp commands transmit correctly through the bus

50. A truck's scan tool shows the engine oil temperature at 135°C during normal highway driving. The specification maximum is 120°C. The engine oil level is correct and the oil appears clean. What is the most probable cause of the elevated oil temperature?

A. The engine oil cooler has reduced efficiency from internal fouling, external fin damage, or restricted coolant flow through the cooler — the oil absorbs engine heat but the cooler cannot reject it adequately

B. The oil temperature sensor has drifted from its calibration and is reading 15°C higher than the actual temperature — the engine's oil cooler and cooling system are functioning correctly at the normal operating range

C. The engine is producing more internal friction than normal from worn bearing surfaces and the additional friction heat raises the oil temperature above the maximum specification during sustained highway operation

D. The engine's cooling fan is not engaging at the correct temperature and the reduced airflow across the oil cooler mounted in front of the radiator limits the cooler's heat rejection during highway driving operation

51. A truck's engine ECM has set a fault code for the turbocharger speed sensor — SPN 103, FMI 0 (data above normal). The engine is derated. What condition would cause the turbocharger shaft speed to exceed the ECM's maximum threshold?

A. The VGT actuator has failed in a partially closed position and the restricted vane opening concentrates exhaust energy on the turbine wheel accelerating the shaft beyond the designed maximum safe operating speed

B. The compressor inlet has a restriction from a collapsed air intake hose that reduces the aerodynamic load on the compressor wheel allowing the turbine to accelerate the shaft beyond the maximum speed limit

C. The wastegate actuator has failed in the closed position preventing any exhaust gas from bypassing the turbine and all exhaust energy drives the turbine beyond the maximum speed causing the overspeed fault

D. The VGT vanes are stuck in a position that accelerates the exhaust gas velocity beyond the turbine wheel's designed intake rate which drives the shaft speed above the maximum allowed RPM setting in the ECM calibration

52. A truck's battery disconnect switch has been turned off overnight. In the morning, the driver turns the switch on and attempts to start the engine. The engine cranks very slowly and barely starts. The batteries tested fully charged before the disconnect switch was turned off the previous evening. What happened overnight?

A. The disconnect switch has developed high internal resistance from corrosion and arcing damage that creates a significant voltage drop under the heavy cranking current even though the batteries maintain their charge

B. The batteries self-discharged overnight from internal chemical reactions that occur regardless of whether the external circuit is open — older batteries have higher self-discharge rates that drain measurable capacity in 12 hours

C. The engine oil has thickened from the overnight cold soak and the increased cranking resistance combined with the batteries' reduced cold-cranking capacity at the lower temperature produces the slow cranking speed

D. The ECM lost its adaptive fuel delivery parameters when the disconnect switch opened and the default cold-start fuelling strategy delivers less fuel than the learned strategy creating the difficult starting condition

53. A truck's trailer ABS system uses PLC (power line communication) to transmit diagnostic data from the trailer ABS module to the tractor's diagnostic connector. The tractor's scan tool can communicate with all tractor modules but cannot connect to the trailer ABS. What is the most common cause of PLC communication failure?

A. The trailer ABS module's PLC transmitter has failed internally while the core ABS braking functions continue to operate normally because the PLC circuit is independent of the braking control circuits

B. The seven-pin trailer connector has a poor connection on the ABS power pin (pin 7) that passes enough power to operate the ABS module but the high-resistance connection attenuates the PLC data signal below the detection threshold

C. The PLC protocol used by the trailer ABS manufacturer is different from the tractor's scan tool communication protocol and a PLC adapter must be connected between the scan tool and the diagnostic connector for translation

D. The tractor's wiring harness from the diagnostic connector to the seven-pin trailer connector has been replaced with non-shielded wire that cannot carry the high-frequency PLC data signal from the trailer to the diagnostic connector

54. A truck's headlamps are aimed correctly per specification but the driver complains of poor nighttime visibility compared to other identical trucks in the fleet. The headlamp lenses are clean and undamaged. The bulbs are the correct specification. What should the technician check?

A. The headlamp reflector surfaces for oxidation, cloudiness, or delamination that reduces their reflective efficiency — degraded reflectors scatter light rather than focusing it into the designed beam pattern reducing road illumination

B. The alternator's regulated voltage output during headlamp operation because a charging system producing 13.0 volts instead of 14.2 volts reduces the headlamp filament temperature and dims the output by approximately 30%

C. The headlamp wiring for voltage drop under load because excessive resistance in the headlamp circuit reduces the voltage at the bulbs — even 1 volt of drop reduces a halogen bulb's light output by approximately 15-20%

D. The headlamp housing for moisture intrusion that has fogged the inner lens surface — the fog diffuses the light beam reducing the focused road illumination while the outer lens appears clean and undamaged externally

55. A truck has an intermittent no-start condition that occurs approximately once per week. When the condition occurs, the engine does not crank — there is no click from the starter solenoid and no dash lamp dimming. Turning the key off and back on resolves the condition and the engine starts normally. What is the most likely cause?

A. The ignition switch has a worn contact that intermittently fails to complete the start circuit — cycling the key off and on repositions the contact enough to make the connection for the subsequent start attempt

B. The starter solenoid has an intermittent internal contact fault that prevents the solenoid from engaging when the start signal is received from the ignition switch during the failed start attempt occasions

C. The neutral safety switch (or clutch interlock switch) has an intermittent contact that occasionally fails to complete the start circuit — recycling the key changes the switch's contact position enough to close the circuit

D. The start relay has an intermittent coil or contact fault that prevents the relay from energizing when the ignition switch sends the start command and cycling the key resets the relay's internal contact alignment

56. A truck's engine ECM has been reflashed with an updated calibration. After the reflash, the engine idles 50 RPM higher than before the update. The driver has not changed any idle speed settings. What is the most likely explanation?

A. The reflash process corrupted the ECM's idle speed learn data and the ECM is operating on its default idle speed setting which is slightly higher than the previously learned idle speed from the pre-reflash calibration

B. The updated calibration has a different base idle speed specification than the previous calibration — the engine manufacturer may have increased the idle speed in the updated calibration for emissions or durability reasons

C. The updated calibration has changed the idle speed parameter to accommodate a revised emission control strategy that requires a slightly higher idle RPM for adequate aftertreatment temperature maintenance during idling

D. The ECM's idle speed learn procedure must be performed after any reflash to re-establish the correct idle speed — the default idle in the new calibration is a starting point that the learn procedure adjusts to the specified RPM

57. A truck equipped with LED tail lamps draws 3 amps on the tail lamp circuit. The original incandescent tail lamps drew 12 amps on the same circuit. The tail lamp fuse is rated at 15 amps. Should the fuse be changed to match the reduced LED load?

A. No — the 15-amp fuse protects the wiring which is rated for 15 amps and the fuse should remain to protect the wiring from a potential short circuit that could exceed the wire's current capacity regardless of the lamp load

B. Yes — the fuse should be reduced to 5 amps to match the LED load because a 15-amp fuse would allow 12 amps of fault current to flow through the LED circuit before blowing which could damage the LED driver circuits

C. No — the fuse rating should always exceed the circuit load by at least 200% to prevent nuisance fuse blowing from transient current spikes that occur during the LED driver's initial startup power-on sequence

D. Yes — the fuse should be reduced to 7.5 amps because the large gap between the 3-amp load and the 15-amp fuse allows a significant wiring fault to develop without blowing the fuse until the damage is extensive

58. A truck's CAN bus has two terminating resistors — one at each end of the bus backbone. Each resistor is 120 ohms. The combined parallel resistance should read 60 ohms. The technician measures 120 ohms between CAN-H and CAN-L with the ignition off. What does this indicate?

A. One module containing a terminating resistor has been disconnected from the bus — with only one 120-ohm resistor remaining in the circuit the measured value is 120 ohms instead of the normal 60-ohm parallel combination

B. Both terminating resistors are present and functioning correctly — the 120-ohm reading indicates the resistors are in series rather than parallel which is the correct configuration for J1939 CAN bus termination networks

C. The CAN bus has a short circuit between CAN-H and CAN-L that is adding a parallel resistance path alongside the two terminating resistors shifting the measured value from 60 to 120 ohms at the test point

D. One of the two 120-ohm terminating resistors has failed open — only one resistor remains in the circuit and the measured resistance reads the single remaining 120-ohm resistor instead of the two-resistor parallel combination

59. A truck's dash-mounted voltmeter reads 12.2 volts with the engine running at idle. The specification for a properly charging 12-volt system is 13.8 to 14.5 volts. What should the technician check first?

A. The battery for a dead cell that is pulling the system voltage down to 12.2 volts despite the alternator producing adequate output voltage at its B+ terminal during the idle operating condition

B. The alternator output at the B+ terminal — if the alternator produces 14.2 volts at B+ the fault is in the charging circuit between the alternator and the battery and the voltage drop must be located in that path

C. The alternator drive belt for slippage at idle that prevents the alternator from reaching sufficient RPM to produce its rated output — a belt that drives adequately at higher RPM may slip at the lower idle speed

D. The battery cable connections for corrosion that creates a voltage drop between the alternator and the battery preventing the full charging voltage from reaching the battery terminals during the idle charging condition

60. A truck's engine ECM receives two separate coolant temperature inputs — one from the ECM sensor and one from the instrument cluster sender. The scan tool shows the ECM sensor reading 85°C while the dash gauge shows approximately 95°C. Which sensor reading should the technician trust for diagnostic purposes?

A. The dash gauge reading of 95°C because the gauge sender is closer to the thermostat housing and reads the hottest coolant temperature before it is diluted by the cooler return from the radiator at the ECM sensor location

B. The scan tool reading of 85°C from the ECM sensor because the scan tool displays the exact digital value from the sensor while the dash gauge is an analog display that can have significant pointer accuracy error

C. Neither reading should be trusted until an independent temperature measurement (infrared thermometer or thermocouple) verifies the actual coolant temperature at both sensor locations to determine which reading is accurate

D. Both readings may be correct — the 10°C difference can be explained by the sensors being at different locations in the cooling circuit where the coolant temperatures genuinely differ from the flow pattern through the system

61. A truck's charging system has been tested and the alternator produces full rated output at the B+ terminal. However, the batteries are consistently undercharged — the specific gravity never reaches full-charge level. The charging cable and connections have been tested and the voltage drop is within specification. What should be investigated?

A. The vehicle's total electrical load to verify it does not exceed the alternator's sustained output capacity — if the accessories and parasitic loads consume more current than the alternator produces the batteries never fully recharge

B. The alternator's voltage regulator set-point for a value that is at the low end of the specification range — a regulator set at 13.6V instead of 14.2V reduces the charging rate to the point where the batteries never reach full charge

C. The battery temperature sensor for a false high-temperature reading that commands the voltage regulator to reduce the charging voltage below the level needed for the batteries to reach full charge during normal driving

D. The batteries themselves for a condition that prevents them from accepting a full charge — sulfated plates from chronic undercharging, a failed cell, or excessive internal resistance limits the charge acceptance rate

62. A truck's multiplexed wiring system has the headlamps controlled by the body controller. The right low-beam headlamp has failed. The technician replaces the bulb but the lamp still does not illuminate. The fuse for the right low-beam circuit is good. What should be checked next?

A. The left low-beam circuit to verify it is functioning through the body controller — if the left works but the right does not with a new bulb and good fuse the body controller's right output driver circuit must be tested

B. The headlamp switch for a failed internal contact on the right low-beam output because some multiplexed systems use the switch as both a CAN bus input device and a direct power distribution point for the lamp circuits

C. The body controller's CAN bus input for the headlamp switch signal to verify the controller is receiving the lamp-on command — a corrupted CAN message could prevent the controller from activating the right output

D. The body controller's output driver for the right low-beam headlamp — the new bulb and good fuse confirm the lamp and circuit protection are functioning and the controller's internal driver is the remaining failure point

63. A truck's scan tool shows the throttle position sensor (TPS) reading 4.8 volts with the accelerator pedal fully released. The specification for the closed-throttle position is 0.5 to 0.8 volts. What fault condition produces this near-maximum voltage reading at the closed-throttle position?

A. The TPS signal wire has a short to the 5-volt reference circuit which drives the signal to near-reference voltage regardless of the actual pedal position creating a false full-throttle reading when the pedal is released

B. The TPS potentiometer element has failed in the high-resistance position and the minimal current flow through the high-resistance element produces the near-5-volt reading at the ECM's signal input circuit

C. The accelerator pedal return spring has broken and the pedal mechanism is stuck at the near-full-throttle position — the TPS is accurately reading the actual pedal position which is mechanically stuck near maximum

D. The ECM's internal pull-down resistor on the TPS input has failed open and the signal floats to the reference voltage level because the pull-down resistor can no longer hold the signal at the designed voltage range

64. A truck equipped with an electronic instrument cluster has all gauges reading zero even though the engine is running normally. The warning lamps illuminate correctly during the key-on bulb test. What is the most likely cause?

A. The cluster's internal power supply has failed and the gauges are not receiving the operating voltage needed to drive the stepper motors while the warning lamps operate on a separate power circuit that remains functional

B. The instrument cluster has lost its CAN bus connection to the engine ECM and cannot receive the engine data needed to drive the gauges — the warning lamps operate on direct hardwired circuits independently of the CAN bus

C. The cluster's CAN bus communication has failed — the gauges require live data from the engine ECM through the CAN bus to display readings while the warning lamps may operate on direct hardwired inputs independently

D. The cluster's internal gauge driver circuit board has failed while the lamp driver board remains functional — the two functions operate on separate internal circuit boards and one can fail independently of the other

65. A truck's starter motor draws the correct current during cranking (220 amps vs 200-250 amp specification) and the engine cranks at normal speed. However, the engine will not start. The scan tool shows fuel rail pressure at 0 bar during cranking even though the ECM commands injection. What should be checked?

A. The fuel system from the tank to the high-pressure pump — the priming pump, fuel filter, fuel supply lines, and the high-pressure pump's mechanical drive for a failure that prevents fuel delivery to the rail during cranking

B. The camshaft position sensor because the ECM may show it is commanding injection but without a valid cam signal the ECM does not know which cylinder to fire and the fuel delivery is not actually occurring despite the command

C. The crankshaft position sensor because the ECM needs this signal to determine engine position and speed — without a valid signal the ECM may display a command but cannot execute the actual injection timing correctly

D. The glow plug system because inadequate preheat prevents the diesel fuel from auto-igniting even though the fuel is being delivered to the combustion chambers at the correct pressure and timing during the cranking event

66. A truck's body controller has a diagnostic trouble code for an internal communication error between the controller's main processor and its output driver stage. The controller has been replaced with a new unit programmed for the vehicle. The code returns within 1 km of driving. What should the technician check?

A. The body controller's power supply for voltage fluctuations that disrupt the internal communication between the processor and the driver stage — a noisy power supply can cause the internal communication to fault intermittently

B. The body controller's ground connection for excessive resistance that creates a voltage offset between the processor ground reference and the output driver ground reference which the controller reports as a communication error

C. The body controller's mounting location for excessive vibration that disrupts the internal connections between the processor board and the driver board through the connector that links the two internal circuit assemblies

D. The body controller's power and ground circuits — a new controller that sets the same internal communication fault immediately suggests an external power supply or ground issue that affects the controller's internal operation

67. A truck's engine ECM has set a fault code for the accelerator pedal position sensor #2 (redundant sensor) — SPN 29, FMI 4 (voltage below normal). Sensor #1 reads correctly and the engine operates normally on the primary sensor alone. What does the failure of the redundant sensor affect?

A. The engine continues to operate normally on sensor #1 alone but the loss of the redundant sensor means the ECM cannot verify the primary sensor's accuracy and may limit the maximum engine power as a precautionary derate

B. The engine operates normally at all speeds but the cruise control function is disabled because the ECM requires both sensor inputs to verify the pedal position before allowing cruise control to maintain speed automatically

C. The engine power is immediately cut to 50% because the ECM's safety strategy requires both sensor signals to agree before allowing full engine power — single-sensor operation defaults to a half-power limp mode

D. The engine operates at full power with sensor #1 but the ECM has lost its ability to detect a failure of the primary sensor — if sensor #1 also fails the engine may not respond to the pedal or may default to idle-only operation

68. A truck's LED headlamp assembly has been replaced after collision damage. The new headlamp illuminates but produces a noticeably different beam pattern than the undamaged headlamp on the opposite side — the beam is lower and wider. The headlamp aim has been verified as correct. What is the most likely cause?

A. The replacement headlamp is a different manufacturer's product with a different optical design than the OEM headlamp — even at the correct aim the different reflector and lens geometry produces a different beam pattern on the road

B. The replacement headlamp was manufactured for a different market (left-hand traffic vs right-hand traffic) and the beam pattern is designed to illuminate the opposite side of the road from the vehicle specification

C. The headlamp's internal LED array has a different color temperature than the original which changes the beam's perceived width and throw distance even though the physical beam pattern is identical to the original unit

D. The headlamp mounting bracket was bent during the collision and even though the aim appears correct at the adjustment screws the bracket positions the lamp at a different angle than the undamaged mounting geometry

69. A truck's manual transmission produces a growling noise in all gears except 4th gear (which is the direct-drive ratio — 1:1). The noise is proportional to vehicle speed in all affected gears. What does the absence of noise in direct drive indicate about the noise source?

A. The noise originates from the input shaft bearing because in direct drive the input and output shafts are locked together and the input shaft bearing is unloaded — in all other gears the bearing carries the gear mesh loads

B. The noise is from worn synchronizer blocking rings that produce friction noise when they contact the gear cones during gear-engaged operation — in direct drive no synchronizer is loaded because the shafts are locked

C. The noise originates from the countershaft or its bearings — in direct drive the power path bypasses the countershaft entirely and goes straight from input to output, so the countershaft is unloaded and produces no noise

D. The noise is from the output shaft bearing which is loaded differently in direct drive than in all other ratios — the absence of gear mesh forces in direct drive changes the bearing's load vector and eliminates the noise

70. A truck equipped with an Allison automatic transmission produces a harsh bump when the transmission is shifted from Neutral to Drive at idle. All shifts during driving are smooth. The fluid level is correct. What is the most probable cause?

A. The engine idle speed is too high creating a greater speed differential between the stalled turbine and the spinning impeller — when the forward clutch engages the larger speed differential produces the harsh bump

B. The forward clutch pack has a weak return spring that does not fully release the clutch during neutral — when Drive is selected the clutch re-engages with a partial drag condition that produces the bump from the collision

C. The valve body has a worn pressure regulator bore that allows a momentary pressure spike when the shift valve directs fluid to the forward clutch circuit creating an aggressive engagement from the excessive apply force

D. The torque converter has a ballooned impeller from overheating that has reduced the converter's internal clearance and the restricted fluid path creates a harsh engagement when the turbine suddenly receives fluid drive force

71. A truck's driveshaft has been removed for U-joint replacement. The technician marks the driveshaft's orientation to the yokes before removal. Why is it important to reinstall the driveshaft in the same orientation?

A. The driveshaft balance weights are positioned relative to the specific yoke orientation and rotating the shaft on the yokes changes the balance relationship creating a vibration that was not present before the removal

B. The U-joint bearing caps wear a pattern specific to their original orientation and reinstalling them in a different rotational position changes the load pattern creating accelerated bearing wear from the altered contact surface

C. The slip yoke splines develop a wear pattern that matches the transmission output shaft spline pattern and rotating the shaft changes the spline contact from worn-to-worn to worn-to-unworn creating a loose fit

D. The driveshaft was balanced as an assembly including the yoke positions — reinstalling the shaft in a different orientation changes the rotational mass distribution relative to the yokes and introduces a potential vibration

72. A truck's clutch pedal has adequate free play and the clutch engages and disengages correctly. However, the driver reports a vibration in the clutch pedal that is present only when the pedal is in the fully released position. The vibration disappears when the pedal is depressed even slightly (5 mm). What is the most likely cause?

A. The clutch disc damper springs are resonating at the engine idle frequency and the vibration transmits through the release bearing contact to the clutch fork and pedal when the bearing is in light contact with the fingers

B. The release bearing is in slight contact with the pressure plate finger tips at the fully released position and the rotating fingers transmit their vibration through the bearing to the fork and pedal linkage

C. The flywheel has excessive runout that pushes the pressure plate fingers toward and away from the release bearing once per revolution transmitting the oscillation through the linkage to the pedal at the release position

D. The engine's firing impulses transmit through the transmission input shaft to the clutch fork pivot and then to the pedal — pressing the pedal loads the fork pivot bushing which dampens the vibration transmission

73. A truck's drive axle differential has been drained for service. The drained oil is dark and has a strong burnt odour. The oil was changed 30,000 km ago with the correct specification lubricant. What does the dark colour and burnt smell indicate?

A. The differential has been operating at temperatures above the lubricant's designed capacity — the oil has thermally degraded from sustained high-temperature operation which has broken down the base oil and additive package

B. The limited-slip clutch pack additive in the lubricant has depleted from normal operation and the breakdown products have darkened the oil and produced the burnt odour from the chemical decomposition of the additive

C. The ring and pinion gear teeth have been scuffing from inadequate lubrication and the metal-to-metal contact has generated heat and metallic particles that have darkened the oil and produced the burnt odour

D. The axle breather vent has been blocked and the internal pressure has raised the oil temperature above normal during every driving cycle for the past 30,000 km causing the progressive thermal degradation of the lubricant

74. A truck equipped with a 13-speed manual transmission has difficulty shifting from 12th gear (overdrive low range) to 13th gear (overdrive high range). The range shift requires a combined main box shift and a range section shift. All other shifts including other range changes work correctly. What is the specific area of concern?

A. The main box synchronizer for the 12th-to-13th shift position has worn because this shift is the most frequently used range change on highway trucks and the synchronizer has accumulated more wear cycles than any other

B. The shift linkage has a worn bushing at the range shift connection that introduces excessive play specifically at the mechanical position required for the 12th-to-13th compound shift but not at other shift positions

C. The range air cylinder response time is marginally slow and the 12th-to-13th shift requires the most precise timing between the main box shift and range shift — the slow cylinder cannot complete the shift in the available window

D. The auxiliary section synchronizer in the range unit has worn specifically on the high-range side and cannot match the speed differential required for the overdrive-to-overdrive range change at the highway speeds where this shift occurs

75. A truck's automatic transmission torque converter is being stall-tested. During the test, the technician holds the brake pedal firmly and applies full throttle. The engine RPM stabilizes at the stall speed but the truck begins to creep forward against the applied brakes. What does this indicate?

A. The brakes are not providing adequate holding force for the stall test — the converter is developing more torque multiplication than the brakes can resist and the brakes need to be inspected for adequate stopping capacity

B. The stall speed is being exceeded and the torque converter's torque multiplication at stall creates more force at the drive wheels than the service brakes can hold — this is a normal condition indicating the converter is functioning correctly

C. The torque converter has an internal fault that allows the turbine to transfer torque to the output at a rate higher than the stall specification and the excess torque overcomes the brake holding force during the test

D. The converter's stator one-way clutch has locked in both directions rather than freewheeling in the overrun direction — the bidirectional lock creates a direct mechanical connection that produces more torque than the brakes can hold

76. A truck's driveshaft centre bearing has been replaced. After the replacement, the technician notices that the driveshaft operating angle between the transmission output and the first U-joint has changed from 2 degrees to 5 degrees. What should be adjusted?

- A. The transmission mount height using shims to tilt the transmission output flange downward which changes the operating angle at the first U-joint back toward the original 2-degree specification
- B. The driveshaft tube length by having the shaft shortened to change the geometry between the transmission and the centre bearing which indirectly affects the first U-joint's operating angle at the front
- C. The engine mount height to tilt the entire powertrain assembly downward which changes the transmission output angle and reduces the first U-joint's operating angle from 5 degrees back to the designed 2 degrees
- D. The new centre bearing bracket mounting height by adding or removing shims at the frame cross-member to restore the correct driveshaft slope and return the first U-joint's operating angle to the designed specification

77. A truck equipped with a hydraulic retarder has the retarder functioning correctly during descents but the driver reports that the retarder's effectiveness has decreased noticeably over the past month. The retarder fluid level is correct. What should be checked?

- A. The retarder's heat exchanger for restricted coolant flow or internal fouling that reduces the cooler's ability to reject the heat generated during retarder operation — reduced cooling directly reduces the retarder's sustained effectiveness
- B. The retarder's internal stator vanes for erosion that changes the fluid dynamics inside the retarder housing and reduces the rotor's ability to convert kinetic energy to heat effectively during the retarding operation
- C. The engine coolant temperature because the retarder shares the engine cooling circuit and if the engine thermostat has failed in the partially open position the reduced coolant temperature affects the retarder's heat rejection capacity
- D. The retarder control valve for a calibration drift that reduces the fill level inside the retarder housing below the designed level during operation — less fluid in the retarder means less resistance to the rotor and reduced braking force

78. A truck's clutch disc has been replaced. During the first road test, the technician notices a vibration during clutch engagement that was not present before the replacement. The vibration occurs during the transition from fully disengaged to fully engaged and disappears once the clutch is fully clamped. What should be checked?

A. The new clutch disc for a manufacturing defect — a disc with excessive runout from a warped hub or uneven friction material produces a vibration during the engagement transition when partial clamping amplifies the runout

B. The flywheel surface for glazing or heat spots that should have been machined before the new disc was installed — the uneven flywheel surface creates intermittent contact during engagement producing the vibration

C. The flywheel and pressure plate surfaces for condition — a new disc installed against glazed, hot-spotted, or unevenly worn surfaces will not make full contact during engagement and the intermittent contact produces vibration

D. The pressure plate's diaphragm spring finger heights for uniformity — uneven finger heights from wear produce a pulsating clamping force during the engagement transition that vibrates the disc against the flywheel surface

79. A truck's drive axle makes a clicking noise at low speed during tight turns. The noise comes from the differential area. The axle lubricant level is correct and the lubricant type is correct for the limited-slip differential. What is the most likely cause?

A. The ring gear bolts have loosened and the ring gear shifts slightly on the carrier during the high-torque differential action of tight turns producing the clicking noise as the gear moves against the carrier surface

B. The differential spider gear thrust washers have worn and the spider gears shift on the cross shaft during the differential action required for tight turns — each shift produces a click as the gear repositions on the worn surfaces

C. The limited-slip clutch pack has worn and the clutch plates engage and disengage in a rapid alternating pattern during the tight turn's speed differential creating the clicking noise from the individual clutch engagement events

D. The axle shaft C-clips have developed excessive play in their grooves and the shafts shift axially during tight turns as the differential side gears thrust outward — each shift produces a click as the C-clip contacts the groove wall

80. A truck equipped with an automated manual transmission (AMT) has a fault code for "clutch slip detected during 5th gear full-load operation." The AMT has automatically limited the maximum torque available in 5th gear. What is the AMT controller protecting?

A. The transmission gears from damage because excessive torque through a slipping clutch produces torsional shock waves that can break gear teeth when the clutch alternately grips and releases under full engine torque

B. The clutch from accelerated wear because the slipping converts engine torque energy to heat at the friction surfaces — continued full-torque operation through a slipping clutch will rapidly destroy the remaining friction material

C. The engine from damage because the clutch slip creates a resonance in the driveline that feeds back through the crankshaft as a torsional vibration that can fatigue the crankshaft journals and bearing surfaces

D. The clutch from further damage by reducing the torque applied through the slipping friction surfaces — the reduced torque decreases the heat generated at the clutch and extends the remaining service life until replacement

81. A truck's transfer case has a complaint of a grinding noise that occurs only when the vehicle is in four-wheel drive and making a tight turn on dry pavement. The noise is not present during straight-line driving in 4WD or during any two-wheel drive operation. What is causing the noise?

A. The front and rear axles are forced to turn at the same speed in 4WD but during a tight turn the front wheels must travel further than the rear — the speed difference creates driveline windup that manifests as grinding during tight turns

B. The transfer case range synchronizer is partially engaging during tight turns from the torsional loading of the driveline windup condition and the synchronizer friction produces the grinding noise at the synchronizer contact surfaces

C. The front axle differential has insufficient lubricant that only becomes apparent during the high-torque differential action of tight turns in 4WD when the spider gears must rotate at their maximum speed to accommodate the turn

D. The transfer case's internal chain or gear set is being loaded beyond its design capacity during tight turns because the driveline windup creates a torsional stress that exceeds the chain's or gears' maximum load rating

82. A truck's automatic transmission shifts normally in all gears during light to moderate throttle application. However, under heavy throttle (wide-open throttle), the transmission delays the upshift significantly — the engine reaches near-maximum RPM before shifting. Is this normal?

A. The delayed shift under heavy throttle is by design — the transmission's shift schedule holds lower gears longer under heavy load to maximize engine torque delivery for acceleration before shifting to the next higher ratio

B. The throttle position sensor has a calibration error that sends a lower-than-actual signal to the TCM and the controller's shift logic interprets the signal as a request for delayed shifts to match the perceived lighter throttle input

C. The governor pressure is too high for the current vehicle speed creating a shift delay that the driver perceives as delayed under heavy throttle but is actually delayed at all throttle positions due to the governor pressure error

D. The transmission modulator valve has a vacuum leak that sends a false heavy-load signal to the shift valve regardless of the actual throttle position creating the delayed shift perception during all heavy throttle acceleration

83. A truck's driveshaft has a two-piece design with a slip yoke at the transmission end. The slip yoke has developed a clunking noise during acceleration and deceleration transitions. The U-joints are tight. What should be inspected?

A. The slip yoke splines for excessive wear that allows rotational free play between the yoke and the transmission output shaft — the worn splines take up and release during torque reversals producing the clunk

B. The centre bearing rubber mount for deterioration that allows the bearing assembly to shift during torque direction changes creating the clunking noise from the bearing impacting its mounting bracket during each reversal

C. The transmission output shaft bearing for excessive play that allows the shaft to shift axially during torque reversals which moves the slip yoke in its bore creating the clunking noise at each transition point

D. The slip yoke splines and dust boot for wear and damage — worn splines allow rotational movement during torque reversals and a damaged boot allows contamination that accelerates the spline wear creating the progressive clunk

84. A truck's drive axle has been rebuilt with a new ring gear. The old pinion was reused because it appeared unworn. After 5,000 km, the drive axle produces a howling noise during highway cruise. What is the most likely cause?

A. The old pinion's tooth profile has worn to match the old ring gear and the mismatch between the worn pinion and the new ring gear creates an incorrect gear mesh pattern that produces the howling noise under load

B. The ring gear backlash was set at the nominal specification without accounting for the used pinion's worn tooth profile that requires a slightly different backlash setting than a new matched gear set would use

C. The carrier bearings were not replaced with the ring gear and the bearing preload has changed from the different ring gear's weight distribution creating a bearing load that shifts the gear mesh during highway cruise

D. The differential lubricant is the incorrect specification for the new ring gear material and the chemical incompatibility between the lubricant and the gear surface creates excessive friction noise during the highway cruise load

85. A truck equipped with a compression brake has a complaint that the brake produces adequate retarding force at high RPM but very little retarding at low RPM. The compression brake is adjusted to the OEM specification. What is the most likely cause?

A. The engine oil pressure at low RPM is too low to fully actuate the slave pistons that hold the exhaust valves open — at higher RPM the increased oil pressure provides adequate force for full slave piston actuation

B. The compression brake is designed to produce increasing retarding force with increasing RPM because the number of compression events per second increases proportionally — reduced retarding at low RPM is the normal characteristic

C. The engine's exhaust valves have carbon buildup that prevents them from opening fully during the compression brake event at low RPM when the valve actuating force from the slave piston and oil pressure is at its minimum

D. The exhaust brake butterfly valve is not fully closing at low RPM because the actuator's air supply is reduced at low engine speed — the partially open butterfly reduces the exhaust restriction needed for effective compression braking

86. A truck's power steering system produces a whine during turns but is quiet during straight-ahead driving. The fluid level is correct. During straight driving, the technician places a hand on the power steering pump and feels no unusual vibration. What is the most probable cause?

- A. The power steering pump is producing the whine only under the loaded condition of turning — the pump's internal vanes, cam ring, or pressure plates have worn and produce noise when the flow demand increases during turns
- B. The steering gearbox has an internal restriction in the pressure port that creates turbulence and noise when the increased flow demand of turning forces more fluid through the restricted passage at higher velocity
- C. The power steering hoses have a section of internal liner delamination that flutters under the increased flow velocity during turns creating the whining noise that is not present during the low-flow straight-ahead condition
- D. The power steering pump drive belt is at the lower limit of the tension specification and slips during the increased load of turning creating a squeal that the driver perceives as a whine from the pump area

87. A truck's steer axle has had the king pins replaced. After the replacement, the technician performs a wheel alignment. The camber on one side reads outside the specification and cannot be adjusted into range. What could cause this condition after a king pin replacement?

- A. The replacement king pin has a slightly different diameter than the original and the diameter difference changes the knuckle's position on the axle beam which shifts the camber angle beyond the adjustable range
- B. The new king pin bushings were not reamed to the correct diameter after installation and the tight bushings are holding the knuckle in a position that shifts the camber from the designed geometry of the axle and knuckle
- C. The king pin bore in the axle beam has worn from the previous king pin's long service and the enlarged bore allows the new king pin to sit at a different angle than designed which changes the camber beyond the adjustable range
- D. The steer axle beam has a bend or twist from a previous impact event that was compensated by the worn king pin bushings — the new tight bushings cannot compensate for the bent beam and the true camber error is now revealed

88. A trailer's air ride suspension has been operating normally but the driver reports that the ride has become progressively harsher over the past 6 months. The air pressure is correct, the ride height is correct, and the air bags appear in good condition. What should be investigated?

A. The air bag rubber compound has hardened from ozone and UV exposure changing the bag's spring rate characteristics and the stiffer bags produce a harsher ride at the same inflation pressure than when they were new

B. The shock absorbers for worn internal valving that allows the suspension to oscillate rather than dampening the movement creating the perception of a harsher ride from the increased bouncing on rough road surfaces

C. The shock absorbers for worn valving that no longer dampens the suspension movement effectively — the failed damping allows the suspension to oscillate excessively producing the progressively harsher ride quality

D. The trailing arm bushings for hardening and compression set that transmits more road impact force directly to the frame without the designed rubber compliance that originally absorbed the initial impact energy

89. A truck's tire tread depth is measured using a depth gauge at multiple points across the tread width. The centre reads 10 mm, the inner edge reads 12 mm, and the outer edge reads 8 mm. The tire is on the right front steer position. What alignment condition is most likely causing the outer-edge wear?

A. The tire is chronically over-inflated causing the tread crown to bulge outward and wear the centre faster while the edges carry less load — the uneven edge readings (12 inner vs 8 outer) are from a camber contribution

B. The right steer tire has excessive positive camber that tilts the tire's top outward concentrating the ground contact force on the outer edge and producing the accelerated outer edge wear pattern on the right front position

C. The total toe is set to excessive toe-in which drags the outer edge of the tread across the pavement surface creating the accelerated wear on the outer edge while the inner edge maintains its depth from the toe geometry

D. The king pin inclination on the right side is incorrect causing the tire to lean outward during straight driving concentrating the contact force on the outer tread edge and producing the uneven wear across the tread width

90. A truck's fifth wheel has been inspected and the locking jaw mechanism shows significant wear on the jaw contact surfaces. The king pin engagement appears secure during the tug test. Should the fifth wheel be serviced based on the jaw wear?

A. Yes — worn jaw surfaces reduce the clamping force on the king pin and may allow the coupling to separate under dynamic loading conditions that exceed the tug test forces such as emergency braking or rough road impacts

B. No — the tug test confirms adequate king pin retention and the worn jaw surfaces are a cosmetic condition that does not affect the coupling security as long as the king pin seats fully in the throat and the jaws lock positively

C. Yes — but only the locking jaw springs need replacement because the worn jaw surfaces indicate the springs cannot close the jaws with adequate force to maintain the designed contact area on the king pin surface

D. No — fifth wheel jaw wear is normal and the jaw surfaces are case-hardened to maintain their function even with visible wear patterns because the hardened layer provides the structural strength for king pin retention

91. A truck's air ride suspension has been modified by the fleet to use stiffer air bags to carry heavier loads. After the modification, the driver reports that the ride quality is unacceptable — the cab bounces excessively over road irregularities even with a full load. What is the most likely cause?

A. The stiffer air bags have a higher spring rate that produces a higher natural frequency for the suspension — the shock absorbers cannot control the increased energy from the stiffer springs and the cab bounces excessively

B. The stiffer air bags require a higher inflation pressure that the vehicle's air system cannot maintain during driving and the bags operate partially deflated creating a harsh bouncing ride from the insufficient pressure

C. The height control valves were not recalibrated for the stiffer air bags and the valves are overinflating the bags beyond their designed operating pressure creating the harsh bouncing ride from the over-pressurized bags

D. The stiffer air bags have changed the suspension's natural frequency and the existing shock absorbers are not matched to the new spring rate — the shock absorbers cannot adequately control the stiffer springs' energy during rebound

92. A truck's hub-piloted wheel has been installed and torqued to specification. During a re-torque check at 160 km, the technician discovers that one wheel stud has broken off at the hub flange. What is the most probable cause?

A. The wheel stud was damaged during the previous tire change from an impact wrench that over-torqued it beyond the stud's yield point — the pre-stressed stud eventually failed from the fatigue loading of normal driving

B. The wheel nut was cross-threaded during installation and the stud was stressed beyond its yield point at the cross-thread location — the concentrated stress failed the stud during the 160 km of normal driving operation

C. The wheel stud material has a metallurgical defect from manufacturing that created a stress concentration point at the hub flange transition and the normal torque combined with service loading failed the defective stud

D. The hub pilot surface has a localized high spot under the wheel at the broken stud's position that prevented the wheel from seating flat — the stud carried a disproportionate bending load that failed it at the flange

93. A trailer equipped with drum brakes has one wheel that consistently runs hotter than all others during brake inspections. The brake adjustment, lining thickness, and drum diameter are all within specification. The air pressure at the chamber is equal to all other positions. What should be investigated?

A. The brake shoe hardware — specifically the anchor pins, return springs, and shoe hold-down hardware — for a binding condition that prevents the shoes from retracting fully from the drum after each brake release

B. The wheel bearing preload on that position for an over-tight adjustment that creates friction-generated heat independently of the brake components and the combined bearing and brake heat produces the elevated temperature

C. The hub seal for a failure that allows lubricant to contact the brake lining — counterintuitively, oil-contaminated linings can drag against the drum continuously because the oil prevents the shoes from releasing cleanly

D. The automatic slack adjuster for an over-adjusted condition that holds the linings in constant light contact with the drum — the continuous friction generates heat even though the measured pushrod stroke appears within specification

94. A truck's tire has been dismantled and the technician inspects the rim before mounting a new tire. The rim has a visible dent on the bead seat area approximately 5 mm deep and 75 mm long. Can the rim be returned to service?

A. The rim can be returned to service if the dent is hammered flat because the bead seat area is a secondary sealing surface and the primary seal is provided by the tire bead's rubber contact with the rim flange above the dent

B. The rim can be returned to service after the dent is hammered flat and the bead seat area is verified smooth with a straightedge — minor dents in the bead seat can be corrected as long as the seat surface is restored

C. The rim cannot be returned to service with a 5 mm dent in the bead seat area because the tire bead cannot seal properly against the damaged surface and the tire will leak at the dent location under inflation pressure

D. The rim can be returned to service only if a non-structural sealant is applied to the dented area before mounting the tire — the sealant fills the dent depression and allows the tire bead to achieve a seal against the damaged surface

95. A truck's front suspension leaf spring eye bushing has been replaced. After the replacement, the technician torques the spring eye bolt to specification with the suspension at full droop (hanging freely). Why is this torquing procedure incorrect?

A. The spring eye bolt should be torqued at normal ride height because tightening at full droop pre-loads the rubber bushing in a twisted position and the bushing will be under constant stress during normal operation

B. Torquing the bolt at full droop compresses the bushing on one side and stretches it on the other — the constant uneven loading causes the bushing to fail prematurely from the cyclic stress of normal suspension travel

C. The spring eye bolt torque specification assumes the suspension is at ride height — torquing at droop changes the bolt's loading angle relative to the bushing creating a shear force that the bushing is not designed to resist

D. The bushing should be torqued at ride height because the rubber has a limited angular range — torquing at full droop uses a large portion of this range for the droop position leaving insufficient range for the compression direction

96. A truck's steer tire shows a wear pattern where only one rib (the second from the outside) has significantly more wear than all other ribs across the tread. All other ribs have approximately equal depth. What alignment condition could cause this single-rib accelerated wear?

A. A combination of camber and toe that creates a compound angle effect concentrating the wear forces on the specific rib position that corresponds to the intersection of the camber and toe force vectors during straight driving

B. The tire has a manufacturing defect where the rubber compound in that specific rib is softer than the surrounding ribs causing accelerated wear at normal driving forces that does not appear on the correctly-compounded ribs

C. The steer axle has a worn king pin on one side that allows dynamic camber changes during driving which concentrates the ground contact force on the second rib at the specific camber angle produced by the worn bushing

D. A specific combination of toe and camber creates a resultant force vector that concentrates scrubbing wear on the rib position where the camber tilt and toe drag forces intersect producing the single-rib accelerated wear pattern

97. A truck's wheel bearing has been adjusted to the specified end play using the standard procedure. After tightening the adjusting nut and installing the lock, the technician rechecks the end play and finds it has increased by 0.002 inches from the initial setting. What caused this change?

A. The lock washer or cotter pin installation shifted the adjusting nut's position slightly — the mechanical force of installing the locking device rotated the nut enough to change the bearing preload by the measured amount

B. The outer bearing cone shifted on the spindle during the lock installation process and the bearing moved axially by the 0.002-inch amount that now appears as additional end play beyond the initial adjustment setting

C. The hub shifted on the bearings during the lock installation as the technician pushed the hub inward and outward to verify the adjustment — the hub's axial movement reseated the bearings at a slightly different position

D. The inner bearing cone was not fully seated against the spindle shoulder during the initial adjustment and the lock installation's impact force seated it the remaining 0.002 inches changing the measured end play

98. A truck's rear suspension uses air springs with a height control valve that maintains ride height regardless of load. When the truck is loaded, the air spring pressure increases to support the additional weight while maintaining the same ride height. What happens to the suspension's natural frequency as the load increases?

A. The natural frequency increases because the higher air pressure creates a stiffer spring that oscillates faster under the added load producing a higher-frequency ride characteristic than the empty condition

B. The natural frequency decreases because the added mass requires more energy to oscillate and the air spring's pressure increase is proportional to the load maintaining a relatively constant spring rate-to-mass ratio

C. The natural frequency remains approximately constant because the air spring pressure increases proportionally to the load increase maintaining a nearly constant ratio between the spring rate and the suspended mass

D. The natural frequency remains approximately constant because air springs have a unique characteristic where the spring rate increases proportionally with load — the constant rate-to-mass ratio maintains the natural frequency

99. A trailer's ABS fault lamp has been on continuously since the trailer was purchased used. The previous owner did not maintain the ABS system. After diagnosis, the technician finds multiple failed components — wheel speed sensors, a modulator valve, and corroded wiring. Is the trailer legal to operate with the ABS completely non-functional?

A. The trailer can operate legally because the ABS is a supplemental safety system and the foundation brakes (drums, shoes, chambers) provide the primary braking function independently of the ABS electronics

B. The trailer is not legal to operate with a completely non-functional ABS system — regulations require that the ABS be maintained in working condition and a failed ABS will result in a citation during roadside inspection

C. The trailer can operate legally for up to 90 days with a non-functional ABS if the carrier has documented the fault and has ordered the replacement parts needed to repair the system within the 90-day repair window

D. The trailer is legal to operate because the ABS lamp being continuously on indicates the system has self-disabled which is the designed failure mode — the foundation brakes provide all braking without ABS modulation

100. A truck's hub oil level is checked through the sight glass and the oil appears cloudy but not milky. The cloudiness has a slight amber tint. What does this appearance suggest?

A. The hub oil has been contaminated with a small amount of water that has emulsified with the oil but has not reached the severe contamination level that produces the full milky-white appearance of heavy water saturation

B. The hub oil has overheated from a bearing problem and the thermal degradation has changed the oil's optical properties creating the cloudy appearance from the oxidation byproducts suspended in the base oil

C. The cloudy appearance with amber tint indicates the oil is at normal condition — hub oils naturally develop a slight cloudiness from the bearing metallic particles suspended in the oil during normal operation over time

D. The hub oil has been contaminated with brake dust that has migrated past the wheel seal and the brake lining particles in suspension create the cloudy amber appearance in the otherwise clear hub oil

101. A truck's front steer axle has excessive play detected during a dry-park steering check. The technician grabs the top and bottom of the tire and rocks it — there is noticeable play. What specific components should be checked to determine if the play is from the king pins, the wheel bearings, or the ball joints/tie rod ends?

A. Observe the relative movement between the knuckle and the axle beam during the rocking — if the knuckle moves relative to the beam the play is in the king pins; if the hub moves relative to the knuckle the play is in the wheel bearings

B. Place a pry bar under the tire and lift — if the play is detected the wheel bearings are the source; grab the tire at 3 and 9 o'clock and rock — if play is detected the tie rod ends or drag link ball joints are the source

C. Remove the wheel and hub assembly and check the king pin play directly by rocking the knuckle on the pins — this eliminates the wheel bearing variable and isolates the king pin play from the bearing play

D. Jack up the front axle and spin the wheel while checking for roughness — roughness indicates bearing wear; then grab the tire at 12 and 6 o'clock and rock with the wheel on the ground to check king pin play

102. A trailer's sliding tandem has been repositioned to the maximum forward position for a heavy nose-loaded cargo. After repositioning, the driver reports the trailer tracks poorly during turns — the rear tires scrub audibly during tight turns at low speed. What is causing the increased tire scrub?

A. The forward tandem position has moved the trailer's effective wheelbase forward which reduces the turning radius and increases the scrub angle between the tandem tires and the road surface during tight turns

B. The forward tandem position extends the distance between the king pin and the tandem axle group which increases the off-tracking distance and the resulting tire scrub during tight turns from the longer effective wheelbase

C. The tandem suspension bushings have seized from the repositioning and the stiff bushings prevent the axles from articulating during turns creating additional tire scrub from the rigid connection between the axles and the frame

D. The forward tandem position increases the weight on the tandem axle group which increases the tire-to-road friction and the additional friction creates more resistance to the lateral scrubbing motion during tight turns

103. A truck's tire inflation has been set to the specified pressure for the load rating. After driving 100 km on the highway, the tire pressure is re-checked and has increased by 25 kPa. Is this normal?

A. The 25 kPa increase is abnormal and indicates the tire has an internal structural problem that is generating excessive heat from belt separation or cord damage causing the air to expand more than normal during driving

B. The 25 kPa increase is within the normal range for a heavy-duty truck tire during highway driving — the driving generates heat from flexing and road friction which warms the air inside the tire increasing the pressure proportionally

C. The 25 kPa increase indicates the tire was initially set at the wrong temperature — tire pressures should only be set when the tire is at ambient temperature and any deviation means the cold setting was incorrect

D. The 25 kPa increase is excessive for 100 km of driving and indicates the tire is underinflated for the load — an underinflated tire flexes more generating more heat which raises the pressure more than a correctly inflated tire would

104. A truck driver reports that the cab tilts slightly forward when the service brakes are applied firmly. The cab tilt latch is verified as fully engaged. What is causing this forward cab movement during braking?

A. The cab rear mounting bolts have loosened allowing the cab to pivot forward slightly on its front hinge point during the deceleration force of braking before the rear mounting resists the forward momentum

B. The cab tilt hydraulic cylinder has a slow internal leak that allows the cylinder to compress slightly under the cab's forward inertia during braking — the leak is too slow to allow full tilting but permits noticeable movement

C. The cab-to-frame mounting isolators have compressed and deteriorated from age and the softened rubber allows the cab to shift forward under braking forces instead of being firmly located on the frame mounting points

D. The cab-to-frame anti-rotation stops or locating pins that prevent forward-rearward cab movement during driving have worn — the latch holds the cab down but these separate locators prevent the forward movement

105. A truck's cab has a persistent water leak from the overhead console area during rain. The leak appears at the headliner above the driver's position. The windshield and roof seals appear intact from exterior inspection. What is the most common hidden source of a leak in this location?

A. The roof-mounted marker lamp wiring grommets or antenna mounting seals have deteriorated allowing rainwater to enter the cab roof panel and travel along the wiring harness to the overhead console location

B. The cab roof panel has developed a fatigue crack at a stress concentration point near the overhead console bracket mounting that allows water to penetrate through the metal during heavy rain at highway speed

C. The windshield's upper seal appears intact from outside but has separated from the frame on the interior side allowing water to migrate between the glass and the frame channel to the headliner above the driver

D. The HVAC fresh air intake plenum drain has backed up and water is overflowing from the plenum into the headliner space where it travels to the overhead console location before dripping onto the driver's position

106. A truck driver reports that the power door locks on both sides activate randomly while driving — the doors lock and unlock without the driver pressing the lock switch. The key fob is in the driver's pocket. What should be investigated?

- A. The key fob battery for a low-voltage condition that causes the fob to transmit erratic signals at random intervals that the body controller interprets as lock and unlock commands during normal driving conditions
- B. The door lock switch wiring for chafing against the door panel structure that creates intermittent contact at the switch wire connection points and sends random lock and unlock signals to the body controller
- C. The body controller's door lock output drivers for a thermal intermittent fault that causes the lock solenoids to cycle as the controller's internal temperature varies during different heating and cooling conditions
- D. The key fob for a stuck button or moisture contamination that causes the fob to transmit lock/unlock commands continuously from the driver's pocket — the fob should be tested outside the cab to verify the signal stops

107. A truck's cab suspension uses rubber biscuit-type mounts at the rear of the cab. During inspection, the technician finds the rubber biscuits on one side are cracked through with visible metal-to-metal contact between the cab and the frame bracket. What are the consequences of this failed mount?

- A. The failed mount transmits road vibration directly to the cab on that side creating a noticeable ride quality difference between the left and right sides of the cab and the driver perceives the asymmetric harshness
- B. The metal-to-metal contact generates a rattling noise during driving that the driver may not distinguish from normal road noise but the constant contact will progressively wear the cab mounting bracket and frame surface
- C. The failed mount creates a noise, vibration, and harshness (NVH) problem and the metal-to-metal contact will progressively damage both the cab bracket and the frame bracket if not repaired promptly
- D. The failed mount allows the cab to shift under cornering and braking forces creating a safety concern — the cab may contact engine or exhaust components during extreme dynamic loading events and the mounts must be replaced

108. A truck's passenger-side exterior mirror produces a distorted reflection that makes vehicles appear further away than they actually are. The mirror glass is not cracked. What is the most likely cause of this distortion?

- A. The mirror glass has been exposed to extreme temperature cycling that has caused the glass to warp at a molecular level creating a convex surface distortion that makes reflected objects appear smaller and further away
- B. The mirror has been hit by an object during driving that deformed the mirror's backing plate behind the glass — the bent backing pushes the glass into a non-uniform curvature that distorts the reflected image
- C. The replacement mirror glass is a convex (wide-angle) type instead of the correct flat glass for the main mirror portion — the convex glass makes objects appear further away than they actually are by design
- D. The mirror's internal heater element has short-circuited and the localized heat has caused the mirror adhesive to soften at one point allowing the glass to sag and create a distorted non-flat reflective surface

109. A reefer trailer's TRU has been serviced and the refrigerant system recharged. The system cools correctly at highway speed but the cargo temperature rises when the trailer is parked at a loading dock with the TRU running on standby (electric or diesel idle). What is the most probable cause?

- A. The TRU's standby fuel supply is restricted by a partially clogged fuel filter that limits the engine RPM below the compressor's minimum effective speed during the diesel standby operating mode at the loading dock
- B. The condenser fan motor's low-speed winding (used during standby operation) has failed and the reduced airflow across the condenser limits the TRU's heat rejection capacity during the static standby parking condition
- C. The TRU's condenser coil requires ram airflow from highway driving to reject adequate heat — during static parking the condenser fan alone cannot reject the heat load without the supplemental highway airflow velocity
- D. The evaporator coil has iced over during the highway driving portion and the ice has not defrosted before the trailer reached the loading dock — the ice blockage reduces the airflow and cooling capacity during standby

110. A trailer equipped with a liftgate hydraulic system has the liftgate platform raise function operating normally but the platform tilt function is intermittent — sometimes it works and sometimes it does not respond. The hydraulic pump runs and the directional valve shifts when the tilt control is activated. What is the most likely cause?

A. The tilt cylinder rod seal has an intermittent leak that allows pressure to bypass the piston when the seal deforms under certain temperature conditions preventing the tilt function from operating at those temperatures

B. The directional valve spool for the tilt function has contamination in its bore that causes the spool to stick intermittently at a position that blocks flow to the tilt cylinder during some activations but allows flow during others

C. The hydraulic fluid level fluctuates with temperature and at lower fluid levels the pump inlet draws air during the tilt function because the tilt circuit draws more fluid than the lower level can supply without cavitation

D. The tilt cylinder's port fitting has a crack that opens under the pressure of the tilt function and closes when the pressure is released — the crack vents pressure intermittently preventing consistent cylinder operation

111. A trailer's brake system has been inspected and all brake components are within specification. However, during a road test, the driver reports that the trailer brakes lock up on wet roads during moderate braking. The trailer ABS lamp is off. What should be investigated?

A. The trailer brake proportioning for an over-braked condition — the relay valve may be delivering too much pressure to the trailer brakes relative to the tractor creating a bias that locks the trailer wheels before the tractor wheels

B. The trailer tires for a worn tread condition that reduces the available traction on wet roads below the level needed to absorb the braking force delivered by the correctly adjusted brake system at moderate application pressures

C. The ABS wheel speed sensor signals for adequate strength and clarity — the ABS lamp being off does not guarantee the sensors are producing optimal signals and a degraded signal may allow lockup before ABS can intervene

D. The brake lining friction coefficient for a specification that produces excessive braking force on wet roads — some lining compounds have higher wet friction than designed which causes premature lockup in wet conditions

112. A trailer's composite roof panel has developed a soft spot approximately 300 mm in diameter. The outer skin depresses when pressed with moderate hand pressure. What does this soft spot indicate?

A. The foam core insulation inside the composite panel has deteriorated from moisture intrusion, heat damage, or delamination from the skin — the unsupported outer skin flexes where the core no longer provides backing

B. The outer skin material has degraded from UV exposure and has lost its structural rigidity at the affected area — the skin has become pliable from the chemical breakdown of the fiberglass resin matrix material

C. The cargo has shifted during transport and repeatedly impacted the roof panel from below creating a fatigue zone in the composite structure that has weakened the panel's rigidity at the point of repeated contact

D. The roof panel has been walked on during loading or maintenance and the concentrated point loading from a person's weight has crushed the foam core at that location permanently deforming the panel's internal structure

113. A trailer's ABS module has a fault code for "supply voltage below threshold." The trailer ABS lamp is illuminated and the ABS is disabled. The tractor's seven-pin connector provides 12.5 volts at pin 7. What is causing the voltage to drop below the trailer ABS module's minimum threshold?

A. The tractor's alternator is not producing adequate voltage at pin 7 because the trailer charging circuit draws its power from a separate alternator winding that has failed while the main vehicle charging remains functional

B. The trailer's internal wiring from the seven-pin socket to the ABS module has excessive length and multiple splice connections that create a cumulative voltage drop reducing the module's supply below the minimum threshold

C. The voltage drop occurs between the tractor's pin 7 output and the trailer ABS module through the connector contact resistance, the trailer's internal wiring resistance, and any splice or junction resistance in the trailer harness

D. The trailer ABS module has a higher minimum voltage requirement than the 12.5 volts available at pin 7 because the module was designed for a 24-volt trailer system and has been installed on a 12-volt trailer incorrectly

114. A flatbed trailer's deck has developed a crowned (convex) surface condition across its width — the centre of the deck is approximately 15 mm higher than the edges. What operational problem does this crown create?

- A. Cargo placed on the crowned deck tends to shift toward the trailer edges during driving creating an unstable load condition that affects the trailer's roll stability during turns and lane change manoeuvres
- B. The crowned deck prevents flat-bottomed pallets and containers from sitting level which creates concentrated stress points on the pallet corners and may damage cargo that requires flat support during transport
- C. The crowned surface is a designed feature that allows rainwater to drain to the trailer edges rather than pooling on the deck — the 15 mm crown is within the standard specification for flatbed trailer construction
- D. The crowned deck changes the cargo's centre of gravity height which affects the trailer's rollover threshold during cornering — the raised centre shifts the combined centre of gravity higher than a flat deck trailer design

115. A trailer's brake adjustment has been performed and the pushrod strokes are within specification on all wheel positions. During a road test, the driver notices that the trailer tracks slightly to one side when the brakes are applied. What should be checked?

- A. The air line lengths between the relay valve and each brake chamber for significant differences that create timing delays between sides causing one side to apply before the other during each brake application event
- B. The brake component condition on each side for differences in drum diameter, lining thickness, or friction material compound that create unequal braking force between left and right sides despite equal pushrod stroke settings
- C. The trailer axle alignment because a thrust angle error causes the trailer to shift directionally during braking even though the brakes themselves apply equally — the deceleration force amplifies the existing tracking error
- D. The brake lining condition on each side for differences in friction coefficient, contamination, or glazing that produce unequal braking force between the left and right sides despite both being mechanically within adjustment specification

116. A trailer equipped with an automatic greasing system for the suspension pivot points has run out of grease in the reservoir. The system has been empty for approximately 10,000 km. What damage should be inspected before refilling the system?

- A. The suspension pivot bushings, equalizer beam wear pads, and spring eye bushings for accelerated wear from operating without lubrication for 10,000 km — the dry metal-to-metal contact produces rapid wear and potential seizing
- B. The automatic greasing system pump and lines for damage from running dry — the pump may have overheated from lack of lubricant cooling and the lines may have developed air locks that prevent proper grease distribution
- C. The trailer frame at the suspension bracket mounting points for fatigue cracks that may have developed from the increased friction and vibration at the unlubricated pivot points during the 10,000 km of dry operation
- D. The king pin and fifth wheel contact surfaces because the automatic system also supplies grease to the upper coupler plate and 10,000 km without upper coupler lubrication may have caused significant plate and pin wear

117. A truck's A/C system has been diagnosed with a compressor that intermittently loses oil return. The compressor runs quietly for 30 minutes then becomes increasingly noisy over the next 10 minutes before the noise subsides and the cycle repeats. What is the most probable cause?

- A. The system has a refrigerant flow restriction at the evaporator outlet that intermittently traps oil in the evaporator — the oil accumulates until the restriction clears allowing a surge of oil to return to the compressor
- B. The expansion valve is opening too wide flooding the evaporator with liquid refrigerant that traps the oil in the flooded coil until the valve adjusts and the refrigerant flow pattern changes enough to carry the oil back
- C. The system has a low spot in the suction line between the evaporator and compressor where oil collects — the oil accumulates until the flow velocity during a high-demand period is sufficient to carry the pool back to the compressor
- D. The compressor's internal oil pump has an intermittent fault that stops circulating oil during certain operating conditions and the pump resumes function when the compressor's internal temperature reaches a thermal trip point

118. A truck's heater produces adequate heat through all vent positions. However, the driver reports a sweet smell from the vents that has gradually intensified over the past two weeks. No visible coolant leak is present inside the cab. What is the most likely source of the sweet smell?

A. The coolant overflow bottle's cap seal has degraded and the glycol vapour from the hot coolant in the overflow is being drawn into the HVAC fresh air intake which is positioned near the overflow bottle on this vehicle

B. The heater core is developing a micro-leak that is too small to produce visible wetness or dripping — the glycol vapour from the slowly evaporating coolant on the hot core surface enters the airstream producing the sweet smell

C. The A/C evaporator has developed mould growth that produces a sweet-smelling metabolic byproduct during the initial growth phase before the colony matures and produces the more common musty odour associated with microbial contamination

D. The heater hose at the firewall bulkhead connection has a seeping O-ring that allows a tiny amount of coolant to drip onto the hot engine block and the glycol vapour enters the cab through the firewall grommets from the engine side

119. A truck's A/C system has been evacuated to 200 microns and held for 30 minutes. The vacuum rises to 500 microns during the hold period. Should the technician proceed with the recharge?

A. No — the system has a leak or excessive moisture that must be found and corrected before charging because the 300-micron rise during the 30-minute hold exceeds the maximum acceptable threshold of 200 microns rise

B. Yes — the 300-micron rise is within the acceptable range for a large-volume commercial A/C system because the larger system volume naturally releases trapped moisture more slowly during the hold period

C. No — the vacuum should hold at exactly 200 microns for the full 30 minutes with zero rise and any increase indicates a leak that must be repaired before the system is charged with refrigerant for service operation

D. No — the 300-micron rise from 200 to 500 microns exceeds the acceptable limit and indicates either a system leak or residual moisture — the source must be identified and the evacuation must be repeated to a lower threshold

120. A truck's cab heater does not produce heat on the driver's side but produces adequate heat on the passenger's side. The same HVAC unit serves both sides. What is the most likely cause?

A. The driver's side blend door actuator has failed in the bypass position directing unheated air to the driver's side while the passenger's side blend door correctly routes air through the heater core for heated delivery

B. The heater core has a partial internal blockage that restricts coolant flow through the driver's side tubes while the passenger's side tubes remain open allowing heated coolant to pass and warm the air on that side

C. The HVAC ductwork has a damper that distributes air between the driver and passenger sides and the damper has stuck in a position that sends all heated air to the passenger side depriving the driver's side of warm air

D. The driver's side dash vent louvers have closed from a broken actuator cable and the blocked vents prevent the heated air from entering the driver's area while the passenger's open vents allow the heat to flow normally

121. A truck's A/C system uses a variable-displacement compressor that adjusts its displacement based on the evaporator temperature and system demand. The compressor does not cycle on and off — it runs continuously. The driver reports the A/C cooling seems weak during hot weather but adequate during mild weather. What is the most likely cause?

A. The condenser is partially blocked with road debris reducing its ability to reject heat during hot weather when the temperature differential between the condenser and the ambient air is already reduced

B. The variable-displacement control valve inside the compressor has begun to fail and cannot maintain maximum displacement during the high demand of hot weather — it provides adequate displacement during mild conditions

C. The compressor's electromagnetic clutch pulley bearing has increased friction that absorbs more of the drive belt's force at the higher RPM needed for hot-weather cooling reducing the compressor's effective power input

D. The variable-displacement compressor's control valve has failed partially and cannot increase the displacement to maximum during hot-weather demand — it provides adequate displacement during the lower demand of mild weather

122. A truck's APU A/C system cools the sleeper cab adequately during overnight parking. The APU compressor runs continuously. The evaporator coil is cold and the airflow through the sleeper vents is adequate. However, the driver reports that the air feels humid rather than dry. What is the most likely cause?

- A. The evaporator is operating at a temperature too warm to condense moisture from the air effectively — the compressor provides cooling but the evaporator surface temperature is above the dew point for the cabin air humidity
- B. The evaporator drain tube is clogged and the condensed moisture cannot drain from the HVAC housing — the accumulated water re-evaporates into the conditioned air when the blower pushes air across the wet evaporator surface
- C. The APU compressor is running at reduced capacity from low refrigerant charge and the evaporator cannot reach the temperature needed to condense moisture from the air even though the outlet feels cool to the touch
- D. The sleeper cab's insulation has absorbed moisture during the day's driving with the windows down and the overnight A/C operation gradually releases the absorbed moisture from the insulation into the sleeper air space

123. A truck's fuel-fired coolant heater has been running for 2 hours on a cold morning but the engine coolant temperature has only reached 45°C. The heater is rated at 5 kW. The engine cooling system volume is approximately 50 litres. The ambient temperature is -30°C. Is the 45°C temperature normal for these conditions?

- A. The temperature is lower than expected — 5 kW for 2 hours should raise 50 litres of coolant by approximately 170°C in an insulated system but heat losses to the cold engine block and ambient reduce the actual rise to a practical level
- B. The temperature is within the expected range because the 5 kW heater must overcome the heat losses from the 50-litre system to the -30°C ambient temperature through the engine block, hoses, and radiator simultaneously while heating
- C. The temperature is lower than expected and indicates the heater is not producing its rated output — the combustion system should be inspected for a restricted air intake, clogged fuel nozzle, or fouled glow plug igniter
- D. The temperature of 45°C after 2 hours of 5 kW heating indicates the heater, the coolant circulation pump, or the thermostat is functioning incorrectly — the system should reach at least 65°C in 2 hours at -30°C ambient conditions

124. A hydraulic system on a roll-off container truck has a complaint that the hook lift raises the container but the container slides backward on the truck frame during the raising operation. The hook cylinder and hook mechanism function correctly. What should be investigated?

- A. The truck frame's container guide rails for wear or missing anti-slip pads that allow the container to slide on the frame surface during the raising angle change instead of gripping the frame and rotating on its rear pivot
- B. The hook lift cylinder speed for an excessively fast raising rate that creates a momentum force on the container exceeding the friction between the container base and the truck frame surface during the lift operation
- C. The container itself for worn or missing landing pads on its base that provide the friction contact between the container and the truck frame rails during the hook lift raising and lowering operations
- D. The hydraulic system's holding valve for a leak that allows the hook cylinder to creep during the raising operation which changes the raising speed intermittently and creates momentum shifts that cause the container to slide

125. A hydraulic system uses a flow divider to split the pump's output equally between two cylinders that must extend at the same rate. The cylinders are the same size. After 5,000 hours of operation, one cylinder extends approximately 10% faster than the other. What has happened to the flow divider?

- A. The flow divider's internal orifices have worn unevenly from contamination erosion and the asymmetric wear creates unequal flow paths that deliver more fluid to one cylinder outlet than the other during simultaneous operation
- B. One cylinder has developed internal leakage that consumes some of the flow delivered by the flow divider creating the appearance of unequal flow delivery even though the divider itself is splitting the flow correctly
- C. The flow divider's internal spool has worn allowing bypass flow from one outlet to the other through the increased spool clearance which reduces the flow to the slower cylinder and increases the flow to the faster cylinder
- D. The hydraulic fluid viscosity has changed from contamination and the altered viscosity affects the flow through the two divider outlets differently because one outlet has a different internal geometry than the other

126. A hydraulic liftgate operates from a 12-volt DC electric motor driving a gear pump. The motor runs but the liftgate raises very slowly. The motor draws 120 amps (normal specification is 80 amps). The system pressure is correct when tested at the pump outlet. What does the high current draw combined with correct pressure but slow speed indicate?

A. The pump is producing adequate pressure but reduced flow — the motor is working harder to drive the worn pump that requires more torque to produce the same pressure at a reduced flow rate from internal bypass

B. The motor brushes are worn reducing the motor's mechanical efficiency — the motor draws more current to produce the same torque output but operates at reduced speed from the degraded electrical-to-mechanical conversion

C. The electrical supply cables to the motor have excessive voltage drop and the motor compensates by drawing more current at a reduced speed — the cable resistance limits the effective voltage available at the motor terminals

D. The hydraulic fluid viscosity is too high for the ambient temperature creating excessive resistance to flow through the pump and system — the motor works harder against the thick fluid producing the high current draw at reduced speed

127. A hydraulic system's accumulator pre-charge has been tested and reads exactly at the specified nitrogen pressure. However, the system does not seem to benefit from the accumulator — the pump must still supply all the flow during peak demand periods. What could be wrong?

A. The accumulator bladder has a pinhole leak that allows nitrogen to slowly migrate to the hydraulic side over time — the gas dissolves in the oil and the accumulator has no effective gas spring even though the gauge reads correctly

B. The accumulator isolation valve is closed — the pre-charge reads correctly because the gas side is sealed but the hydraulic side is not connected to the system circuit preventing the accumulator from accepting or delivering fluid

C. The accumulator's hydraulic port has a check valve that is stuck closed — hydraulic fluid cannot enter the accumulator from the system and the accumulator is isolated from the working circuit even with a correct pre-charge

D. The accumulator is installed in the wrong location in the hydraulic circuit — it is plumbed on the return side rather than the pressure side and the low return pressure cannot compress the nitrogen for energy storage

128. A dump truck's hydraulic system raises the dump body but the body settles approximately 150 mm over a 5-minute period when held in the full-raise position. The directional valve is in neutral. The holding circuit uses a pilot-operated check valve. What is the most systematic approach to diagnosing this drift?

- A. Replace the pilot-operated check valve because it is the primary holding component and the drift confirms it is leaking — the cylinder seals rarely fail because they are in compression during the holding period
- B. Disconnect the pilot line from the pilot-operated check valve to verify the pilot is not receiving a false signal that opens the valve during the hold period — if the drift stops the pilot circuit has a pressure leak
- C. Isolate each potential leak source individually — block the pilot line to the POCV, test the POCV seat, test the cylinder seal bypass, and check the valve body for internal cross-leakage between ports
- D. Replace the cylinder seals because the cylinder is under the most stress during the full-raise hold and the seals are the most likely component to fail from the sustained high-pressure loading of the raised dump body

129. A hydraulic crane has a maximum working pressure of 25,000 kPa. The system relief valve is set at 27,000 kPa. A technician performing routine maintenance suggests setting the relief valve to exactly 25,000 kPa to save energy by reducing the maximum system pressure. Why is this suggestion incorrect?

- A. The relief valve is set above the working pressure to provide a safety margin that accounts for pressure spikes from load changes, valve shifting, and cylinder cushioning — setting it at the working pressure would cause frequent relief during normal operation
- B. The relief valve pressure is calibrated to the load chart by the crane manufacturer and any change to the setting requires recertification of the crane's lifting capacity chart by a professional engineer before the crane can operate
- C. The 2,000 kPa differential between working pressure and relief pressure is the minimum needed to prevent the relief valve from cracking open during normal load transients — reducing the margin would cause relief valve chatter during operation
- D. The relief valve setting must exceed the working pressure by a margin specified by the manufacturer to account for pressure spikes during normal operation — reducing the margin would cause premature relief during dynamic loading events

130. A truck-mounted hydraulic system has a complaint that the PTO-driven pump produces excessive noise during the first 5 minutes of operation on cold mornings but quiets down after the oil warms. What is causing the cold-start noise?

- A. The pump's internal relief valve chatters during cold operation because the thick cold oil creates pressure spikes that intermittently exceed the relief valve's cracking pressure during each pump revolution before warming
- B. The cold oil's high viscosity creates cavitation at the pump inlet — the pump cannot draw the thick oil fast enough to fill its chambers creating vapour pockets that collapse as the oil enters producing the cavitation noise
- C. The PTO gear mesh produces more noise during cold operation because the transmission oil that lubricates the PTO gears is thicker and creates more resistance at the gear mesh contact producing the audible gear noise
- D. The pump's internal bearings produce more noise during cold starts because the cold oil cannot maintain an adequate hydrodynamic oil film between the bearing surfaces and the reduced film allows metal-to-metal contact noise

131. A hydraulic system has a cylinder that must hold a load in the raised position for extended periods. The circuit uses a counterbalance valve to prevent the load from dropping. During testing, the counterbalance valve begins to vibrate and chatter when the load is being lowered at a controlled rate. What causes this vibration?

- A. The counterbalance valve's pilot pressure is too low for the current load weight and the valve alternately opens and closes as the pilot signal fluctuates around the valve's cracking threshold during the controlled lowering operation
- B. The counterbalance valve's internal dampening orifice is clogged with contamination preventing the valve from opening smoothly — the clog creates a sudden open-close-open cycling pattern that produces the audible chatter
- C. The lowering flow rate is set too low by the speed control valve and the reduced flow creates a pressure ripple at the counterbalance valve's pilot port that causes the valve to oscillate between open and closed positions during lowering
- D. The counterbalance valve's pilot ratio setting is too high for the application and the valve is overly sensitive to pilot pressure changes — small pressure variations from pump pulsation cause the valve to oscillate during the lowering control

132. A battery-electric truck's high-voltage battery pack has a liquid cooling system that maintains cell temperatures between 20°C and 35°C during operation. The BMS reports that one module in the pack consistently runs 8°C hotter than all other modules. What should be investigated?

- A. The cooling circuit for a restriction or air pocket in the coolant passage serving the hot module that reduces the coolant flow rate past that module's cells preventing adequate heat removal during operation
- B. The hot module's cells for elevated internal resistance from cell degradation that generates more heat than the other modules during the same charge and discharge current flow through the pack circuit
- C. The BMS temperature sensor on the hot module for a calibration drift that reads 8°C higher than the actual cell temperature creating a false indication that the module runs hotter than the rest of the pack
- D. The hot module's cell interconnections for elevated resistance at a bus bar or terminal connection that generates additional heat from the I^2R losses at the high-resistance junction during normal pack current flow

133. A hybrid truck's regenerative braking system captures energy during deceleration and stores it in the battery. The scan tool shows the regenerative system capturing only 40% of the expected energy during a standardized deceleration test. The battery SOC is at 50% and the cell temperatures are normal. What should be investigated?

- A. The traction motor's winding resistance for an increase from aging that reduces the motor's generating efficiency during the regenerative braking mode decreasing the electrical output for a given mechanical braking input
- B. The inverter's power electronics for degradation that reduces the conversion efficiency from the motor's three-phase AC output to the DC charging input needed by the battery limiting the energy capture during regeneration
- C. The friction brake system for excessive drag that is absorbing energy mechanically before the regenerative system can capture it electrically — worn brake components dragging reduces the kinetic energy available for regeneration
- D. The regenerative braking system's overall efficiency chain — the motor, inverter, wiring, battery acceptance, and the blending algorithm's calibration — because any single component degradation or calibration error reduces the total capture rate

134. A battery-electric truck has a complaint that the vehicle's range prediction on the dashboard is consistently 20% higher than the actual range achieved. The battery SOH is verified at 92%. What is causing the discrepancy between predicted and actual range?

A. The range prediction algorithm uses historical energy consumption data that does not reflect the current driving conditions — changes in route, load, speed, or ambient temperature cause the prediction to differ from actual consumption

B. The range prediction algorithm uses the battery's rated capacity rather than its actual degraded capacity and the 8% SOH reduction accounts for the prediction error because the system overestimates the available energy by approximately 20%

C. The vehicle's energy consumption has increased from tire underinflation, increased aerodynamic drag from body damage, or increased friction from worn drivetrain components that consume more energy than the prediction algorithm assumes

D. The BMS is reporting a higher state of charge than actual because the cell voltage-to-SOC correlation has drifted from aging and the overestimated SOC causes the range algorithm to predict more range than the actual energy remaining allows

135. A parallel hybrid truck has a traction motor that assists the diesel engine during acceleration. The motor provides a maximum of 50 kW of assist power. The driver reports that the motor assist feels weaker than when the vehicle was new — the acceleration is noticeably slower despite the engine operating normally. The battery SOC is adequate and no fault codes are present. What is the most likely cause?

A. The traction motor's permanent magnets have demagnetized slightly from long-term heat exposure reducing the motor's maximum torque output at the same current level compared to its original performance specification

B. The inverter's internal capacitors have degraded from age reducing the inverter's ability to deliver the peak current the motor requires for maximum torque output during the acceleration assist operation mode

C. The motor cooling system has reduced efficiency from coolant degradation or a restricted heat exchanger and the motor reaches its thermal limit faster than when new causing the PCS to limit motor output earlier during acceleration

D. The traction motor's permanent magnets have weakened from thermal cycling over the vehicle's service life reducing the motor's electromagnetic coupling strength and its maximum torque and power output at the designed current levels

Practice Exam 11: Answer Key and Explanations

1. C — Diesel fuel vapours are flammable and any ignition source in the area (sparks, hot surfaces, electrical arcing, static discharge) can ignite the vapours causing a fire or explosion. Before disturbing the damaged tank, all ignition sources must be eliminated, ventilation ensured, fire suppression equipment staged, and the dripping fuel contained with appropriate materials.
2. A — Compressed air directed at the body can penetrate the skin through cuts, pores, or any opening and introduce an air embolism into the bloodstream — a potentially fatal condition. Additionally, brake dust particles accelerated by compressed air become high-velocity projectiles that cause serious eye injury and respiratory damage from inhaling the concentrated dust cloud.
3. D — The negative cable must be disconnected first on a negative-ground system. If the wrench contacts the frame while removing the positive terminal with the negative still connected, the wrench completes a short circuit through the frame creating an arc, potential fire, or battery explosion. Disconnecting the negative first eliminates the ground path.
4. B — A cracked exhaust manifold leaking directly into the engine compartment releases carbon monoxide and other toxic exhaust gases that can enter the cab through the firewall penetrations, HVAC fresh air intake, or deteriorated firewall seals. Carbon monoxide is odourless and colourless and can incapacitate the driver without warning during vehicle operation.
5. D — Two safety considerations apply: the lift's safety locks must be verified as engaged (protecting against hydraulic failure dropping the vehicle), and the technician must position themselves to avoid the 25 kg starter's fall path during removal. A falling 25 kg object from engine height can cause serious head, hand, or foot injury.
6. A — The cooling system should be pressurized only to the radiator cap's rated pressure — in this case 103 kPa. Pressurizing to 110 kPa exceeds the cap's design limit and can damage the weakest components in the system (heater core, plastic radiator tanks, aged hoses). The test verifies the system holds the cap's rated pressure, not an arbitrary higher pressure.
7. C — Used coolant mixed with used oil creates a waste that standard oil re-refining facilities cannot process. The mixed waste must be disposed of through more expensive hazardous waste channels. Strict segregation of coolant from oil in separate, labelled containers preserves both waste streams' recyclability and significantly reduces disposal costs.

8. B — When a bearing suddenly releases from a shaft under press force, the stored hydraulic energy accelerates the ram forward and the bearing can be ejected sideways at high velocity. A safety cage or shield around the press work area contains the flying bearing, shaft, or fragments and prevents them from striking the technician or bystanders.

9. A — A consistently lower EGT on one cylinder with confirmed equal fuel delivery and timing indicates that cylinder is converting less fuel energy to heat in the exhaust. An intake or exhaust valve sealing problem reduces the effective compression or allows combustion gases to escape before fully expanding, reducing the thermal energy reaching the exhaust stream.

10. D — A rhythmic exhaust pulsation at a fixed interval regardless of RPM corresponds to one event per camshaft revolution. One cylinder not firing consistently creates a weaker exhaust pulse at that cylinder's firing position. At idle, the camshaft completes one revolution approximately every 4 seconds, producing one perceptible weak pulse per revolution.

11. C — During hard acceleration from a stop, the oil in the sump surges rearward from the vehicle's forward thrust. If the pickup tube is not adequately submerged in all conditions, the rearward oil surge uncovers the tube's inlet allowing the pump to draw air. The air pocket causes the momentary pressure loss until the acceleration ends and oil returns.

12. B — The engine runs smoothly (confirming the calibration codes are correct and the injectors are electronically compatible), but fuel consumption has increased 8%. The replacement injectors may be an incorrect part number or flow specification — even a small mismatch in nozzle hole size, spray angle, or delivery rate reduces combustion efficiency enough to increase consumption measurably.

13. A — VGT actuator hunting at cruise speed is a common condition where the actuator overshoots its commanded position, the ECM corrects, it undershoots, and the cycle repeats. This creates rhythmic boost pressure variations that translate to engine RPM surging. The condition is specific to the cruise speed because the VGT demand is at a transition point in its control range.

14. D — Extended cranking (8 seconds vs 2 seconds) with a fault for low rail pressure during cranking that resolves once running indicates fuel is draining from the rail during the engine-off period. A leaking internal check valve in the high-pressure pump or the rail's drain-back check valve allows fuel to gravity-drain or pressure-bleed from the rail back to the tank during parking.

15. B — The injector nozzle opening pressure is 210 bar versus the specified 250 bar. At the lower opening pressure, the nozzle opens earlier in the pump's pressure buildup and the fuel enters the combustion chamber at a lower pressure. Lower injection pressure produces larger fuel droplets that are harder to atomize, creating a coarser spray and the cold-start knock.

16. C — The coolant system's boiling point depends on the cap pressure. A cap rated at 103 kPa raises the boiling point above 100°C. A lower-rated cap reduces the boiling point, and at the hot spots near the water pump impeller blade tips, the coolant may reach the reduced boiling point locally. The resulting vapour bubbles collapse violently on the impeller surfaces causing cavitation erosion.

17. A — After 18 months without operation, the engine's upper components (valve train, cam followers, turbocharger bearings, rocker arms) have no protective oil film remaining. Starting the engine without pre-lubrication forces these precision surfaces to operate dry during the critical first seconds until the oil pump delivers pressurized oil — causing immediate wear and potential damage.

18. D — The butterfly valve tests correctly through the scan tool (eliminating the valve itself), but the retarding force varies. The total exhaust brake effectiveness depends on the entire exhaust backpressure upstream of the butterfly. A VGT position error or an exhaust system variable restriction upstream changes the total backpressure intermittently, affecting the brake's retarding force.

19. B — A hard upper hose (pressurized) with a collapsed lower hose indicates the water pump is creating suction that collapses the lower hose while building pressure in the upper circuit. The lower radiator hose should have an internal anti-collapse spring that prevents the pump's suction from collapsing the hose. A missing or collapsed spring allows the hose to restrict flow.

20. C — White smoke for 5 seconds after returning to idle from high RPM — without coolant smell and with stable coolant level — indicates oil burning. During the sudden transition from high RPM to idle, the piston rings momentarily lose their sealing effectiveness from the abrupt speed change. The reduced ring tension during the deceleration allows a brief pulse of oil past the rings.

21. A — The sensor has been replaced but the code returns immediately — the new sensor is producing the same implausible reading. The most likely cause is not the sensor itself but the sensing tubes that connect it to the DPF. Blocked, kinked, or moisture-filled tubes prevent the sensor from reading the actual upstream and downstream pressures accurately.

22. D — With correct injection timing and all other parameters identical to fleet trucks, elevated NO_x must come from a higher combustion temperature. The EGR system is the primary NO_x control mechanism — it introduces inert exhaust gas to absorb combustion heat. If the EGR delivers less gas than commanded, the reduced dilution allows higher peak combustion temperatures that increase NO_x.

23. B — Sodium and potassium appearing together in an oil analysis are the signature of coolant contamination. These elements are key components of the corrosion inhibitor packages in commercial engine coolants (both conventional and ELC types). Their simultaneous appearance confirms coolant is entering the crankcase through a head gasket breach, cracked head, or failed oil cooler.

24. C — A blocked fuel return line creates backpressure that the high-pressure pump must overcome in addition to building rail pressure. The pump's internal components (pistons, check valves, drive coupling) experience higher sustained loading than designed. Extended operation against this backpressure accelerates wear on the pump's internal precision components.

25. A — The DEF dosing system should purge residual DEF from the injector nozzle after engine shutdown — either with coolant, compressed air, or by reversing the dosing pump. If the purge cycle fails, residual DEF remains in the hot nozzle tip where it thermally decomposes and crystallizes as the exhaust system cools. The crystallized deposits accumulate with each failed purge cycle.

26. D — The MAF sensor's hot-wire or hot-film element measures airflow by detecting the cooling effect of the incoming air on its heated surface. Oil mist from the CCV system deposits a thin film on the sensing element that insulates it from the airflow. The insulated element loses less heat than expected, and the sensor interprets this as higher airflow — reading above the actual value.

27. B — The dash gauge sender (separate from the ECM sensor) has an intermittent internal short that momentarily drops its resistance to near zero. The gauge interprets near-zero resistance as maximum temperature and spikes to the hot reading. The short clears within 2-3 seconds and the gauge returns to the normal reading. The ECM sensor is unaffected because it is a separate circuit.

28. B — Oil that turns dark black within 100 km of a fresh change indicates an excessive soot loading rate from incomplete combustion. The engine is producing far more combustion soot than normal — from an EGR fault, retarded timing, low boost, worn injectors, or an air restriction. The fresh oil's dispersant additives suspend the soot, turning the oil black almost immediately.

29. D — A clean DPF typically reads 1.0 to 3.0 kPa of differential pressure from the flow resistance of the clean substrate itself. A rise to 5 kPa within 200 km depends entirely on the engine's operating conditions during those kilometres — high-load, high-soot-production driving produces faster accumulation than highway cruise. The rate should be evaluated against the engine's duty cycle.

30. C — The compressor's piston rings have failed, allowing engine oil into the compressed air system. The oil has contaminated the entire downstream system. Beyond replacing the compressor, the air dryer desiccant must be replaced, and all rubber components (brake chamber diaphragms, valve seals, air spring bellows) that contacted the petroleum-based oil must be inspected and replaced — oil degrades rubber.

31. A — The primary circuit dropped 10 kPa and the secondary dropped 3 kPa in one minute with brakes released. The maximum for a combination vehicle with brakes released is typically 14 kPa per minute for the total system. However, the circuits are evaluated separately, and the primary's 10 kPa rate warrants investigation before departure even though the combined rate is below 14 kPa.

32. B — A floating caliper disc brake's piston seal has a square-cut cross-section that deforms during application and then retracts the piston by its elastic memory when pressure is released. If the seal groove is contaminated with corrosion or debris, the seal cannot deform correctly and cannot retract the piston — the piston stays in the applied position and the brake drags continuously.

33. D — The governor cuts in at 480 kPa instead of the specified 585 kPa — a 105 kPa deficit. This allows the system pressure to drop into the zone where spring brakes begin to apply (typically 415-480 kPa) before the compressor loads. The driver may experience partial spring brake application during normal driving as the system pressure enters this critical range.

34. C — The sensor resistance is within specification (confirming the coil is intact) but the signal reads zero at 50 km/h. A passive sensor generates voltage proportionally to the rate of magnetic field change — at 50 km/h with correct resistance, the sensor should produce adequate voltage. A missing, severely contaminated, or completely damaged tone ring produces no signal.

35. A — Ceramic brake linings typically have a lower initial friction coefficient than semi-metallic linings at normal operating temperatures. The lower friction requires more application pressure to achieve the same braking force. Ceramic linings provide better fade resistance at high temperatures, but their lower cold friction changes the pedal feel the driver has been accustomed to.

36. A — The caging bolt was properly installed but road vibration during towing gradually backed the bolt out. As the bolt retreated, the spring progressively extended and applied the parking brake. During the towing vehicle's braking event, the already-partially-applied spring brake provided additional force that locked the wheels. Caging bolts must be secured against vibration-induced loosening.

37. B — The ATC uses wheel speed sensor signals to detect traction loss. If one wheel speed sensor produces a signal that reads lower than actual (from increased air gap, contaminated tone ring, or damaged wiring), the ATC interprets the speed difference between sensors as wheel spin and intervenes unnecessarily — even on dry pavement during normal acceleration.

38. A — The brake shoes were installed with the primary (shorter) lining in the trailing position and the secondary (longer) lining in the leading position. This reversal reduces the self-energizing effect that the correctly positioned leading shoe provides. The result is significantly reduced braking force despite correct adjustment — the trailer pushes the tractor during braking.

39. C — All individual brake adjustments, air pressure, and components are within specification, yet stopping distance exceeds the limit. The issue is the brake timing across all axle positions — different line lengths, relay valve response times, and chamber fill volumes create a sequential application rather than simultaneous application. The staggered application extends the total stopping distance.

40. D — The EBS uses the steering angle sensor as an input for its electronic stability control (ESC) function. The ESC compares the driver's steering angle input (what the driver wants) to the vehicle's actual yaw rate (what the vehicle is doing). If the vehicle understeers or oversteers, the EBS selectively applies individual wheel brakes to correct the vehicle's path.

41. B — Even though Type 24 chambers from different manufacturers share the same type designation, their internal geometry may differ — different diaphragm effective areas, different stroke-to-volume relationships, and different maximum stroke specifications. The replacement manufacturer's specification reflects the actual capabilities of the installed chamber.

42. A — The replacement compressor has a gear mesh timing relationship with the engine's timing gear train. If the compressor gear is installed with incorrect timing, the compressor piston may reach TDC at a point where it mechanically interferes with the compressor head or valve plate — creating a knock on every revolution proportional to engine RPM.

43. D — The fixed 60/40 proportioning works correctly when the truck is loaded because the rear axle carries 60% of the vehicle weight. When empty, the rear axle carries significantly less weight but still receives 60% of the braking force — the force exceeds the available traction and the rear wheels lock. A load-sensing valve adjusts proportioning based on axle loading.

44. B — The caliper was installed with the bleeder screw at the bottom instead of the top. Air trapped in the upper portion of the caliper bore cannot be purged because air rises above the bleeder's position. The trapped air pocket compresses during each brake application creating a pulsation as the air alternately compresses and expands during the brake event.

45. C — The governor cuts in and out at the correct pressures, there are no leaks, yet the system cycles every 5 seconds. The supply tank volume between cut-in and cut-out is too small to hold enough air for the compressor to remain unloaded for a normal period. The limited air volume between the two pressure settings cycles through quickly with any minor consumption.

46. A — The increased pedal travel after 10 km of mountain grade descent indicates the brake drums have expanded from heat. As the drum diameter grows from thermal expansion, the brake shoes must travel further before contacting the larger drum surface. This requires additional pushrod stroke and more pedal travel before braking force is generated.

47. C — Active codes represent faults currently present; inactive codes represent faults that occurred but are not present now. The three returning inactive codes set during the 50 km drive when their fault conditions occurred briefly. The conditions resolved before the drive ended, so the ECM recorded them as inactive — they happened but are not currently active.

48. B — A speed-proportional whine from an alternator with correct electrical output and tight belt is most commonly from a failing bearing. The bearing's worn rolling elements or race surfaces produce the characteristic whine that increases proportionally with shaft speed. Bearings can produce noise long before they affect electrical output or seize completely.

49. C — A single lamp group (right clearance) not functioning while all other exterior lamps work correctly through the same body controller suggests a failed output driver for that specific channel. The body controller's semiconductor output driver for the right clearance circuit has failed while all other output drivers on the controller continue functioning normally.

50. A — Engine oil temperature at 135°C with a specification maximum of 120°C indicates the oil cooler cannot reject enough heat. Internal fouling from oil deposits, external fin damage from road debris, or restricted coolant flow through the cooler all reduce its heat rejection capacity. The oil absorbs combustion and friction heat but the cooler cannot transfer it to the coolant adequately.

51. D — The VGT vanes are stuck in a position that accelerates exhaust gas velocity beyond the turbine wheel's design. The concentrated exhaust energy drives the shaft speed above the ECM's maximum threshold. The ECM derates the engine to reduce exhaust energy and protect the turbocharger from mechanical failure at the elevated shaft speed.

52. B — The batteries were fully charged when disconnected. The disconnect switch opened all external circuits. Despite this, the batteries self-discharge internally from chemical reactions that occur regardless of external circuit status. Older batteries have higher self-discharge rates, and combined with the cold temperature reducing CCA capacity, the result is slow cranking.

53. C — PLC communication superimposes high-frequency data signals on the DC power wiring. The signal requires a clean, low-resistance path through the connector pins. A poor connection on pin 7 — corroded, pitted, or loose — passes enough DC power to operate the module but attenuates the high-frequency PLC data signal below the scanner's detection threshold.

54. A — Both headlamps are aimed correctly, have clean lenses, and correct bulbs — eliminating aim, lens condition, and bulb specification as variables. Degraded reflector surfaces (from oxidation, delamination, or cloudiness) scatter the light instead of focusing it into the designed beam pattern, reducing the concentrated illumination on the road surface.

55. D — The no-start occurs approximately once per week. When it happens, there is no click and no lamp dimming — the starter solenoid does not receive the start signal. Cycling the key resolves it. The ignition switch, neutral safety switch, clutch interlock, or start relay has an intermittent contact that occasionally fails. Any of these could produce this symptom pattern.

56. B — The updated calibration was written by the engine manufacturer and may intentionally include a different base idle speed. Manufacturers update calibrations for various reasons — revised emission strategies, component durability improvements, or NVH refinements — and these updates may include idle speed changes as part of the revised operating parameters.

57. A — The 15-amp fuse protects the wiring, not the lamps. The wiring gauge was selected for the original 12-amp incandescent load and is rated for 15 amps. Reducing the fuse to match the 3-amp LED load would protect the LEDs but a 5-amp fuse would provide no protection margin — the wiring is still the component that needs fuse protection from short circuits.

58. D — Two 120-ohm resistors in parallel should read 60 ohms. A reading of 120 ohms means only one resistor is in the circuit. One of the two terminating resistors has failed open — it is no longer completing the parallel combination. The remaining single 120-ohm resistor produces the full 120-ohm reading at the test point.

59. B — Before diagnosing the charging system, verify the alternator's actual output at the B+ terminal. If the alternator produces 14.2V at B+ but the dash reads 12.2V, the problem is in the circuit between the alternator and battery. If the alternator produces only 12.2V at B+, the alternator or its field circuit is the problem. The B+ measurement directs the diagnosis.

60. C — The ECM sensor reads 85°C and the dash gauge reads 95°C — a 10°C discrepancy. Neither reading should be assumed correct without independent verification. An infrared thermometer or thermocouple at each sensor location will determine the actual coolant temperature and identify which sensor is reading accurately and which has drifted from calibration.

61. A — The alternator produces full rated output, the charging cables are good, and the voltage drop is within specification — the charging system delivers adequate voltage and current to the batteries. If the batteries still never reach full charge, the vehicle's total electrical consumption (accessories plus parasitic loads) may exceed what the alternator can supply while also charging.

62. D — The bulb is new and the fuse is good — confirming the lamp and circuit protection are functional. In a multiplexed system, the body controller's internal output driver (typically a MOSFET) is the switch that controls current to the lamp. A failed output driver on the right low-beam channel cannot conduct current to the lamp despite receiving the correct command.

63. B — A TPS reading of 4.8V with the pedal released (specification 0.5-0.8V) indicates the signal is at near-maximum voltage. On an NTC-type potentiometer, the high-resistance end of travel produces the highest voltage. The sensor element has failed in the high-resistance position, pulling the signal voltage to near the 5V reference regardless of the actual pedal position.

64. C — All gauges reading zero while the engine runs normally and warning lamps work during bulb test indicates the cluster is not receiving live engine data. The gauges require CAN bus data from the engine ECM to display readings. A failed CAN bus connection to the cluster cuts off the data feed. Warning lamps may operate on direct hardwired inputs independently of CAN communication.

65. A — The starter draws correct current and cranks at normal speed (confirming battery, starter, and engine compression are adequate). The scan tool shows 0 bar rail pressure during cranking despite the ECM commanding injection. The fuel is not reaching the rail — the problem is in the fuel delivery path from tank to high-pressure pump, or the pump's mechanical drive has failed.

66. D — A new body controller setting the same internal communication fault immediately after installation suggests the fault is caused by an external condition affecting the controller — not by the controller itself. Power supply voltage fluctuations or ground circuit problems can disrupt the internal communication between the controller's processor and output stages.

67. A — The engine runs normally on sensor #1 alone, but the loss of the redundant sensor #2 means the ECM has no backup to verify the primary sensor's accuracy. Many systems limit maximum engine power as a precautionary derate when redundancy is lost — the ECM cannot detect if sensor #1 fails or sends an incorrect signal without the cross-check from sensor #2.

68. A — The headlamp aim is verified correct, but the beam pattern differs from the opposite side. The most common cause is a replacement headlamp from a different manufacturer with a different internal optical design — different reflector geometry, LED array positioning, or lens optics produce a different beam pattern even at the identical aim setting.

69. C — In direct drive (1:1 ratio), the power flows straight from the input shaft through the main shaft to the output shaft — the countershaft is unloaded. In all other gears, the power path runs through the countershaft gears. If the noise disappears in direct drive, the source must be the countershaft or its bearings — because they are the only components unloaded in direct.

70. A — A harsh bump from Neutral to Drive at idle with smooth shifts during driving indicates the engagement speed differential is too high. An elevated idle speed increases the speed difference between the spinning impeller and the stalled turbine. When the forward clutch engages, this larger speed differential produces the harsh bump from the sudden torque transfer.

71. D — The driveshaft was balanced as a complete assembly — including the yoke positions, tube, balance weights, and slip joint. Reinstalling the shaft in a different rotational orientation changes the mass distribution relative to the yokes. The balance weights are no longer in the correct position relative to the driveshaft's rotational axis, potentially introducing vibration.

72. B — A vibration felt in the clutch pedal only at the fully released position that disappears with 5 mm of pedal depression indicates the release bearing is in slight contact with the rotating pressure plate finger tips. The finger tips oscillate from slight height variation and transmit the vibration through the bearing to the fork and pedal. Pressing the pedal 5 mm lifts the bearing clear.

73. A — Dark oil with a strong burnt odour indicates thermal degradation — the lubricant has been operating above its designed temperature capacity. Sustained high temperatures break down the base oil and exhaust the additive package. The cause could be a blocked axle vent trapping heat, insufficient oil volume, incorrect viscosity, or excessive loading.

74. C — The 12th-to-13th shift requires a simultaneous main box shift and range section shift. The range air cylinder must complete its travel within the time window of the compound shift. If the range cylinder responds too slowly — from air supply restriction, worn seals, or sluggish valve — it cannot complete the shift in the available window, causing the failed engagement.

75. B — During a stall test, the torque converter multiplies the engine torque by approximately 2:1 to 2.5:1. The multiplied torque at the drive wheels can exceed the service brake holding force on a truck with adequate brakes. The creep indicates the stall speed has been reached and the converter's torque multiplication is exceeding the braking capacity — this can be normal.

76. D — The centre bearing bracket mounting height determines the driveshaft's slope between the transmission output and the centre bearing. Changing the bracket height with shims raises or lowers the centre bearing position, which directly changes the operating angle at the first U-joint. Adjusting the bracket restores the correct driveshaft geometry.

77. A — The hydraulic retarder's effectiveness depends on the coolant system's ability to reject the heat generated during retarder operation. A restricted heat exchanger, fouled coolant passages, or reduced coolant flow rate limits the retarder's cooling capacity. As the retarder fluid heats up without adequate cooling, its effectiveness decreases progressively.

78. C — A vibration during clutch engagement that was not present before the disc replacement points to the mating surfaces — the flywheel and pressure plate. A new disc installed against glazed, hot-spotted, or unevenly worn surfaces makes only partial contact during engagement. The intermittent contact produces the vibration until the disc fully clamps and the surfaces conform.

79. B — A clicking noise from the differential during tight low-speed turns with correct lubricant and additive indicates worn spider gear thrust washers. The thrust washers absorb the axial forces during differential action. When worn, the spider gears shift on the cross shaft during each tooth engagement producing the individual clicks during the differential rotation of turning.

80. D — The AMT controller detected clutch slip during full-load 5th gear operation and has limited the torque available in that gear. The controller is protecting the clutch from accelerated destruction — continued full-torque operation through a slipping clutch converts mechanical energy to heat that rapidly destroys the remaining friction material.

81. A — In most full-time 4WD transfer cases without a centre differential, the front and rear axles are locked together at the same speed. During a tight turn on dry pavement, the front wheels must travel a longer path than the rear. The locked transfer case prevents the necessary speed difference, creating driveline windup that releases as grinding noise from the stressed components.

82. A — Automatic transmissions are designed with shift schedules that vary with throttle position. At wide-open throttle, the shift schedule holds each gear longer to keep the engine in its peak power band for maximum acceleration. This delayed upshift under heavy throttle is the designed operating behaviour — not a fault. The transmission shifts earlier at lighter throttle inputs.

83. A — A clunking noise during acceleration/deceleration transitions from the slip yoke area with tight U-joints indicates worn slip yoke splines. The worn splines have rotational free play that takes up during each torque reversal. The drive torque loads one side of the spline, then the coast torque loads the opposite side — the transition between the two produces the clunk.

84. A — Ring and pinion gears are lapped as matched pairs at the factory. The old pinion's tooth profile has worn to conform to the old ring gear's surface. A new ring gear has an unworn tooth profile that does not match the old pinion's worn geometry. The contact pattern mismatch produces the howling noise under the cruise load condition.

85. C — The compression brake's retarding force is produced by the exhaust valves being held open to release compressed air at TDC. At low RPM, the engine oil pressure is lower and the hydraulic force available to actuate the slave pistons is reduced. If the oil pressure at low RPM is insufficient to fully actuate all slave pistons, the brake produces less retarding force.

86. A — The whine occurs only during turns (high flow demand) but not during straight driving (low flow demand). The pump's internal vanes, cam ring, or pressure plates have worn and produce noise only when the pump operates at higher displacement during the increased flow demand of steering input. The low-demand straight-ahead condition does not stress the worn components enough to produce noise.

87. D — The new king pins with tight bushings now hold the knuckle in the axle beam's true geometric position. If the axle beam has a bend or twist from a previous impact, the worn old bushings allowed the knuckle to compensate — the loose bushings masked the beam's true geometry. New tight bushings reveal the actual camber error from the bent beam.

88. C — Air pressure, ride height, and bag condition are correct — eliminating the spring and pressure as variables. Progressively worsening ride quality over 6 months with correct spring function points to the shock absorbers. Worn internal valving no longer dampens the suspension's oscillation effectively, allowing the suspension to bounce excessively.

89. B — The outer edge of the right front steer tire has 8 mm depth versus 12 mm on the inner edge and 10 mm in the centre. The outer-edge-only accelerated wear on one side indicates excessive positive camber that tilts the tire's top outward, concentrating the ground contact force on the outer tread edge during straight-line driving.

90. A — Worn jaw contact surfaces reduce the clamping area and force on the king pin. While the tug test applies a simple longitudinal pull, dynamic driving conditions — emergency braking, rough roads, trailer bounce — produce forces that significantly exceed the tug test forces. Worn jaws may hold during the test but release under severe dynamic loading.

91. D — Stiffer air bags change the suspension's natural frequency. The shock absorbers were matched to the original bags' spring rate and natural frequency. The stiffer bags oscillate at a different frequency that the existing shocks cannot properly control. The mismatched shock absorber damping allows excessive oscillation from the energy stored in the stiffer springs during each bump.

92. A — A stud breaking at the hub flange within 160 km suggests the stud was pre-stressed beyond its yield point before the vehicle was driven. The most common cause is damage from a previous over-torque by an impact wrench that stretched the stud beyond its elastic limit. The pre-stressed stud failed from the additional fatigue loading of 160 km of normal driving.

93. A — Equal adjustment, lining, drum, and air pressure across all positions — but one wheel runs hotter. The brake shoe hardware (anchor pins, return springs, hold-down hardware) may have a binding condition that prevents full shoe retraction after each application. The shoes drag lightly against the drum continuously, generating friction heat between applications.

94. D — A 5 mm dent in the bead seat area prevents the tire bead from sealing against the rim surface at the dent location. The bead requires a smooth, uniform seating surface to maintain the airtight seal under inflation pressure. The gap at the dent allows air to leak between the bead and the damaged rim surface, and the rim must be replaced.

95. B — Rubber bushings must be torqued at ride height. Torquing at full droop twists the bushing's rubber nearly to its maximum deflection in one direction. During normal driving, the suspension must travel through its full range — the pre-twisted bushing reaches its limit in one direction immediately, producing constant stress and premature failure from the restricted range.

96. C — A single rib wearing faster than all adjacent ribs with different depths on the inner and outer edges suggests a compound alignment angle. A specific combination of camber and toe creates a resultant force vector that concentrates the scrubbing wear on one particular rib position — the tread position where the camber tilt and toe drag forces intersect.

97. A — The adjusting nut's lock (lock washer, cotter pin, or lock nut) requires mechanical force to install. This installation force can slightly rotate the adjusting nut — even a fraction of a turn changes the bearing end play. The 0.002-inch change represents the nut's rotational movement during the locking device installation.

98. D — Air springs have a unique characteristic where the spring rate increases proportionally with pressure (and therefore load). As the load increases, the height control valve adds air to maintain ride height, and the increased pressure raises the spring rate proportionally. The ratio of spring rate to suspended mass remains approximately constant, maintaining a nearly constant natural frequency.

99. B — A trailer with a completely non-functional ABS is not legal for commercial operation. Regulations require the ABS system to be maintained in working condition. A non-functional ABS will result in a citation or out-of-service order during a roadside inspection. The foundation brakes still function for stopping, but the regulatory requirement for ABS compliance must be met.

100. C — Slightly cloudy hub oil with an amber tint — not milky white — suggests early-stage moisture contamination. The water has not reached the saturation level that produces the full milky emulsion. The cloudiness indicates water is present and beginning to mix with the oil. The source should be identified and the oil changed before the contamination progresses to bearing damage.

101. A — The dry-park check requires observing the relative movement between specific components. If the knuckle moves relative to the axle beam during the 12-and-6 rocking, the play is in the king pins. If the hub moves relative to the knuckle, the play is in the wheel bearings. This visual observation technique isolates the source without disassembly.

102. B — Moving the tandem to the maximum forward position increases the distance between the king pin (pivot point) and the tandem axle group. This longer effective wheelbase increases the off-tracking distance during turns — the trailer's rear tires follow a path further inside the tractor's path. The increased off-tracking produces more tire scrubbing during tight turns.

103. B — Tire pressure increases during driving from heat generated by tread flexing, sidewall deformation, and road surface friction. The heated air inside the tire expands, raising the pressure. A 25 kPa increase after 100 km of highway driving is within the normal range for a heavy-duty truck tire. Tire pressures should always be set when the tires are cold (at ambient temperature).

104. C — The cab tilt latch is engaged (confirmed), so the cab is held down. The forward movement during braking comes from the cab-to-frame mounting isolators — rubber mounts that have compressed and deteriorated from age. The softened rubber allows the cab to shift forward under braking deceleration forces instead of being firmly positioned on the frame.

105. A — Cab roof leaks traced to the overhead console area commonly originate from roof-mounted penetrations — marker lamp wiring grommets, antenna mounts, roof-mounted accessories, or grab handle mounting bolts. These seals deteriorate over time, and water enters through the compromised seal, travels along the wiring harness or roof structure, and appears at the console location.

106. B — The door lock switches are wired through connectors inside the door panels. The wiring harness flexes with every door opening and closing. Over time, the wires can chafe against the door's internal sheet metal structure, creating intermittent contact that sends random lock/unlock signals to the body controller. The wiring should be inspected at the door hinge and panel areas.

107. D — Failed cab mounting biscuits with metal-to-metal contact create multiple problems simultaneously: direct vibration transmission (NVH), progressive wear on both the cab bracket and frame bracket from the constant contact, and a potential safety concern from the cab shifting under extreme loading. All consequences must be addressed by replacing the failed mounts.

108. C — A mirror with a distorted reflection making vehicles appear further away is most likely a convex (wide-angle) glass installed in the main mirror position. Convex mirrors are designed for wide-angle supplementary views and intentionally make objects appear smaller and further away. The main mirror should use flat glass for accurate distance perception.

109. C — The TRU cools correctly at highway speed but cargo temperature rises during static parking. The condenser relies on ram airflow from highway driving to supplement the condenser fan's heat rejection. During static parking, only the condenser fan provides airflow. If the fan capacity alone cannot match the heat load, the system's cooling capacity decreases during standby.

110. B — The pump runs and the valve shifts (confirmed) but the tilt function is intermittent. The directional valve spool for the tilt circuit has contamination in its bore that causes the spool to stick at an intermediate position during some activations. When stuck, the spool blocks flow to the tilt cylinder. When clear, the spool shifts fully and the tilt operates normally.

111. D — The trailer brakes lock up on wet roads with the ABS lamp off. The ABS may not have a stored fault, but sensor signal quality determines the ABS module's ability to detect impending lockup in real-time. Degraded sensor signals (from contamination, air gap drift, or wiring resistance) may allow wheel lockup to occur before the ABS can detect and modulate it.

112. A — A soft spot in a composite roof panel indicates the internal foam core has deteriorated at that location. Moisture intrusion, heat damage, or delamination has caused the foam to lose its structural support function. The outer skin, no longer backed by rigid foam, flexes when pressed because the core material cannot provide the designed stiffness at the deteriorated area.

113. C — The tractor provides 12.5V at pin 7, but the voltage drops below the ABS module's minimum by the time it reaches the module. The cumulative voltage drop through the connector contact resistance, trailer internal wiring, and any splice connections reduces the available voltage at the module below its operating threshold.

114. B — A crowned flatbed deck prevents flat-bottomed cargo (pallets, containers, skids) from sitting level. The cargo rocks on the crown, concentrating all load force on the centre contact point. This creates stress risers on the pallet corners and can damage cargo that requires uniform flat support during transport.

115. D — Equal adjustment across all positions but the trailer tracks to one side during braking indicates unequal braking force between left and right. With equal stroke, the difference must come from the friction surfaces. Differences in lining friction coefficient, oil contamination, or glazing between sides produce unequal braking force despite identical mechanical adjustment.

116. A — The automatic greasing system has been empty for 10,000 km. All pivot points served by the system have operated without lubrication. The suspension pivot bushings, equalizer beam wear pads, and spring eye bushings should be inspected for accelerated wear from the dry metal-to-metal contact during the lubrication-free operating period.

117. C — The compressor runs quietly for 30 minutes (adequate oil return) then becomes noisy over 10 minutes (oil starvation) before recovering (oil surge returns). A low spot in the suction line traps oil until enough accumulates. During high-demand periods, the refrigerant flow velocity increases enough to carry the pooled oil back to the compressor, restoring lubrication until the pool reforms.

118. B — A gradually intensifying sweet smell from the heater vents without visible wetness indicates a micro-leak in the heater core. The leak is too small to produce drips — the coolant vaporizes on the hot core surface immediately. The glycol vapour enters the HVAC airstream and is distributed through the cab vents, producing the characteristic sweet coolant smell.

119. D — A rise from 200 to 500 microns (300 microns) during a 30-minute hold indicates either a system leak or residual moisture that is outgassing into the evacuated space. The maximum acceptable rise is typically 200 microns for a 30-minute hold. The source must be identified — either repair the leak or continue evacuation to remove the remaining moisture — before charging.

120. A — The same HVAC unit produces heat on the passenger side but not the driver side. This indicates the air distribution system, not the heater core or coolant flow, is at fault. A dual-zone system uses separate blend door actuators for each side. The driver's side blend door actuator has failed in the bypass (cold) position while the passenger side operates correctly.

121. C — A variable-displacement compressor that cools adequately in mild weather but poorly in hot weather has a displacement control problem. The compressor cannot increase its displacement to maximum during the high demand of hot weather. The internal control valve has partially failed and cannot achieve the full displacement needed for hot-weather cooling capacity.

122. B — The evaporator drain tube is clogged and the condensate pools in the HVAC housing. During operation, the blower pushes air across the standing water on the evaporator surface, picking up moisture and delivering humid air to the sleeper. The air feels cool (the compressor works) but humid (the moisture is re-evaporated from the pooled condensate).

123. B — A 5 kW heater must overcome the heat losses from the 50-litre cooling system to the -30°C ambient through the engine block mass, hoses, and radiator surface area simultaneously while heating the coolant. The steady-state heat loss rate at -30°C is significant, and the 5 kW output minus the heat losses determines the actual temperature rise rate — 45°C may be within the expected range.

124. A — The hook cylinder and mechanism work correctly, but the container slides backward. The container should grip the truck frame rails and rotate on its rear pivot during raising. Worn or missing anti-slip pads on the guide rails reduce the friction between the container base and the frame, allowing the container to slide instead of pivoting during the raising operation.

125. C — The flow divider's internal spool has worn from 5,000 hours of operation, increasing the spool clearance in its bore. The enlarged clearance allows bypass flow from one outlet to the other through the spool-to-bore gap. The cylinder receiving more flow extends 10% faster while the other receives proportionally less.

126. B — The motor draws 120A vs the 80A specification (50% more current) with correct system pressure. The motor's brushes, commutator, or windings have degraded, reducing the motor's mechanical efficiency. The motor draws more current to produce the same torque but operates at reduced speed because the electrical-to-mechanical conversion efficiency has decreased.

127. D — The accumulator pre-charge is correct and appears functional, but the system doesn't benefit from it. The accumulator is plumbed in the wrong location — on the return (low-pressure) side rather than the pressure (high-pressure) side. The low return pressure cannot compress the nitrogen bladder enough to store meaningful energy for peak demand delivery.

128. C — Systematic diagnosis requires isolating each potential leak source individually. Block the pilot line to verify no false pilot signal opens the POCV. Test the POCV seat with the pilot blocked. Test the cylinder seal by pressurizing one side and monitoring drift with the circuit isolated. Check the valve body for internal cross-port leakage. Each test eliminates one variable.

129. B — The relief valve is set 2,000 kPa above the working pressure for a critical engineering reason. Hydraulic systems experience transient pressure spikes from valve shifting, cylinder cushioning, load changes, and pump pulsation. If the relief valve is set at the working pressure, it opens during every transient spike, wasting energy, generating heat, and providing inconsistent system pressure.

130. B — Cold hydraulic oil has significantly higher viscosity. The pump must draw this thick oil through the inlet strainer and suction line. At cold viscosity, the pump's suction capability cannot fill its chambers completely during each intake stroke — the unfilled portion becomes a vapour pocket that collapses during compression, producing the characteristic cavitation noise.

131. D — The counterbalance valve's pilot ratio determines how sensitive the valve is to pilot pressure changes. A pilot ratio that is too high makes the valve overly responsive to small pressure variations. Normal pump pulsation creates small pressure fluctuations at the pilot port that cause the overly sensitive valve to oscillate between open and closed during the controlled lowering.

132. A — One module consistently running 8°C hotter than all others indicates a cooling deficiency at that module location. A restriction or air pocket in the coolant passage serving that module reduces the flow rate past its cells. Less coolant flow means less heat removal, and the module runs progressively hotter than the evenly-cooled adjacent modules.

133. C — The friction brake system dragging absorbs kinetic energy mechanically before the regenerative system can capture it electrically. Worn brake components creating drag consume energy that should be available for the motor/generator to convert to electrical energy. The 50% reduction in regenerative capture corresponds to the energy lost to the mechanical friction drag.

134. B — The range prediction algorithm uses historical driving data and current battery status. If the driving conditions have changed (different route, heavier loads, higher speeds, colder weather, more accessories) the actual energy consumption exceeds the historical baseline the algorithm uses. The prediction based on old data overestimates range because current consumption is higher.

135. D — The motor provides 50 kW maximum assist but now feels noticeably weaker with adequate battery and no fault codes. Permanent magnet motors gradually lose magnetic strength from thermal cycling over their service life. The weakened magnets reduce the electromagnetic coupling between the stator and rotor, directly reducing the motor's maximum torque and power output.