PRACTICE EXAM 9: RED SEAL TRUCK AND TRANSPORT MECHANIC SIMULATION (135 QUESTIONS)

1. A technician is tasked with steam cleaning an engine compartment before performing diagnostic work. The engine is a common rail diesel with multiple electronic sensors and connectors. What precaution must be taken before steam cleaning?

A. Disconnect only the alternator B+ wire to prevent moisture from shorting the charging circuit during the cleaning operation

B. Cover or protect sensitive electronic components, connectors, and the air intake opening, and avoid directing the high-pressure steam at electrical connections and sensors

C. Remove the engine ECM from the vehicle entirely and store it in a dry location until the steam cleaning is completed and the engine is fully dried

D. Run the engine at high idle during the steam cleaning to ensure all moisture evaporates immediately from the hot engine surfaces before it can penetrate seals

2. A shop is performing a large fleet PM service and has generated 200 litres of used engine oil. The shop's waste oil storage tank is full. A technician suggests pouring the excess oil into empty drums and storing them behind the shop until the waste oil hauler arrives next week. What is the concern with this plan?

A. Used engine oil stored in drums loses its recycling value within 48 hours of being exposed to open air and must be disposed of as hazardous waste instead

B. The drums will attract insects and rodents that contaminate the oil with biological material making it non-recyclable under provincial environmental regulations

C. Storing used oil in drums behind the shop is acceptable as long as the drums are sealed and labelled but there is no environmental concern with temporary outdoor storage

D. Used oil drums stored outdoors must be on a secondary containment pad to capture spills, must be sealed and labelled, and must comply with the provincial storage regulations for waste petroleum

3. A technician is replacing a fuel injector on a heavy-duty diesel engine. During the removal, a small O-ring falls into the injector bore in the cylinder head. The bore leads directly into the combustion chamber. What must the technician do?

A. Install the new injector and start the engine — the O-ring material will burn up harmlessly during the first combustion cycle and pass through the exhaust system as ash

B. Use a magnetic pick-up tool to retrieve the O-ring since the rubber material contains a steel reinforcing wire that will be attracted to the magnetic tool tip in the bore

C. Retrieve the O-ring before installing the new injector because foreign material in the combustion chamber can damage the piston, valves, or injector tip during engine operation

D. Pour a small amount of diesel fuel into the bore to float the O-ring to the surface where it can be easily retrieved with a pair of needle-nose pliers before injector installation

4. A fleet shop has recently experienced two near-miss incidents involving technicians working under vehicles supported only by hydraulic floor jacks. Management has decided to implement a new policy. What is the minimum standard that should be adopted?

A. Every vehicle lifted by a floor jack must be immediately supported by rated jack stands at approved lift points before any technician positions themselves under the vehicle for any purpose

B. Hydraulic floor jacks manufactured after 2020 are equipped with internal safety locks that make jack stands unnecessary as long as the jack is inspected annually by a certified hydraulic equipment technician

C. Technicians may work under vehicles supported by floor jacks only if a second technician is standing by to pump the jack handle if the jack begins to settle during the work being performed underneath

D. The shop should purchase air-over-hydraulic jacks that have a built-in mechanical lock feature eliminating the need for separate jack stands as long as the lock is engaged before work begins

5. A technician is draining the coolant from a heavy-duty diesel engine. The coolant is an extended life (OAT) ethylene glycol product. During draining, approximately 2 litres of coolant spills onto the shop floor near the floor drain. What is the environmental concern?

A. Ethylene glycol coolant is classified as non-toxic to aquatic life and can be safely flushed down the floor drain with water since municipal treatment facilities are equipped to process glycol compounds

B. The coolant spill will evaporate within minutes at normal shop temperatures and does not require cleanup because the glycol content prevents the liquid from reaching the floor drain before evaporation

C. The primary environmental concern is that the coloured dye in the coolant will permanently stain the concrete floor surface and the shop owner will be liable for the cosmetic damage to the facility

D. Ethylene glycol is toxic to animals and aquatic life and must not enter the floor drain — the spill must be contained with absorbent material immediately and disposed of as regulated waste

6. During a routine PM inspection, a technician finds that the driver's seatbelt webbing has a 25 mm cut approximately 100 mm from the latch plate. The cut does not extend more than halfway through the webbing width. What action is required?

A. Apply a seatbelt webbing repair patch over the cut using the adhesive-backed repair kit approved by the seatbelt manufacturer for field repairs of partial-width webbing damage

B. Document the finding as informational and advise the driver to request a replacement at the next major service since the remaining webbing width provides adequate restraint strength

C. Replace the seatbelt assembly because any cut or damage to the webbing compromises its ability to restrain the occupant during a collision and the belt cannot be field-repaired safely

D. Fold the webbing to conceal the cut and secure it with a zip tie so the damaged section is not exposed to the latch plate's abrasion during normal use until a replacement belt is ordered

7. A technician notices that an apprentice is using an open-end wrench to tighten a brake bleeder screw. The apprentice rounds the hex corners on the bleeder because the wrench slipped twice during tightening. What tool should have been used?

A. A six-point box-end wrench or socket that fully engages all six corners of the hex and distributes the turning force evenly to prevent rounding the softer brass or steel bleeder fitting

B. A twelve-point socket that provides twice as many contact points as a six-point tool distributing the force across a larger surface area to prevent rounding the bleeder's hex corners

C. An adjustable wrench set to the tightest possible jaw setting to maximize the contact with the bleeder hex and prevent the jaw from slipping during the tightening rotation of the tool

D. A pair of locking pliers adjusted to grip the bleeder hex tightly since the pliers can conform to the shape of the slightly rounded hex and apply more tightening force than a wrench

8. A technician is performing electrical work on a truck and needs to solder a wire connection in the engine compartment. The soldering iron is plugged into a 120-volt shop outlet. What electrical safety device should protect the outlet circuit?

A. A standard 15-amp circuit breaker that trips if the soldering iron draws more than the circuit's rated capacity protecting the building wiring from overcurrent damage

B. A ground fault circuit interrupter (GFCI) that detects imbalanced current between the hot and neutral conductors and trips within milliseconds to protect the technician from electrical shock

C. A surge protector power strip that filters voltage spikes from the shop's electrical system to protect the soldering iron's heating element from damage caused by transient overvoltage events

D. An isolation transformer that separates the soldering iron's circuit from the building ground system to prevent any ground fault current from flowing through the technician's body during the work

9. A heavy-duty diesel engine has a complaint of excessive white smoke during DPF regeneration only. The white smoke is not present during normal driving. Coolant level is stable. What is the most likely cause of the regeneration-only white smoke?

A. The DOC has failed and cannot oxidize the late-post injection hydrocarbons which exit the tailpipe as unburned white fuel vapour during the regeneration cycle only

B. The SCR catalyst is overheating during regeneration and the excessive temperature is decomposing the ammonia stored on the catalyst surface producing white ammonia gas

C. The DPF substrate has developed cracks that open during the thermal expansion of regeneration allowing combustion gases to bypass the filter and exit as visible white smoke

D. The late-post fuel injection is delivering excessive fuel to the exhaust — more than the DOC can oxidize — and the unburned hydrocarbons pass through the DPF as white fuel vapour

10. A truck's engine oil analysis report shows chromium levels at 15 ppm — significantly above the previous trend of 2 to 4 ppm. Iron and aluminium levels remain stable. What specific engine component contains chromium and is the most likely source?

A. The main bearing overlays which use a chromium alloy coating to resist corrosion from acidic combustion byproducts that enter the oil through blow-by during normal engine operation

B. The exhaust valve faces which are chrome-plated for heat resistance and the chrome is being eroded by the hot exhaust gas flow during each exhaust valve opening event in the cycle

C. The piston ring faces — specifically the top compression ring which is typically chrome-plated for wear resistance — and the elevated chromium indicates accelerated ring face wear

D. The crankshaft journal surfaces which are chrome-hardened for wear resistance and the elevated reading indicates the journal surfaces are wearing faster than the bearing overlay material

11. A heavy-duty diesel engine is being tested on a chassis dynamometer. At full load and rated speed, the engine produces 350 horsepower. The specification calls for 400 horsepower. All fuel system parameters (rail pressure, injector delivery, timing) are within specification. What should be checked to account for the 50-horsepower shortfall?

A. The turbocharger boost pressure and the intake air restriction because insufficient air charge limits the fuel that can be burned completely reducing the engine's peak power output below specification

B. The exhaust backpressure from the aftertreatment system because a partially loaded DPF or restricted SCR catalyst robs engine power by forcing the engine to work against the elevated exhaust restriction

C. The charge air cooler effectiveness because a cooler that is restricted or has reduced efficiency delivers hotter less-dense intake air that reduces the oxygen available for combustion at full load

D. The engine's parasitic losses from accessories (air compressor, power steering pump, alternator, fan) because these loads subtract directly from the engine's gross power output reducing net available power

12. A diesel engine has a condition where it runs away — the engine speed increases uncontrollably toward the maximum governed RPM. The driver shuts the engine off with the key but the engine continues to run. What is happening and what should be done?

A. The fuel injection system has stuck in the full-delivery position and the only way to stop the engine is to engage a gear and stall it against the locked driveline transmission brake

B. The engine is ingesting a flammable substance through the air intake (such as crankcase oil, turbo seal oil, or ambient vapours) that fuels combustion independently of the diesel fuel injection system

C. The engine ECM has lost communication with the fuel metering system and the default fuel delivery is at maximum — disconnecting the battery will shut down the ECM and stop fuel delivery immediately

D. The engine's governor spring has broken and the injection pump cannot return to the idle position — blocking the fuel supply line with a clamp will starve the engine of fuel and stop it safely

13. A technician is measuring the piston-to-head clearance (squish clearance) on a diesel engine using soft lead wire or clay placed on the piston crown. After rotating the engine through TDC by hand, the compressed wire measures 0.5 mm. The OEM specification is 0.8 to 1.2 mm. What is the risk of this insufficient clearance?

A. The piston may contact the cylinder head during normal operation from thermal expansion causing catastrophic mechanical damage to the piston crown, head surface, and valve train components

B. The reduced clearance concentrates the combustion energy into a smaller volume creating detonation-like pressure spikes that fatigue the connecting rod bearings and crankshaft journals prematurely

C. The squish effect is too aggressive and the increased air velocity in the squish area promotes pre-ignition of the fuel charge before the injector fires causing rough idle and cold-start knocking

D. The reduced squish clearance increases the compression ratio above the engine's design limit which raises cylinder pressure beyond the head gasket's clamping capacity causing gasket failure

14. A common rail diesel engine produces a metallic knocking noise from one cylinder that is louder at idle and diminishes as RPM increases. The noise is eliminated when the injector on that cylinder is electronically disabled through the scan tool. What does this confirm?

A. The connecting rod bearing on that cylinder has excessive clearance and the knocking is caused by the bearing impact under the combustion load that is eliminated when fuelling stops

B. The piston pin on that cylinder is worn and the combustion pressure pushes the piston against the worn pin producing the knock that stops when the combustion event is eliminated

C. The fuel injector on that cylinder is delivering too much fuel causing a hydraulic pressure spike in the combustion chamber that produces the metallic knock heard at idle speed

D. The noise could be from an over-advancing injector, excessive fuel delivery, or a combination creating a combustion knock — eliminating the injection stops the combustion event and the noise

15. A truck's engine coolant has been tested with a refractometer and shows a freeze protection level of -25°C. The fleet operates in Northern Alberta where winter temperatures regularly reach -40°C. What specific action is needed?

A. Drain a portion of the coolant and replace it with concentrated antifreeze to raise the glycol percentage until the refractometer reads -45°C or lower for adequate Northern Alberta freeze protection

B. Add supplemental coolant additive (SCA) to the existing coolant which depresses the freeze point by an additional 15°C beyond the current glycol-based protection level reading on the refractometer

C. Switch to a propylene glycol coolant because propylene glycol provides significantly better freeze protection than ethylene glycol at the same concentration ratio in the cooling system mixture

D. Install an engine block heater as the primary freeze protection strategy and leave the coolant at its current protection level since the block heater prevents freezing during overnight parking periods

16. A diesel engine's variable geometry turbocharger has the vanes replaced during a turbocharger rebuild. After reinstallation, the engine produces adequate boost at high RPM but very little boost at low RPM. The VGT actuator moves through its full range when tested with the scan tool. What was likely done incorrectly during the rebuild?

A. The VGT actuator was not calibrated after the rebuild and the ECM's commanded vane positions do not correspond to the actual physical positions of the new vanes in the turbine housing

B. The new vanes were installed with the wrong orientation and their angle creates restriction at high RPM (producing boost from forced flow) but cannot accelerate gas at low RPM flow rates

C. The turbine housing was not cleaned properly before reassembly and residual carbon deposits prevent the new vanes from closing fully at low RPM where maximum closure is needed for boost

D. The VGT actuator calibration was not performed after the vane replacement — the ECM's learned positions for the old vanes do not match the new vanes' physical positions causing incorrect vane angles at low RPM

17. An oil analysis trending report for a heavy-duty diesel engine shows a gradual increase in silicon and aluminium over three consecutive samples while all other metals remain stable. What condition does this dual-element trend suggest?

A. The engine's pistons are wearing (aluminium) and the cylinder liners are scuffing (silicon) from insufficient lubrication during cold-start conditions

B. Dirt is entering the engine through a compromised air filtration system — silicon is from airborne silica (sand/dust) and aluminium is from the piston material being abraded by the ingested particles

C. The coolant has become contaminated with antifreeze that contains silicate corrosion inhibitors (silicon) and the corrosion is attacking the aluminium components in the cooling system

D. The engine oil additive package is breaking down releasing both silicon-based anti-foam agents and aluminium-based viscosity modifiers into solution that appear as wear metals in the analysis

18. A diesel engine's fuel system has a transfer pump that supplies fuel from the tank to the high-pressure pump. The transfer pump produces 450 kPa of supply pressure. During diagnosis of a low-power complaint, the technician measures the transfer pump pressure and reads 280 kPa. What effect does this reduced supply pressure have on the high-pressure system?

A. The high-pressure pump cannot fill its compression chambers completely during each intake stroke because the reduced supply pressure provides insufficient fuel volume to charge the pump at rated engine speed

B. The high-pressure pump compensates automatically for the lower supply pressure by increasing its stroke length and the engine performance is not affected until the supply drops below 150 kPa

C. The reduced supply pressure only affects the engine during cold starts when the fuel viscosity is highest — at operating temperature the thinner fuel flows freely regardless of the transfer pump pressure

D. The fuel rail pressure sensor compensates for the lower supply pressure by commanding the metering unit to open wider which fully offsets the reduced transfer pump output at all engine operating conditions

19. A technician is replacing a diesel engine's cylinder head gasket. The head gasket is a multi-layer steel (MLS) type. Before installing the new gasket, what surface preparation is critical for MLS gasket sealing?

A. Apply a thin layer of gasket sealant to both sides of the MLS gasket to ensure positive sealing between the gasket's embossed steel layers and the mating surfaces of the block and head

B. Roughen the block and head surfaces with 60-grit sandpaper to provide a mechanical grip for the MLS gasket since the smooth metal layers require surface texture to prevent the gasket from shifting

C. Verify that both the block deck and head deck surfaces are clean, flat, and within the manufacturer's surface finish specification because MLS gaskets require extremely smooth surfaces for proper sealing

D. Coat the head bolts with anti-seize compound to ensure accurate torque readings during the head bolt tightening sequence since MLS gaskets require more precise torque control than fiber gaskets

20. A heavy-duty diesel engine has been running at idle for 8 hours during a winter overnight rest period. When the driver increases the RPM to depart, the engine surges and hunts for approximately 30 seconds before settling into smooth operation. What is the most probable cause of this momentary instability?

A. The fuel injector nozzle tips have accumulated carbon during the extended idle period and the carbon partially blocks the spray holes until the increased fuel pressure and flow at higher RPM clears the deposits

B. The turbocharger shaft bearings have cooled during the extended idle and the thickened oil creates momentary resistance to spool-up until the oil warms and thins from the increased exhaust flow at higher RPM

C. The engine oil has cooled below its optimal viscosity range from the extended idle and the thickened oil creates resistance in the hydraulically actuated fuel system until the oil reaches operating temperature

D. The EGR valve has accumulated moisture condensation during the extended idle period and the water momentarily disrupts the intake air charge until it evaporates from the increased exhaust heat at higher RPM

21. A heavy-duty diesel engine has a diagnostic code for high crankcase pressure. The CCV system has been verified as clean and functioning. A blow-by test using a calibrated flow meter shows blow-by at the maximum acceptable limit. Compression testing shows all cylinders within specification. What could explain the borderline blow-by with good compression?

A. The compression test was performed with the engine cold which produces artificially high readings because the tighter cold clearances between rings and liners temporarily seal better than when the engine is hot

B. The piston rings may be worn but the ring end gaps are not yet large enough to cause a measurable compression loss — the gaps allow gas to pass during the power stroke (blow-by) but still seal adequately during the compression stroke

C. The engine block has a cracked cylinder wall that leaks combustion gas into the crankcase but does not affect compression because the crack is below the lowest ring travel position and only pressurizes during the power stroke

D. The valve guide seals have failed and combustion gas is leaking past the valve stems into the crankcase through the guide clearance which the blow-by test measures as crankcase pressure but compression testing does not detect

22. A diesel engine has been operating with biodiesel fuel (B20 — 20% biodiesel blend) for the past year. The engine's fuel filters are clogging at double the rate compared to when the engine ran on standard diesel. What property of biodiesel causes this accelerated filter clogging?

A. Biodiesel acts as a solvent that dissolves existing fuel system deposits from the tank walls, fuel lines, and internal components — the dissolved material then accumulates on the fuel filter element at an accelerated rate

B. Biodiesel has a higher cloud point than standard diesel and the wax crystals that form at moderate temperatures clog the filter element faster than the paraffin wax in standard diesel fuel compositions

C. Biodiesel produces more combustion soot than standard diesel and the additional soot contamination enters the fuel return circuit and clogs the filter on the supply side during each return flow cycle

D. Biodiesel has a higher moisture absorption rate than standard diesel and the absorbed water promotes microbial growth in the fuel system — the microbial colonies produce biomass that clogs the filter

23. A diesel engine equipped with a NOx adsorber catalyst (NAC) instead of an SCR system has a fault code indicating the catalyst efficiency is below threshold. The engine does not use DEF. How does the NAC system reduce NOx emissions, and what causes its efficiency to decline?

A. The NAC stores O_2 during lean operation and releases it during rich operation to oxidize NOx into harmless N_2 — efficiency declines from oxygen sensor contamination that prevents accurate rich/lean cycling

B. The NAC uses a platinum washcoat that chemically bonds with NOx molecules permanently removing them from the exhaust stream — efficiency declines as the platinum sites become saturated with stored NOx

C. The NAC absorbs and stores NOx during normal lean diesel operation and periodically purges the stored NOx through a brief rich-fuel event — efficiency declines from sulphur poisoning of the catalyst surface

D. The NAC converts NOx to ammonia using a secondary fuel injection into the exhaust and then converts the ammonia to N_2 on a downstream catalyst — efficiency declines from ammonia slip catalyst degradation

24. A technician is diagnosing a diesel engine that starts and runs for exactly 30 seconds before shutting down. The engine restarts immediately and runs for another 30 seconds before shutting down again. The pattern is perfectly consistent. There are no active fault codes. What should the technician investigate?

A. The fuel tank return line for a restriction that creates backpressure on the injector return circuit — the pressure builds over 30 seconds until it exceeds the injector closing force and the engine starves of fuel

B. The engine oil pressure for a gradual drop that triggers a low-oil-pressure shutdown after 30 seconds — the engine restarts with a brief surge of cold oil pressure that decays as the oil thins from engine heat

C. The fuel system for an intermittent air ingestion problem that takes 30 seconds to draw enough air into the fuel circuit to cause the engine to stall from the accumulated air disrupting fuel delivery to the rail

D. The anti-theft or security system for a timed engine shutdown — some immobilizer systems allow the engine to run for a preset duration (typically 30 seconds) before shutting down if the security key is not authenticated

25. A diesel engine's EGR cooler has been replaced due to a leak. After the replacement, the engine runs normally but the EGR flow rate measured by the scan tool is 15% lower than the commanded value at all operating conditions. What should be checked?

A. The EGR valve actuator for a calibration error that occurred when the new cooler was installed — the actuator may need to be recalibrated to account for the new cooler's flow characteristics

B. The new EGR cooler for a mismatch in internal tube diameter, tube count, or flow path configuration that creates more restriction than the original cooler's design and limits the maximum EGR flow rate

C. The intake manifold differential pressure sensor for a drift that causes the ECM to underestimate the actual EGR flow — the flow may be correct but the sensor reads low and triggers the underage fault

D. The exhaust manifold pressure upstream of the EGR cooler inlet for a restriction that reduces the pressure differential driving the exhaust gas through the cooler and into the intake manifold at all conditions

26. A heavy-duty diesel engine has been rebuilt. During the initial break-in period on a dynamometer, the technician monitors the crankcase pressure with a water manometer. Over the first 4 hours of break-in, the crankcase pressure gradually decreases from 100 mm H_2O to 50 mm H_2O. What does this decreasing trend indicate?

A. The piston rings are seating progressively against the cylinder liner walls — as the rings conform to the bore surface the blow-by decreases and the crankcase pressure drops correspondingly during the break-in period

B. The engine oil is gradually migrating from the crankcase into the combustion chambers through the ring end gaps and the reduced oil volume in the crankcase lowers the pressure reading on the manometer

C. The crankcase ventilation system is gradually clearing residual assembly debris and sealant that was partially blocking the vent path and the improved venting lowers the measured crankcase pressure over time

D. The cylinder liner surface honing pattern is being polished away by the new rings and the smoother surface creates less turbulence in the crankcase gases resulting in a lower pressure reading on the manometer

27. A diesel engine equipped with a DPF has been parked for 6 weeks. When the engine is started, the DPF differential pressure sensor reads significantly higher than the value recorded before the parking period. The engine has not been operated since parking. What caused the pressure reading to increase while the engine was off?

A. Moisture has condensed inside the DPF substrate during the extended parking period and the liquid water has partially filled the filter channels increasing the measured differential pressure reading

B. The DPF soot has chemically oxidized from ambient air exposure during the parking period and the resulting ash residue has a higher flow resistance than the original soot that it replaced in the filter channels

C. The differential pressure sensor tubes have developed moisture or condensation blockage during the extended cold-soak parking period that creates a false high-pressure reading until the tubes dry out during operation

D. The DPF substrate has experienced thermal shock from the temperature differential between the hot engine shutdown temperature and the ambient parking temperature causing micro-cracks that increase restriction

28. A heavy-duty diesel engine has developed a knocking noise from the front of the engine that increases with RPM. The noise is present at idle and becomes louder and more rapid as RPM increases. The noise does not change when individual injectors are disabled. What front-of-engine component should be inspected?

A. The crankshaft vibration damper (harmonic balancer) for a failed rubber element, a separated inertia ring, or a loose mounting bolt that allows the damper to wobble on the crankshaft creating the speed-dependent knock

B. The front crankshaft main bearing for excessive clearance that allows the crankshaft nose to oscillate radially producing a knock that increases with RPM from the centrifugal loading on the rotating assembly

C. The oil pump drive gear inside the front timing cover for a chipped tooth that impacts the driven gear once per revolution creating a knock frequency that increases proportionally with engine speed

D. The front engine mount for a failed rubber element that allows the engine to contact the frame cross-member during each combustion impulse producing a knock that increases with the firing rate at higher RPM

29. A diesel engine has been fuelled with gasoline accidentally. The driver drove approximately 5 km before the engine began running rough and lost power. The engine was shut down and the truck was towed to the shop. What damage is most likely to have occurred?

A. The cylinder liners are scored from the gasoline washing the protective oil film from the liner walls because gasoline is a solvent that removes the lubricating oil boundary layer from the piston ring contact area

B. The fuel injectors, high-pressure pump, and fuel metering components are damaged because gasoline lacks the lubricity of diesel fuel and the reduced lubrication causes rapid metal-to-metal wear in the precision-fit components

C. The turbocharger bearings are damaged because the gasoline combustion produces significantly higher exhaust temperatures that exceed the turbocharger bearing oil's thermal breakdown temperature threshold

D. The cylinder head gasket has failed because gasoline has a lower autoignition temperature than diesel and the resulting pre-ignition detonation produces pressure spikes that exceed the gasket's clamping capacity

30. A truck's air compressor has been rebuilt with new piston rings and valves. After installation, the compressor builds air pressure but significantly slower than specification — the build-up time from 585 to 690 kPa exceeds the maximum allowable time. All downstream components (dryer, governor, reservoirs) have been verified as correct. What should be checked on the rebuilt compressor?

A. The compressor's unloader mechanism for a failure that is partially unloading the compressor during what should be the loaded (compressing) phase reducing its effective pumping capacity

B. The compressor's discharge valve for incorrect seating that allows compressed air to leak back through the valve during the compression stroke reducing the net air volume delivered per cycle

C. The compressor's intake valve for restricted opening that limits the air volume entering the cylinder during the intake stroke resulting in less air available for compression on each upstroke cycle

D. The compressor's crankshaft bearing clearances for excessive play that allows the piston to tilt in the bore during the compression stroke reducing the effective compression ratio and output volume

31. A heavy-duty truck equipped with rear drum brakes and front disc brakes has a complaint of poor braking performance. During testing, the technician measures the stopping distance and finds it exceeds the specification by 20%. All brake adjustments are within specification. What system-level condition could explain the extended stopping distance despite correct individual brake adjustment?

A. The front disc brake pads have a lower friction coefficient than the rear drum linings creating an imbalance where the front brakes contribute less stopping force than designed despite correct adjustment

B. The air system pressure is at the governor cut-out specification but the actual delivery pressure at the brake chambers during application is reduced from restricted relay valves, long lines, or undersized fittings

C. The ABS system is activating prematurely on the front disc brakes because the steer axle is lightly loaded and the ABS reduces front brake pressure before maximum deceleration is achieved on every stop

D. The brake chambers have correct stroke but the air pressure delivery rate to the chambers is too slow causing a gradual build-up that delays full braking force instead of the designed rapid application response

32. A truck's front steer axle air disc brakes produce a high-pitched squeal during moderate to heavy braking. The pads are at 60% life remaining, the rotors are within specification, and the caliper slide pins move freely. What is the most probable cause?

A. The brake pad friction material compound has hardened from heat exposure creating a glazed surface that vibrates against the rotor at an audible frequency during moderate to heavy application pressure

B. The brake pad anti-rattle clips or springs are missing or incorrectly installed allowing the pads to vibrate in the caliper bracket during application which produces the high-pitched squeal from the metal contact

C. The rotor has developed a micro-thin layer of corrosion at the pad contact area during overnight parking that produces a squeal until the friction material clears the surface oxide during the first few stops

D. The brake caliper piston bore has developed scoring that causes the piston to tilt slightly during application pressing the pad unevenly against the rotor which excites a harmonic vibration producing the squeal

33. A trailer equipped with spring brakes has been parked for several weeks. When the tractor couples and supplies air, the spring brakes on one axle do not release. Air pressure at the spring brake chambers reads full supply pressure. What is the most probable cause?

A. The spring brake chambers on that axle have internal corrosion from moisture that has caused the power springs to bind in their housing preventing them from compressing even with full supply air pressure applied

B. The brake shoes on that axle have rusted to the brake drum surface during the extended parking period and the spring brake chambers are functioning correctly but cannot overcome the mechanical bond between shoes and drum

C. The spring brake relay valve for that axle has failed in the exhaust position and is dumping the supply air before it can reach the spring chambers despite the gauge showing pressure at the supply line upstream

D. The air lines to the spring brake chambers on that axle have frozen condensation blockages that prevent the supply air from reaching the spring brake diaphragm even though pressure reads correctly at the supply fitting

34. A truck's brake pedal has a noticeably harder feel than normal — the driver must push with significantly more force to achieve the same braking effect. The air system pressure is normal and there are no air leaks. What should be checked?

A. The brake chambers for seized pushrod seals that resist the diaphragm's movement during application requiring more air pressure (and therefore more pedal effort) to achieve the same pushrod stroke

B. The foot valve return spring for a binding condition that prevents the foot valve plunger from responding to light pedal input — the driver must push harder to overcome the binding spring resistance

C. The relay valves for internal contamination that increases the crack pressure — the valves require higher input signal pressure to begin delivering air to the brake chambers compared to their designed crack pressure

D. The foot valve for a restricted air inlet port that limits the air flow rate entering the valve during pedal application — the driver pushes harder trying to force more air through the restricted port for faster response

35. An S-cam brake has one shoe contacting the drum but the other shoe on the same wheel is not contacting. The S-cam rotates when the brake is applied. What is the most likely mechanical cause?

A. The non-contacting shoe has a broken anchor pin that prevents the shoe from pivoting when the S-cam pushes against its roller allowing the shoe to slide along the backing plate instead of rotating into the drum

B. The S-cam lobe on the non-contacting shoe's side has worn flat and cannot push that shoe's roller outward far enough to bring the lining into contact with the drum surface during the brake application cycle

C. The brake shoe return spring on the non-contacting side has seized in the retracted position with enough force that the air chamber pressure cannot overcome the spring's resistance to extend the shoe outward

D. The automatic slack adjuster has over-adjusted the brake so far that the S-cam has rotated past its effective range on one side — the cam pushes one shoe normally but has passed the peak for the other shoe

36. A truck driver reports that the vehicle pulls to the left during a hard stop on dry pavement. During moderate braking, the vehicle stops straight. What does this speed-dependent pull indicate?

A. The left front brake has a higher friction coefficient lining that only produces enough additional force to overcome the vehicle's directional stability at high deceleration rates during hard braking events

B. The right front brake has a condition that limits its maximum force output — at moderate braking both sides produce similar force but during hard braking the right side cannot match the left side's maximum output

C. The ABS system is modulating the right front wheel excessively during hard braking because the wheel speed sensor on that side has a calibration error that triggers ABS intervention below the actual lockup threshold

D. The steering gearbox has excessive play that allows the steering to shift under the heavy deceleration forces of hard braking creating a pull that is not perceptible during the lighter forces of moderate braking

37. A truck's air brake system has an unusual condition where the brakes apply with a delay when the pedal is first pressed, but once applied, the braking force is normal and the brakes hold as expected. The delay is approximately 1 second longer than normal. What is the most likely cause?

A. One or more brake chamber pushrod strokes are excessively long requiring additional air volume to fill the extra chamber travel before the diaphragm contacts the pushrod and begins moving the brake application mechanism

B. The air dryer has a restricted outlet that limits the flow rate from the dryer to the reservoirs and the downstream brake valve cannot deliver air faster than the restricted dryer allows during the initial application phase

C. The foot valve has worn inlet seals that allow a brief bypass before the seals seat under pressure and begin delivering application air — the one-second delay is the time required for the seals to seat under pedal pressure

D. The relay valves have a delayed response from contaminated internal pistons that require a higher signal pressure to overcome the static friction before they begin delivering air to the brake chambers from the reservoirs

38. A trailer's brake adjustment has been verified and all pushrod strokes are within specification. However, during a brake application test, the right rear wheel on one axle produces significantly less braking force than the left rear wheel. Both brake chambers are the same type and size. What should be inspected?

A. The brake drum on the right side for an out-of-round condition or excessive diameter that prevents the properly adjusted shoe from contacting the drum with adequate force across the full lining contact area

B. The automatic slack adjuster arm length on the right side for an incorrect replacement unit that has a different arm length than the left side changing the mechanical advantage of the application even at the same stroke

C. The air supply line to the right rear brake chamber for a partial restriction that slows the air delivery to that chamber during application producing a delayed and reduced braking force on that wheel position

D. The brake lining on the right side for oil contamination from a leaking axle seal that has reduced the friction coefficient of the lining material below the level needed for adequate braking force at that wheel position

39. A truck's automatic slack adjuster has been manually backed off to create excessive clearance for brake drum removal during a brake job. After installing the new linings and drum, the technician installs the slack adjuster but forgets to reset it to the correct initial adjustment. What will happen during the first few brake applications?

A. The excessive clearance will cause a brake imbalance until the automatic slack adjuster gradually takes up the extra clearance over the next 10 to 15 brake applications as the adjuster's internal mechanism ratchets to the correct position

B. The automatic slack adjuster will immediately take up all the excess clearance on the first brake application and the brake will be at the correct adjustment from the first stop after the installation

C. The excessive clearance may cause the brake chamber pushrod to exceed its maximum stroke limit before the linings contact the drum potentially causing the diaphragm to bottom out and the chamber to be damaged

D. The automatic slack adjuster will not function because it requires the initial clearance to be set within the manufacturer's specified range before the automatic adjustment mechanism can engage and operate correctly

40. A truck equipped with electronic braking system (EBS) has a complaint that the rear axle brakes apply too aggressively during light pedal applications. The front brakes feel normal. The EBS system has no fault codes. What should be investigated?

A. The rear axle load sensor for an incorrect reading that tells the EBS controller the rear axle is more heavily loaded than it actually is causing the controller to command higher rear brake pressure during light applications

B. The rear brake pad friction material for a higher-than-specification coefficient that produces more stopping force per unit of pressure application than the EBS controller's calibration expects for the rear axle position

C. The EBS rear axle pressure modulator for a proportioning error that delivers higher-than-commanded pressure to the rear brake chambers during light application despite the controller's command for reduced pressure

D. The EBS pedal travel sensor for a non-linear response that sends a higher-than-actual pedal position signal to the controller during light pedal travel causing the controller to command excessive rear brake pressure

41. A truck's parking brake holds the vehicle on a moderate grade. However, when the driver releases the parking brake to depart, the truck rolls backward approximately 300 mm before the service brakes can be applied. What feature, present on some modern air brake systems, prevents this rollback?

A. A hill-hold or anti-rollback feature that maintains service brake pressure or delays the spring brake release until the driver begins to accelerate preventing the vehicle from rolling during the parking-to-driving transition

B. The parking brake valve is designed with a metered release that gradually releases the spring brakes over a 3-second period allowing the driver time to apply the service brakes before the spring force fully releases

C. The transmission control module detects the grade through the vehicle's inclinometer and holds the output shaft brake until the engine produces enough torque to prevent rollback during the departure sequence

D. The ABS module continuously monitors the wheel speed during parking brake release and applies the service brakes automatically if it detects any wheel rotation in the reverse direction during the release event

42. A truck's air compressor is running continuously without cycling to the unloaded state. The air pressure gauge reads 950 kPa and continues to rise. What has failed?

A. The air system safety valve which should open at approximately 1,035 kPa to prevent overpressurization has failed in the closed position and the pressure is building beyond the system's design maximum

B. The governor has failed and is not sending the unload signal to the compressor when the cut-out pressure is reached — the compressor continues to compress air and the pressure rises unchecked toward the safety valve setting

C. The air dryer purge valve is stuck open and the pressure reading on the gauge is inaccurate because the purge valve is venting air at the same rate the compressor is supplying it creating a false steady reading

D. The compressor's intake valve is stuck in the open position which actually prevents the compressor from building pressure because it breathes through the open valve during both the intake and compression strokes

43. A tractor-trailer combination has been involved in a minor collision. During the post-collision inspection, the technician finds that one trailer brake chamber has a visible dent in the non-pressure housing (the spring side). The chamber appears to hold air pressure normally. Should the chamber be replaced?

A. The chamber can remain in service because the dent is on the non-pressure housing and the spring side does not contain pressurized air during normal service brake operation

B. Monitor the chamber at the next PM inspection — if the dent has not worsened and the chamber continues to hold pressure normally the chamber is safe for continued service operation

C. The chamber should be replaced because the dent may have weakened the housing wall which contains the powerful spring — a housing failure would release the spring with dangerous explosive force

D. The dent can be repaired by heating the housing and pressing it back to its original shape from the outside using a hydraulic press and a forming die matched to the chamber's original curvature

44. A truck's brake system has been serviced and the rear brakes re-lined. During the post-service road test, the technician performs several moderate stops and notices the rear brakes require significantly more pedal pressure than before the service. What is the most likely cause?

A. The new brake linings have a lower initial friction coefficient than the worn linings they replaced and require a bedding-in period of several hundred stops before the friction level reaches the design specification

B. The new brake linings are the correct part number but the lining arc radius does not match the drum radius — the linings only contact the drum at the ends creating reduced braking force per unit of application pressure

C. The rear brake chambers were accidentally disconnected from the air supply during the service and the technician did not reconnect them properly — the reduced pedal response is from the front brakes working alone

D. The automatic slack adjusters need to readjust to the new lining thickness and the initial adjustment is too loose to provide immediate full contact between the linings and drums during the first several applications

45. A truck's air system has a secondary reservoir that supplies the front steer axle brakes. During testing, the technician discovers that the one-way check valve between the supply tank and the secondary reservoir has failed in the open position (allowing flow in both directions). What is the safety consequence?

A. If the supply tank develops a leak the secondary reservoir will also lose pressure because the failed check valve cannot isolate the secondary from the leaking supply — both circuits lose pressure simultaneously

B. The front steer axle brakes will receive excessive pressure because the failed check valve allows the higher supply tank pressure to feed directly into the secondary circuit exceeding the designed operating pressure

C. The secondary reservoir will drain backward through the failed check valve into the supply tank during every brake application reducing the air available for the front steer axle brakes on subsequent applications

D. The failed check valve will cause the air dryer to purge the secondary reservoir during each unload cycle because the dryer sees the secondary as part of the supply circuit through the open valve path

46. A trailer's brake system uses long-stroke brake chambers. During an inspection, the technician measures the pushrod stroke and finds it at 57 mm. The maximum allowable stroke for this long-stroke chamber type is 64 mm. The adjustment limit for replacement consideration is typically 70% of maximum. Is this chamber within acceptable limits?

A. The stroke is approaching the adjustment limit and the technician should inspect the linings, drum condition, and automatic slack adjuster to determine whether the chamber needs adjustment or the brake components need replacement

B. The 57 mm stroke is within the 64 mm maximum allowable stroke and the brake is legal for continued operation — no action is required at this time since the measurement is below the out-of-service threshold

C. The stroke exceeds the acceptable limit because long-stroke chambers must be maintained at 50% or less of the maximum stroke to ensure adequate reserve travel for emergency brake applications during fully loaded operation

D. The chamber stroke is acceptable at 57 mm and the long-stroke design provides the additional reserve capacity needed for the trailer's tandem axle configuration — the measurement should be documented for trending

47. A truck's battery terminal voltage reads 12.65 volts with the engine off and all loads disconnected. The technician performs a conductance test on the battery and the tester reports "replace battery." What does this discrepancy between the resting voltage and the conductance test result indicate?

A. The conductance tester is more reliable than the voltage test because it measures the battery's internal plate condition rather than just the surface charge which can mask a failing battery with good resting voltage

B. The voltage reading is incorrect because the DMM's input impedance is loading the battery and pulling the reading higher than the actual terminal voltage creating a false-good voltage indication

C. The conductance tester has a defective algorithm that occasionally produces false "replace" results and the 12.65V resting voltage confirms the battery is in good condition and does not need replacement

D. The battery has a full surface charge from recent driving that produces the correct resting voltage but the internal plate condition has deteriorated to the point where the battery cannot deliver adequate cranking current

48. A truck's scan tool shows the engine ECM is receiving a constant 5.0-volt signal from the coolant temperature sensor. The sensor is an NTC thermistor with a 5-volt reference supply. What fault condition produces a constant 5.0-volt reading on an NTC sensor?

A. A short to ground in the sensor signal wire pulls the voltage to zero which the ECM reads as extremely hot and compensates by increasing cooling fan speed to maximum during all operating conditions

B. The sensor element has failed internally creating a zero-resistance path that pulls all the reference voltage to ground and the ECM reads maximum temperature from the fully grounded signal circuit

C. An open circuit in the sensor or its signal wire — with no sensor resistance in the circuit, the 5-volt reference is not pulled down and the ECM reads the full reference voltage which it interprets as extremely cold

D. The sensor is functioning correctly at 5.0 volts which corresponds to a very cold coolant temperature reading — this is normal for an engine that has been sitting overnight in freezing ambient conditions

49. A truck equipped with LED headlamps has the left headlamp flickering intermittently. The right headlamp operates normally. A DMM connected to the left headlamp connector shows a steady 13.8 volts during the flickering. What should the technician investigate?

A. The left headlamp's internal LED driver circuit for an intermittent thermal fault that causes the driver to cycle the LEDs off and on as it overheats and cools during normal operation in the headlamp housing

B. The CAN bus communication between the body controller and the left headlamp module for intermittent data corruption that causes the lamp controller to misinterpret the brightness command periodically

C. The alternator for AC ripple voltage that is not visible on the DMM's DC voltage display but is affecting the LED driver circuit's sensitive electronic components causing the intermittent flicker behaviour

D. The body controller's output driver for the left headlamp for a failing semiconductor that cannot maintain a stable current output and cycles between conducting and non-conducting states intermittently

50. A truck's starter motor draws 450 amps during cranking. The specification is 200 to 250 amps. The engine cranks slowly and barely starts. Battery voltage during cranking drops to 9.2 volts. What does the excessive current draw combined with slow cranking indicate?

A. The batteries are weak and cannot supply adequate voltage to the starter which responds by drawing more current in an attempt to produce the torque needed to crank the engine against its compression

B. The starter motor has an internal fault — a shorted armature winding, grounded field coil, or seized bearing — that creates an excessive electrical load resulting in high current draw and reduced mechanical output

C. The engine has a mechanical condition creating excessive cranking resistance — such as a hydrolocked cylinder, seized accessory, or incorrect oil viscosity — that forces the starter to draw more current against the load

D. The battery cables have excessive voltage drop that limits the voltage available to the starter motor causing it to draw more current to compensate for the reduced voltage at the motor's input terminals

51. A truck's instrument cluster displays a "check engine" lamp and the scan tool retrieves multiple fault codes from several different modules simultaneously. The codes appeared at the same time. The vehicle was operating normally before the codes set. What is the most likely root cause?

A. A software virus has infected the vehicle's CAN bus system and is causing multiple modules to set erroneous fault codes simultaneously as the virus corrupts each module's diagnostic monitoring routines

B. The engine ECM has set a critical fault that cascaded to other modules through the CAN bus — each module responded to the engine fault by setting its own related code based on the engine data it receives

C. The alternator has had a momentary voltage spike or dropout that affected all modules simultaneously — the resulting power interruption caused each module to log a fault code during its re-initialization sequence

D. The vehicle's CAN bus backbone has developed an intermittent fault that corrupted data to multiple modules at the same instant — each module set a code based on the corrupted data it received during the event

52. A truck has a seven-pin trailer electrical connector. Pin 7 (auxiliary power) provides 12-volt power to charge the trailer's auxiliary battery and power the trailer ABS. The technician measures the voltage at pin 7 with a trailer connected and reads 11.2 volts. The tractor battery voltage reads 13.8 volts. What is causing the 2.6-volt drop?

A. The auxiliary circuit fuse in the tractor is undersized for the combined trailer ABS and battery charging current load which creates a voltage drop across the partially restricting fuse element during operation

B. The trailer ABS module has a higher-than-normal current draw that overloads the pin 7 circuit and the excessive current through the normal circuit resistance creates the 2.6-volt drop between the battery and the pin

C. High resistance in the pin 7 circuit — corroded connector pins, a damaged wire, or a loose connection between the tractor battery and the trailer connector — creates the voltage drop under the load current

D. The tractor's trailer charging relay has a worn contact that adds resistance to the circuit and the relay should be replaced to restore full voltage delivery to the trailer auxiliary circuit through pin 7

53. A truck's battery equalizer on a 24-volt system is producing a humming noise that was not present when the unit was new. The equalizer still produces 12 volts for the auxiliary accessories. What does the humming noise indicate?

A. The equalizer's internal power transistors or transformer are beginning to fail — the humming typically indicates a loosening component, saturating transformer, or failing switching element that will eventually fail completely

B. The equalizer is functioning correctly and the humming is normal for a battery equalizer under load — the noise increases proportionally with the load current drawn by the 12-volt accessories during operation

C. The 12-volt load has increased beyond the equalizer's rated capacity and the transformer is saturating from the excess current creating an audible humming noise from the magnetic field oscillation in the core

D. The equalizer's cooling fan bearing has worn and the fan vibration is being transmitted through the housing as a humming noise — replacing the fan restores quiet operation without affecting the equalizer function

54. A truck's multiplexed body electrical system has the marker lamps turn on when the ignition is switched to the "run" position, before the headlamp switch is turned on. This was not the vehicle's original behaviour. What should the technician check?

A. The headlamp switch for an internal short that sends a signal to the body controller simulating a lamp-on command when the ignition reaches the run position before the driver manually activates the switch

B. The body controller's customer configuration parameters for an incorrect setting that activates the marker lamps with the ignition switch rather than with the headlamp switch as the original factory programming intended

C. The marker lamp wiring for a short to the ignition run circuit that bypasses the body controller's output and powers the markers directly from the ignition switch's run position terminal through the shared wire path

D. The instrument cluster for a firmware update that changed the marker lamp activation logic from headlamp-switch-dependent to ignition-switch-dependent as part of a visibility safety enhancement update

55. A truck's glow plug system on a light-duty diesel engine has one glow plug that draws significantly less current than the other five glow plugs. The measured current for the low plug is 3 amps while all others draw 11 to 12 amps. What does this indicate?

A. The glow plug with 3 amps draw has a swollen tip that is contacting the prechamber wall creating a partial short to ground that diverts current away from the heating element and reduces its total circuit current

B. The glow plug's power supply wire has excessive resistance from a corroded connector or damaged wire that limits the current flow to that specific plug while the others receive full voltage through their connections

C. The low-drawing glow plug is the correct newer specification that requires less current because it heats faster using a ceramic element rather than the older metallic element design used in the other five positions

D. The glow plug element has developed increased resistance from aging or a partial internal break that limits the current flow through the element — the plug may still glow but produces insufficient heat for cold starting

56. A truck's scan tool shows the engine intake manifold temperature at 95°C during normal highway driving. The ambient temperature is 25°C. The specification calls for intake manifold temperature to be within 15°C of ambient at highway speed. What does the elevated intake temperature indicate?

A. The EGR valve is stuck partially open during highway cruise introducing hot exhaust gas into the intake manifold and raising the temperature above the specification for this driving condition

B. The charge air cooler (intercooler) has a significant reduction in cooling efficiency from internal contamination, external fin damage, or reduced airflow that prevents it from cooling the compressed intake air adequately

C. The turbocharger compressor has excessive bearing wear that allows the shaft to wobble creating friction heat that transfers to the compressed air charge raising the discharge temperature above normal specifications

D. The engine thermostat is stuck closed causing the engine to run hot which radiates heat to the intake manifold through the block and head casting raising the measured manifold temperature above the specification

57. A truck's alternator has been replaced. After the replacement, the charge indicator lamp on the dashboard stays on with the engine running even though a DMM at the battery shows 14.1 volts. What was likely missed during the installation?

A. The alternator's sense wire (voltage sensing lead) was not connected — without this input the alternator charges by default but the charge lamp circuit remains energized because the lamp relay does not receive the sensing signal

B. The alternator's ground cable was not properly tightened creating a high-resistance ground that allows the alternator to charge through an alternative ground path but cannot pull the lamp circuit to ground to extinguish the lamp

C. The new alternator is a different manufacturer than the original and the internal lamp driver circuit uses a different voltage threshold than the vehicle's lamp circuit expects to extinguish the charge indicator during operation

D. The alternator drive belt is one size too long creating slight slippage that prevents the alternator from reaching its full field current — the charging voltage reaches 14.1V but the internal regulation circuit does not confirm full output

58. A truck's J1939 CAN bus has been tested using an oscilloscope. The CAN-H signal shows normal square wave pulses but the CAN-L signal is a flat line at 2.5 volts. What does this indicate?

A. The CAN bus is functioning normally because the CAN-L wire is a reference ground that maintains a steady voltage while the CAN-H wire carries the actual data signal through its voltage variations

B. One of the two terminating resistors on the CAN bus has failed open and the CAN-L signal cannot develop properly because the termination network is incomplete on the low side of the differential pair

C. The CAN-L wire has a short to the CAN reference voltage (2.5V) or an open circuit that prevents the CAN transceiver from pulling the CAN-L signal to its active state during data transmission events

D. The CAN bus is operating in a degraded single-wire mode where only CAN-H carries data and CAN-L is disabled — this mode provides reduced communication speed but maintains basic module communication

59. A truck's ABS module sets a fault code for the right front wheel speed sensor — SPN 790, FMI 5 (current below normal). The sensor is an active (powered) type. What does FMI 5 indicate for an active sensor?

A. The sensor element has a partial short to ground that diverts some of the current away from the signal path creating a reduced signal current that the ABS module detects as below the normal operating range

B. The sensor's permanent magnet has weakened from age and heat exposure and cannot generate adequate current for the ABS module to distinguish the wheel speed signal from the background electrical noise

C. The sensor's supply voltage is too low from a voltage drop in the power supply wire and the reduced voltage limits the current the active sensor can generate in its signal circuit during wheel rotation

D. The sensor or its wiring has an open circuit or excessive resistance that reduces the current flow below the ABS module's minimum threshold for recognizing a valid signal from the active wheel speed sensor

60. A truck's daytime running light (DRL) system activates the headlamps at reduced brightness when the engine is running and the headlamp switch is off. The DRL on one side is significantly brighter than the other. Both bulbs are the same type. What should be checked?

A. The DRL module for an uneven output that delivers different voltage levels to each headlamp during the DRL operating mode creating a brightness imbalance between the left and right DRL lamp outputs

B. The brighter side's DRL circuit for a fault that is providing full headlamp voltage rather than the reduced DRL voltage — the full voltage illuminates that lamp at full brightness instead of the designed DRL level

C. The DRL control relay for pitted contacts on one set of output terminals that create voltage drop on the dimmer side while the other side receives full DRL voltage through the undamaged relay contact set

D. The headlamp reflectors for different levels of oxidation or cloudiness that affect the perceived brightness of identical bulbs operating at the same voltage creating a visual imbalance between the two sides

61. A truck's electric over air (EOA) shift system for the transmission range selection uses solenoid valves controlled by the shift controller. The driver selects a range but the transmission does not shift. Air pressure is confirmed at the shift solenoid assembly. The solenoids click when activated. What should be checked next?

A. The air passages between the solenoid assembly and the transmission range cylinder for blockage, frozen condensation, or disconnected lines that prevent the solenoid's air output from reaching the shift mechanism

B. The transmission range synchronizer for mechanical wear that prevents it from engaging the selected range even though the air cylinder receives pressure and attempts to move the shift mechanism into position

C. The shift controller for a software fault that commands the correct solenoid but does not verify the shift completion and continues sending the command without detecting that the range has not actually engaged

D. The transmission input shaft speed sensor for an erratic signal that prevents the shift controller from authorizing the range shift because it cannot confirm the input speed is within the acceptable range for the shift

62. A truck's cruise control system maintains speed correctly on level ground but disengages on grades when the engine load increases above approximately 70%. No fault codes are stored. What is the most likely cause?

A. The accelerator pedal position sensor signal is reaching its maximum voltage at 70% load and the cruise control module interprets the maxed-out signal as a manual throttle override which disengages the cruise

B. The engine ECM is entering a derate condition at high load that reduces the available power below what the cruise control needs to maintain speed and the speed deviation triggers the cruise to disengage automatically

C. The cruise control is disengaging because the vehicle speed drops below the minimum cruise set-point by more than the allowable tolerance as the engine cannot maintain speed on the grade at the current load level

D. The exhaust brake or engine retarder is activating on the grades from a faulty switch input and the retarder activation sends a disengage signal to the cruise control module through the CAN bus communication path

63. A truck's power window on the passenger side moves up normally but moves down very slowly. The motor draws normal current in both directions. The switch has been tested and provides correct voltage in both positions. What is the most probable cause?

A. The window glass is misaligned in its channel creating friction that is greater in the downward direction than the upward direction from the glass contacting the channel at a different angle during each travel direction

B. The window motor has a partial internal short that reduces its torque output in one direction of rotation while maintaining normal current draw from the reduced back-EMF of the shorted winding section

C. The window regulator mechanism has a worn gear or damaged cable section that creates more resistance in one direction of travel than the other slowing the motor's effective speed despite normal current and voltage

D. The window regulator mechanism has a binding condition in the downward travel direction — a bent track, worn roller, dry guide channel, or damaged cable creates more mechanical resistance in the down direction

64. A truck's battery disconnect switch is an electronic type (not a mechanical knife switch). The switch has a remote-control button in the cab. When the driver presses the disconnect button, the main battery contactor opens but a small parasitic drain of 50 milliamps remains. What is the most likely source of this residual drain?

A. The electronic disconnect switch itself requires a small continuous current draw to maintain its internal control circuit, voltage monitoring, and the contactor coil hold circuit in the ready-to-reconnect state

B. The engine ECM keep-alive circuit bypasses the main battery disconnect contactor through a separate always-on wire that maintains the ECM's adaptive learning memory during the battery-off parking period

C. The alternator's voltage regulator has a reverse-leakage path through its internal diodes that allows a small current to flow from the battery through the alternator windings to ground during the engine-off period

D. The body controller maintains a CAN bus wake-up listener circuit that draws continuous current to monitor for remote keyless entry signals even when the main battery disconnect has opened the main power circuit

65. A truck's scan tool retrieves a fault code from the transmission control module — SPN 523, FMI 2 (transmission gear — erratic/intermittent). The transmission intermittently slips out of gear during moderate acceleration. What should be inspected?

A. The transmission gear position sensor or its circuit for an intermittent signal fault that causes the TCM to momentarily lose track of the selected gear position and command a neutral condition during the signal dropout

B. The transmission torque converter for a failed stator one-way clutch that allows the stator to freewheel during moderate acceleration creating a torque multiplication loss that feels like gear slippage to the driver

C. The transmission valve body for a sticking pressure regulator that intermittently drops the main line pressure below the clutch pack's holding capacity during moderate acceleration causing the gear to slip momentarily

D. The engine ECM for a torque management error that reduces engine power during moderate acceleration creating the sensation of transmission slippage even though the transmission is maintaining full gear engagement

66. A truck's tail lamp circuit uses a pulse-width-modulated (PWM) output from the body controller. The tail lamps are standard incandescent bulbs. The technician measures the voltage at the tail lamp connector and reads 7.2 volts on a standard DMM. The lamps appear to be at approximately 50% brightness. What is the DMM actually measuring?

A. The actual RMS voltage of the PWM signal which represents the effective DC voltage that produces the 50% brightness level at the incandescent lamp filaments during the normal dimmed tail lamp operation mode

B. An inaccurate reading because a standard DMM cannot accurately measure PWM signals — it averages the on-time and off-time voltage creating a reading that does not represent the actual signal characteristics

C. The correct battery voltage minus a 6-volt drop across the body controller's PWM output driver — the driver has a large internal voltage drop that limits the output to 7.2V regardless of the PWM duty cycle setting

D. The average voltage of the PWM signal — the DMM is averaging the 12V "on" periods and 0V "off" periods which at approximately 50% duty cycle produces the 7.2V average reading corresponding to 50% brightness

67. A truck has an aftermarket GPS tracking device installed that uses the vehicle's OBD diagnostic connector for power and CAN bus data. The fleet manager reports that the device occasionally transmits incorrect vehicle speed data to the fleet management server. What is the most likely cause?

A. The diagnostic connector's CAN bus pins have developed corrosion that intermittently disrupts the data signal quality causing the GPS device to misread the vehicle speed PGN from the corrupted data stream

B. The GPS tracking device is reading the vehicle speed from the wrong J1939 PGN address and occasionally receives data from a different parameter that it misinterprets as vehicle speed on the CAN bus

C. The vehicle's engine ECM broadcasts the vehicle speed at a different update rate than the GPS device expects and the timing mismatch causes the device to sample the speed data at the wrong point in the update cycle

D. The GPS device's internal speed calculation from satellite data conflicts with the CAN bus vehicle speed data and the device alternates between the two sources creating intermittent discrepancies in the transmitted speed

68. A truck's windshield wiper system has a complaint that the wiper speed does not change when the driver rotates the wiper speed switch from low to high. The wipers operate at a constant speed regardless of the switch position. The switch has been tested and provides the correct resistance values at each position. What is the most probable cause?

A. The wiper motor's internal brush assembly has worn to the point where both the low-speed and high-speed brush connections make contact simultaneously causing the motor to run at a single speed regardless of switch input

B. The wiper motor's internal speed control circuit or the body controller's wiper speed output is not varying the motor's supply voltage or ground path correctly despite receiving the correct resistance signal from the switch

C. The wiper arm spring tension is too high creating a drag on the motor that limits its maximum speed to the same speed as the low-speed setting regardless of the voltage supplied to the motor at the high-speed selection

D. The wiper motor ground circuit has excessive resistance that limits the current flow through both the low and high speed windings to the same effective level causing both speed settings to produce identical wiper speeds

69. A truck equipped with an automated manual transmission (AMT) has a fault code for the clutch position sensor signal out of range. The clutch engages and the truck drives but the shifts are harsh and the engagement point is inconsistent. What does the out-of-range sensor signal affect?

A. The AMT controller uses the clutch position sensor to determine the exact position of the release bearing relative to the pressure plate fingers — without accurate position data the controller cannot execute smooth controlled engagement

B. The clutch position sensor provides feedback to the ECM about the engine load during shifting so the ECM can reduce fuel injection timing during the shift event to smooth the torque transition between gears

C. The clutch position sensor monitors the clutch disc thickness and reports the remaining lining life to the instrument cluster so the driver can anticipate when a clutch replacement will be needed at the next service

D. The AMT controller uses the sensor data to calculate the clutch disc temperature during engagement and limits the slip time to prevent overheating — without the data the controller defaults to a rapid harsh engagement

70. A truck's differential has been serviced with new gear oil. After 500 km, a loud howling noise develops from the rear axle during highway cruise at steady speed. The noise was not present before the oil change. What is the most likely cause?

A. The replacement gear oil is the wrong specification — a different viscosity grade or an incorrect GL rating that does not provide adequate film strength for the hypoid gear mesh producing the howling from metal contact

B. The oil change procedure introduced air into the differential housing and the trapped air pocket creates cavitation at the ring gear mesh during highway cruise speeds producing the audible howling noise

C. The ring and pinion backlash has shifted because the new oil has a different thermal expansion characteristic than the old oil changing the gear mesh clearance at operating temperature compared to the previous fill

D. The drain plug magnet was not reinstalled after the oil change and the fine metallic particles that normally collect on the magnet are now circulating through the gear mesh creating the abrasive howling noise

71. A truck's automatic transmission has a persistent neutral condition — the engine revs freely when any drive gear is selected but the vehicle does not move. The fluid level is correct and the fluid appears clean with no burnt odour. What is the most likely cause?

A. The torque converter has lost its fluid charge from a failed internal check valve and the empty converter cannot transmit engine torque to the transmission input shaft through the fluid coupling mechanism

B. The transmission output shaft has sheared at the spline connection to the rear axle driveshaft and the internal transmission components are functioning but the output torque cannot reach the drive wheels

C. The transmission main pressure regulator valve is stuck in the low-pressure position and cannot develop adequate apply pressure to engage any clutch pack — all clutches slip simultaneously under any load

D. The forward clutch pack hub has sheared its connection to the transmission input shaft and the input shaft spins freely inside the hub without transmitting torque to the planetary gear set in any drive range

72. A truck's clutch pedal has no resistance — it drops to the floor freely when pressed and does not return. There is no fluid on the floor and the clutch reservoir is full. What has failed?

A. The clutch pressure plate diaphragm spring has broken and the clutch is permanently disengaged — the pedal drops freely because there is no spring load for the hydraulic system to work against

B. The clutch master cylinder has a complete internal bypass — the piston seal has failed entirely and the piston moves through the fluid without building any pressure in the cylinder bore during the pedal stroke

C. The clutch release bearing has seized on its guide sleeve and the slave cylinder cannot extend against the seized bearing creating a hydraulic lock that the pedal overcomes by bypassing the master cylinder seal

D. The clutch slave cylinder has separated from its mounting bracket and the pushrod has lost contact with the release fork — the master cylinder pumps freely because the slave cylinder has no mechanical resistance

73. A drive axle ring and pinion gear set has been replaced. The technician sets the backlash to the middle of the specification range and checks the contact pattern with marking compound. The drive side pattern is centered on the tooth face. The coast side pattern is at the toe. What adjustment is needed?

A. The backlash setting is affecting the coast pattern differently than the drive pattern — adjusting the backlash alone will shift the coast pattern but doing so will also shift the already-correct drive pattern off centre

B. No adjustment is needed — the coast pattern at the toe is acceptable because coast loading is significantly lighter than drive loading and the toe contact provides adequate surface area for the reduced coast torque

C. Move the pinion deeper into the housing by increasing the pinion shim thickness — this shifts the coast pattern from the toe toward the centre without significantly affecting the already-centered drive pattern

D. The ring and pinion are a mismatched set because a correctly set-up gear pair should show identical patterns on both the drive and coast sides — the gears must be replaced with a properly matched set

74. A truck equipped with a 13-speed manual transmission has a complaint that the driver cannot select reverse gear. All forward gears engage normally. The clutch fully disengages when the pedal is depressed. What should be checked?

A. The reverse idler gear mechanism — a worn shift fork, bent shift rail, stuck detent, or a damaged reverse idler gear prevents the reverse gear from engaging even though the main transmission gears and synchronizers work correctly

B. The clutch disc for a warped condition that drags against the flywheel even with the clutch pedal fully depressed preventing the countershaft from decelerating to the zero-RPM needed for non-synchronized reverse engagement

C. The transmission lubricant for an incorrect viscosity that is too thick for the ambient temperature creating excessive drag on the countershaft that prevents it from stopping quickly enough for the reverse idler to engage

D. The engine idle speed for an RPM setting that is too high for smooth reverse engagement — some transmissions require the engine to idle below 600 RPM for the non-synchronized reverse gear to engage without grinding

75. A truck's inter-axle differential lock will not disengage after the driver switches it off. The indicator lamp turns off when the switch is released but the lock remains mechanically engaged. What is the most likely cause?

A. The air shift actuator's return spring has broken and the actuator cannot retract the shift fork to disengage the locking collar even though the air supply has been exhausted from the actuator cylinder

B. The shift controller has a software fault that releases the indicator lamp signal before confirming the mechanical disengagement creating a false indication that the lock has released when it is still engaged

C. The inter-axle differential lock actuator's exhaust port is blocked preventing the air from venting — the trapped air holds the actuator in the engaged position even after the supply solenoid de-energizes

D. The locking collar is bound on its splines from driveline torque loading — the lock was engaged under load and the torque keeps the collar pressed against the engagement teeth preventing disengagement until the load is relieved

76. A truck's driveshaft has been removed for U-joint replacement. During reinstallation, the technician installs the driveshaft with the slip yoke at the rear (axle end) instead of the original position at the front (transmission end). What effect does this incorrect orientation have?

A. The driveshaft will operate normally because the slip yoke position does not affect the driveshaft's rotational balance or the U-joint working angles during normal vehicle operation in any driving condition

B. The slip yoke position is critical because the driveshaft was originally balanced with the slip yoke at a specific end — reversing it changes the mass distribution and creates a rotational imbalance producing vibration

C. The reversed slip yoke will not affect balance but will change the U-joint phasing between the front and rear joints — if the yoke ears are not aligned the joints will not cancel each other's vibration properly

D. The reversed slip yoke position will cause the driveshaft to bind during suspension travel because the slip joint must be on the transmission end where the suspension movement is minimal relative to the axle end

77. A truck equipped with a torque converter and automatic transmission has a stall speed test result of 2,400 RPM. The specification is 2,100 to 2,200 RPM. What does the higher-than-specified stall speed indicate?

A. The engine is producing more power than specification and the additional torque is spinning the impeller faster before the converter's fluid coupling can absorb the energy and reach the stall equilibrium point

B. The torque converter's stator one-way clutch has failed allowing the stator to freewheel in both directions which reduces the converter's torque multiplication and allows the impeller to spin faster at stall

C. The transmission has an internal clutch pack that is slipping during the stall test — the slipping clutch reduces the load on the converter and allows the engine to reach a higher RPM before the stall point

D. The torque converter has an internal leak that reduces the fluid coupling efficiency between the impeller and turbine — the reduced coupling allows the impeller to spin faster at the stall test equilibrium point

78. A truck's automatic transmission has been rebuilt. During the first road test, the transmission shifts normally in all forward ranges but will not engage reverse. The valve body has been inspected and is correct. What should the technician check inside the transmission?

A. The reverse band, its servo, and the reverse clutch pack for incorrect assembly — a band not anchored properly, a servo installed backward, or a clutch pack assembled with the wrong disc and plate sequence

B. The reverse idler gear for incorrect installation position — if the gear was installed on the wrong side of the reverse idler shaft the gear teeth cannot mesh with the output shaft reverse gear during engagement

C. The governor valve for a stuck condition that sends a false vehicle speed signal to the valve body preventing the reverse circuit from pressurizing because the valve body interprets the signal as a forward motion

D. The torque converter for incorrect installation on the input shaft — if the converter is not fully seated on the stator support and pump drive the converter cannot engage the pump correctly for reverse pressure

79. A truck's driveshaft has a two-piece design with a centre support bearing. The centre bearing rubber mount has deteriorated and the driveshaft is sagging at the centre support. What symptoms will this sagging produce?

A. The sagging centre bearing changes the U-joint working angles at both the front and rear joints creating a vibration that varies with vehicle speed and becomes most pronounced at the speed where the angles produce resonance

B. The sagging changes the vertical alignment of the driveshaft which moves the centre of gravity below the rotational axis creating an imbalance that produces a constant vibration at all vehicle speeds above 30 km/h

C. The sagging allows the front driveshaft section to contact the frame cross-member during suspension compression events producing an intermittent clunking noise that occurs only when driving over large bumps at any speed

D. The deteriorated mount allows the driveshaft to oscillate vertically during operation creating a speed-dependent vibration that changes the U-joint working angles dynamically and produces a vibration that varies with load and speed

80. A truck's clutch release bearing is being replaced. During the removal, the technician notices that the clutch disc friction material has a glazed, shiny appearance. The disc still has 4 mm of material remaining (minimum is 2 mm). What caused the glazing?

A. The clutch was operated at high temperature from excessive slipping during prolonged hill starts, frequent stop-and-go traffic, or driver technique that holds the clutch partially engaged for extended periods

B. The clutch disc was manufactured with an incorrect friction material compound that has a lower heat tolerance than the specification requires for this engine's torque output and the vehicle's operating duty cycle

C. The flywheel and pressure plate friction surfaces have developed hard spots from heat that transfer their hardened surface pattern to the clutch disc material creating a mirror-like appearance on the disc surface

D. The clutch hydraulic system has been keeping the release bearing in slight contact with the pressure plate fingers reducing the clamping force and causing continuous micro-slipping that glazed the disc over time

81. A heavy-duty truck's transmission has a complaint that a grinding noise occurs specifically when downshifting from 6th to 5th gear. All other downshifts are smooth. The clutch fully disengages. What is the most likely cause?

A. The 5th gear synchronizer has worn blocking ring material that cannot slow the gear speed adequately during the downshift — the speed mismatch between the input and 5th gear produces the grinding during engagement

B. The engine brake is not deactivating during the 6th-to-5th downshift and the compression braking is accelerating the input shaft above the speed that the 5th gear synchronizer can match during the shift event

C. The countershaft gear set has excessive backlash in the 5th gear position that causes the gear teeth to clash during the downshift when the synchronizer attempts to match the higher gear speed of the 5th ratio

D. The driver is not double-clutching correctly during the 6th-to-5th downshift and the engine RPM increase (rev-matching) is insufficient to bring the input shaft to the correct speed for the 5th gear engagement

82. A tandem axle truck's drive axle vent has become blocked with road debris and mud. What is the consequence of operating with a blocked axle vent?

A. The blocked vent causes pressure to build inside the axle housing from thermal expansion of the trapped air and lubricant which forces oil past the axle shaft seals and pinion seal causing external oil leaks

B. The differential gears will overheat because the blocked vent prevents the hot air from escaping the housing and the trapped hot air insulates the gears from the cooling effect of the ambient airflow

C. The blocked vent creates a vacuum inside the axle housing when the axle cools which pulls air and moisture past the seals contaminating the lubricant with water and causing internal corrosion of the bearings

D. Both pressure buildup during heating and vacuum during cooling occur — the pressure pushes oil past seals during operation and the vacuum during cool-down draws moisture in through the seals contaminating the lubricant

83. A truck's transfer case has a complaint of a clunking noise when shifting between 2WD and 4WD while the vehicle is stationary. The shift mechanism operates correctly and 4WD engages. What causes the clunk?

A. The transfer case output yoke has excessive play in its bearing that produces a single impact noise when the shift mechanism transitions between the two drive modes during the stationary engagement

B. The front driveshaft is not aligned with the front axle input yoke and when 4WD engages the misaligned joints create a sudden rotational snap as the components are forced into alignment by the locking mechanism

C. The transfer case shift mechanism has normal engagement noise from the sliding clutch collar contacting the engagement teeth — some clunking is inherent in the positive-engagement design of most transfer cases

D. The transfer case lubricant has thickened from cold temperature and the viscous resistance to the shift mechanism's movement creates a delayed engagement that produces a clunk when the collar suddenly snaps into position

84. A truck equipped with a rear axle limited-slip differential has a complaint of chatter during slow tight turns on dry pavement. The chatter produces a rhythmic vibration felt through the seat and heard from the rear axle area. What is the most likely cause?

A. The limited-slip clutch discs have worn and the preload spring pressure cannot maintain consistent friction during the speed differential required for tight turns — the discs alternately grab and slip producing chatter

B. The differential spider gears have worn flat spots that catch during each revolution producing a rhythmic impact that is amplified by the limited-slip clutch pack's preload into a noticeable chatter during tight turns

C. The ring and pinion gear set has excessive backlash that only manifests during tight turns when the differential action creates a variable loading on the ring gear teeth producing the rhythmic chatter vibration

D. The limited-slip differential fluid additive has been depleted or the wrong lubricant was used — the friction modifier is essential for smooth clutch engagement and its absence causes the clutch discs to grab and release alternately

85. A truck's drive axle has been rebuilt with a new carrier assembly. After installation, the axle operates normally except that the speedometer reads 5% higher than actual vehicle speed. What was set incorrectly during the rebuild?

A. The speedometer calibration in the ECM or instrument cluster was not updated to reflect the new carrier assembly's tooth count on the vehicle speed sensor exciter ring which differs from the original carrier

B. The ring and pinion ratio in the new carrier assembly differs from the original by approximately 5% which changes the output shaft speed relative to the wheel speed and produces the speedometer error

C. The ABS wheel speed sensor air gap on the drive axle was set too tight during the rebuild creating a stronger signal that the ABS module interprets as a faster wheel speed than the actual rotation rate

D. The vehicle speed sensor was damaged during the carrier installation and is generating additional signal pulses per revolution that the ECM interprets as a higher vehicle speed than the actual speed

86. A truck's power steering system makes a groaning noise during slow-speed turns in cold weather. The noise diminishes as the vehicle warms up. The fluid level is correct and the correct fluid type is installed. What is the most likely cause?

A. The power steering pump's internal clearances tighten in cold weather from thermal contraction creating a temporary interference between the pump rotor and the cam ring that produces the groaning noise

B. The power steering fluid's cold-temperature viscosity is too high for the pump's flow passages and the thick fluid creates cavitation at the pump inlet during the high-flow-demand condition of slow turns

C. The steering gearbox internal seals contract in cold weather allowing internal bypass that creates turbulence in the hydraulic circuit producing the groaning noise until the seals warm and expand to their normal fit

D. The power steering fluid viscosity is at the upper limit of the specification for the ambient temperature and the thick cold fluid creates cavitation and flow noise through the pump and gearbox until it warms and thins

87. A truck's front wheel alignment shows the following readings: Left camber: +0.5°, Right camber: +1.5°, Total toe: 0.0° (in specification). The camber specification is +0.25° to +1.0° per side. What symptoms will this 1.0° camber difference between sides produce?

A. The truck will not track straight because the unequal camber creates a steering pull toward the side with the greater camber angle during straight-line driving on a flat level road surface

B. The truck will pull to the right during driving because the greater positive camber on the right side creates a conicity effect that steers the vehicle toward the high-camber side during straight-line travel

C. The tires will wear evenly because the total toe is in specification and toe is the primary alignment angle that affects tire wear — camber differences between sides primarily affect steering pull not tire wear

D. The right steer tire will show accelerated wear on the outer edge because the +1.5° camber exceeds the specification and tilts the tire outward concentrating the load on the outer tread edge during straight driving

88. A truck's leaf spring has broken its centre bolt. The axle has shifted rearward on the spring pack approximately 10 mm. What symptoms will this axle shift produce?

A. The broken centre bolt allows the spring leaves to fan out during operation creating a softer ride that the driver may initially perceive as an improvement before the structural failure of the spring pack progresses

B. The shifted axle changes the caster angle on the affected side which alters the steering geometry and may cause the vehicle to pull to one side during straight-line driving and braking on level road surfaces

C. The broken centre bolt has no immediate operational effect because the U-bolts and spring clips provide adequate axle retention and the 10 mm shift is within the normal tolerance for leaf spring axle alignment

D. The 10 mm axle shift changes the wheelbase on that side creating a thrust angle that causes the vehicle to dog-track — the rear axle is no longer perpendicular to the vehicle centreline and the truck tracks at an angle

89. A truck equipped with automatic tire inflation (ATI) has the ATI system maintaining all tires at the correct pressure during highway driving. When the truck parks overnight, one drive axle tire loses 35 kPa by morning. The ATI system restores the pressure within 10 minutes of starting the engine the next morning. Is this a concern?

A. The tire is functioning normally — all tires lose some pressure during overnight temperature drops and the 35 kPa loss is within the normal range for thermal contraction of the air inside the tire during parking

B. The ATI system is masking a slow tire leak by automatically replenishing the air — the tire should be inspected for a puncture, valve stem leak, or bead seal issue that causes the overnight pressure loss

C. The tire pressure loss is caused by the ATI system's rotary seal leaking when the system is depressurized overnight — the seal holds under the dynamic conditions of driving but seeps when the system is static

D. The tire is losing pressure through normal permeation through the rubber casing material which is accelerated during the overnight temperature drop — this permeation rate is normal for the tire's age and compound

90. A truck's steer axle king pin inclination (KPI) angle has been measured at 2 degrees less than specification on both sides. The caster and camber are within specification. What effect does the reduced KPI have on the vehicle's steering characteristics?

A. The reduced KPI increases the steering effort at low speeds because the king pin geometry requires more force to turn the wheels when the inclination angle is below the designed value for the axle

B. The reduced KPI has no measurable effect on the vehicle's steering characteristics because the caster and camber angles compensate for the KPI reduction and maintain the designed steering response

C. The reduced KPI decreases the vehicle's straight-line stability because the wheels have less tendency to self-centre after a turn with the reduced inclination angle providing less geometric feedback through the steering

D. The reduced KPI decreases the steering wheel returnability after turns — the reduced inclination provides less self-centering force through the vertical load acting on the pivot geometry reducing the wheel's tendency to return to straight-ahead

91. A truck's hub-piloted wheel has been installed with all ten lug nuts torqued to the correct specification. During a re-torque check at 160 km, three adjacent nuts have lost approximately 20% of their initial torque. The remaining seven nuts hold their torque. What specific condition does the three-adjacent-nut pattern suggest?

A. The hub pilot surface has a localized high spot, contamination, or damage under those three stud positions that prevents the wheel from seating flat — the incomplete seating compresses during initial driving and the nuts lose torque

B. Those three studs have been over-torqued during a previous service and the threads have yielded allowing the studs to stretch permanently which prevents them from maintaining adequate clamping force at the specified torque

C. The wheel bolt circle has a localized distortion from a previous impact event that affects the hole spacing at those three adjacent positions changing the geometry enough to reduce the effective clamping force on those studs

D. The lug nuts on those three positions are a different manufacturing lot with slightly different thread pitch tolerances that create a less positive engagement with the stud threads compared to the other seven matching nuts

92. A trailer equipped with disc brakes has the brake pads replaced. After the replacement, the technician verifies the caliper slide pin operation by pushing the caliper body back and forth on its mounting bracket. The caliper moves freely. Why is this verification important for disc brake function?

A. The caliper must slide to allow the brake pad to retract from the rotor surface when the brake is released — a seized caliper holds the pad against the rotor creating continuous drag and accelerated pad and rotor wear

B. The caliper must slide freely to equalize the clamping force between the inboard and outboard pads — a seized caliper applies force to only one pad creating uneven pad wear and reduced overall braking effectiveness

C. A freely sliding caliper ensures the caliper piston can fully retract during brake release — if the caliper is seized the piston cannot pull back into its bore and the brake remains partially applied during driving

D. A seized caliper changes the brake pad's contact angle with the rotor surface creating a tapered wear pattern on the pads that reduces the effective pad life and produces a wedging action that increases brake drag

93. A truck's front suspension has a rubber-bushed torque rod connecting the steer axle to the frame. The rubber bushing on one end has completely separated from the metal sleeve. What effect does this bushing failure have on the steer axle?

A. The steer axle is no longer restrained in the fore-aft direction on that side and will shift position under braking and acceleration forces changing the caster angle dynamically and affecting the steering response

B. The failed bushing allows the torque rod to move freely in its bracket creating a clunking noise over bumps but has no effect on axle alignment because the other torque rods maintain the axle's geometric position

C. The steer axle will shift laterally under cornering forces because the failed bushing removes one of the lateral constraint points that prevent the axle from tracking to one side during turns

D. The failed bushing creates a secondary vibration at the steer axle's natural frequency that is excited by road surface irregularities and transmits through the steering linkage as a shimmy at specific vehicle speeds

94. A truck's tire has been repaired with a plug only (no internal patch). The repair was performed from the outside without dismounting the tire. Is this repair method acceptable for a commercial vehicle tire?

A. An external plug-only repair is acceptable for commercial tires in the tread area as a temporary measure for up to 10,000 km after which the tire must be dismounted and a combination plug-patch installed permanently

B. An external plug-only repair is acceptable for all tire positions as long as the plug material is rated for the tire's speed rating and the puncture is within the repairable tread zone defined by the tire manufacturer

C. An external plug-only repair is not acceptable for commercial vehicle tires — the proper repair requires dismounting the tire, inspecting the interior for damage, and installing a combination plug-patch from the inside

D. An external plug-only repair is acceptable only for trailer tires because trailer tires operate at lower speeds and loads than steer or drive axle tires and the reduced stress allows the plug to maintain an adequate seal

95. A truck's air suspension height control valve has been replaced. After the replacement, the technician must adjust the valve's control arm to set the correct ride height. If the arm is set too short, what will happen to the ride height?

A. The suspension will ride higher than specification because the shortened arm signals the valve that the vehicle is too low and the valve continuously adds air to the springs trying to reach the height that the arm indicates as correct

B. The suspension will ride lower than specification because the shortened arm reaches its target position before the air springs are fully inflated allowing the valve to stop adding air at a height below the design specification

C. The shortened arm will cause the valve to oscillate between adding and exhausting air because the arm's reduced travel range does not match the valve's designed dead band creating a continuous cycling condition

D. The shortened arm has no effect on ride height because the valve's internal calibration determines the height setting and the arm length only affects the speed at which the valve responds to height changes during driving

96. A truck equipped with hub-piloted disc wheels has a chronic problem with wheel-off events on one specific position (right rear outer). The wheel nuts are torqued correctly at every service and re-torqued at the specified interval. What should the technician investigate as the root cause?

A. The brake rotor for excessive runout that creates a cyclic loading on the wheel studs during every wheel revolution — the repeated bending stress fatigues the studs until they fail and the wheel separates

B. The wheel nut seating surface for damage or wear that prevents the nut from achieving full clamping force despite the torque wrench reading the correct value — a worn seat bottoms out before adequate force is achieved

C. The hub pilot and the wheel centre bore for damage, corrosion, or mismatch that prevents the wheel from centring correctly creating an eccentric load that produces cyclic stud bending during every revolution

D. The wheel stud protrusion length for insufficient thread engagement with the lug nuts — if the studs are too short the nuts may reach full torque before achieving adequate thread engagement for secure retention

97. A heavy-duty truck's front leaf spring has a noticeable gap between the main leaf and the second leaf approximately 100 mm from the spring eye. The gap is visible without any load applied. What does this gap indicate?

A. The spring's interleaf friction pads have worn away allowing the leaves to separate slightly — the gap is cosmetic and does not affect the spring's load-carrying capacity or the suspension's ride characteristics

B. The gap is a normal manufacturing characteristic of progressive-rate leaf springs that allows the second leaf to engage only after the primary leaf deflects a specific amount under increasing load conditions

C. The spring has fatigued and the interleaf contact has broken down — the gap indicates the main leaf has lost camber and the spring pack is no longer performing as a cohesive unit requiring spring replacement

D. The main leaf has taken a permanent set from overloading and has straightened relative to the second leaf — the spring rate has changed and the spring should be replaced to restore the correct ride characteristics and axle alignment

98. A trailer's air ride suspension has been converted from a fixed-height system to an adjustable-height system with a dump valve for loading dock height adjustment. After the conversion, the trailer drops to the bump stops when the dump valve is activated but will not return to ride height when the valve is closed. What is the most likely cause?

A. The dump valve is draining the air from both the air springs and the supply reservoir simultaneously and the depleted reservoir does not have enough stored air to reinflate the springs when the valve closes

B. The height control valve linkage was disconnected or damaged during the dump valve installation and the valve cannot detect that the suspension needs air added when the dump function is deactivated after use

C. The dump valve is installed in the wrong location — it should be plumbed between the air springs and the height control valve but has been installed between the height control valve and the supply reservoir

D. The air springs have been damaged by the repeated full-compression cycling during dump valve use and the bags have developed permanent creases that prevent them from reinflating to the full ride height position

99. A truck's steer tire shows a distinct feathered wear pattern — each tread rib has a sharp edge on one side and a rounded edge on the other when felt with the hand across the tread. What alignment condition causes feathered wear?

A. Incorrect toe setting — either excessive toe-in or toe-out causes each tread element to be dragged sideways across the road surface creating the sharp-edged feathered wear pattern on the steer tire tread ribs

B. Excessive positive caster that creates a trailing effect on the steer tires causing each tread block to be pushed forward creating the feathered wear pattern from the front-to-back scrubbing action during driving

C. Excessive positive camber that tilts the tire outward loading the outer tread ribs more heavily than the inner ribs creating a diagonal wear pattern that feels feathered when touched across the tread surface

D. Worn king pin bushings that allow the steer knuckle to shift dynamically during driving creating an alternating toe change with each bump that produces the feathered wear pattern from the variable toe scrubbing

100. A truck's hub assembly has been removed for brake service. During removal, the technician notices that the hub oil has turned a milky grey colour. The axle vent is clear and the wheel seal appears intact. What is the most likely source of the water contamination?

A. The hub cap or cover gasket has deteriorated and is allowing road spray to enter the hub cavity during wet-weather driving — the water mixes with the oil during bearing rotation creating the milky grey emulsion

B. The wheel seal is passing water from the exterior during pressure-washing or driving through deep water even though it appears intact from a visual inspection — the seal's lip may be worn on the water-side surface

C. Condensation forms inside the hub cavity from temperature cycling between hot operation and cold ambient parking — the repeated condensation accumulates water in the oil over time producing the milky grey colour

D. The hub oil contains a water-miscible additive that has degraded from heat exposure and the additive breakdown releases water molecules that were previously bound in the additive's chemical structure into the free oil

101. A trailer's tandem axle group has been weighed on platform scales. The front axle of the tandem weighs 8,500 kg and the rear axle weighs 7,200 kg. The trailer is loaded with evenly distributed cargo. What is the most likely cause of this 1,300 kg weight difference between the tandem axles?

A. The trailer frame has a permanent twist from a previous overloading event that shifts the cargo weight toward the front tandem axle creating the unequal distribution between the front and rear axle positions

B. The suspension equalizer system (walking beam, equalizer beam, or air system) is not functioning correctly and is not distributing the load equally between the two axle positions across the tandem group

C. The trailer's sliding tandem position has shifted the axle group forward of its designed position placing more of the cargo's centre of gravity over the front axle of the tandem creating the weight imbalance

D. The front tandem axle's suspension springs or air bags have a higher spring rate than the rear axle's springs from an incorrect replacement that causes the stiffer front springs to carry a larger share of the load

102. A truck's wheel has been removed for tire replacement. During the tire change, the technician notices a crack in the wheel disc (the centre section between the hub bolt holes and the rim). The crack is approximately 50 mm long. What action is required?

A. Weld-repair the crack using the correct electrode and procedure for the wheel material type and return the wheel to service after NDT inspection of the repair to verify the weld is free of defects

B. The wheel cannot be repaired and must be scrapped — wheel disc cracks compromise the structural integrity of the wheel and welding introduces heat-affected zones that reduce the wheel's fatigue strength

C. Monitor the crack at each tire rotation service — if the crack does not grow beyond 75 mm the wheel remains serviceable and should be documented for trending to establish the growth rate over time

D. Drill a stop-hole at each end of the crack to arrest its propagation and return the wheel to a non-steer axle position where the reduced structural margin is acceptable for the lower steering loads at that position

103. A truck's steer axle has had both king pins replaced. After the replacement, the technician checks the steering for free play and finds it within specification. However, during a road test, the steering feels vague and the truck wanders slightly at highway speed. What should be checked?

A. The king pin bushing preload — if the new king pins were installed without adequate bushing preload the knuckle can move loosely on the pins creating the vague feel and wandering despite the free play being within specification

B. The steering damper for replacement because the king pin service may have disturbed the damper mounting and the damper's reduced effectiveness is contributing to the vague steering feel at highway speed

C. The wheel alignment for changes caused by the king pin replacement — the new king pins may have shifted the camber, caster, or SAI angles from their previous positions affecting the steering response characteristics

D. The steer tire inflation pressures because king pin replacement requires the tires to be deflated for axle removal and the tires may not have been reinflated to the correct specification after the service was completed

104. A truck cab has a persistent water leak that appears on the passenger-side floor only during heavy rain while driving at highway speed. The leak is not present during light rain or when the vehicle is stationary in heavy rain. What does this driving-condition-specific leak pattern suggest?

A. The passenger-side door seal has a gap at the upper corner that only allows water penetration when the door flexes from highway-speed aerodynamic pressure during heavy rain driving conditions

B. The cab's body panel seams have a sealant failure at the windshield lower corner that requires both heavy rain volume and highway-speed wind pressure to force water through the gap into the cab interior

C. The passenger-side window glass has a microscopic crack that flexes open from cab body deflection at highway speed allowing water to penetrate only during the combination of heavy rain and highway driving

D. The HVAC fresh air intake cowl seal has deteriorated and heavy rain at highway speed overwhelms the cowl drain system forcing water through the HVAC housing and dripping onto the passenger floor from the ductwork

105. A truck's cab-over-engine design requires the cab to tilt for engine access. The hydraulic tilt cylinder has developed a weeping leak at the rod seal. The cylinder functions normally — the cab tilts and lowers correctly. Should the cylinder be repaired?

A. The weeping seal should be replaced immediately because the cylinder rod seal is the only barrier preventing the cab from tilting forward uncontrollably if the seal fails completely during a highway braking event

B. The weeping is cosmetic and does not affect function — the cab tilt system has a mechanical latch that holds the cab in the driving position independently of the hydraulic cylinder making the seal non-critical for safety

C. The cylinder should be monitored at each PM interval — if the weep rate increases beyond one drop per minute the seal should be replaced but the current weep rate does not warrant immediate cylinder service

D. The cylinder rod seal should be replaced because the weeping fluid drips onto the engine and creates a fire hazard from the hot exhaust manifold surface directly below the tilt cylinder's mounted position on the cab

106. A truck driver reports that the cab interior becomes excessively hot during summer driving even with the A/C system working correctly. The A/C outlet temperature is within specification. The cab does not have window tinting or a sunroof. What cab-related modification would most effectively reduce the interior heat gain?

A. Install a cab roof-mounted air deflector that redirects airflow over the cab reducing the solar heat gain through the roof panel by creating a shaded air layer above the cab's metal roof surface during highway driving

B. Apply a ceramic-particle window tint film to the windshield and side windows that blocks a significant percentage of infrared solar radiation while maintaining the required visible light transmission for commercial vehicles

C. Install additional cab insulation in the headliner and door panels to create a thermal barrier between the exterior metal surfaces and the interior cab space reducing the radiant heat transfer during solar exposure

D. Replace the existing cab roof panel with an insulated composite panel that has a higher thermal resistance than the standard metal panel reducing the heat conducted through the roof from direct solar exposure

107. A truck's cab access steps have broken mounting brackets on the right side. The steps hang loosely and shift under the driver's weight when entering the cab. Beyond the inconvenience, what is the primary concern?

A. The loose steps create a trip-and-fall hazard for the driver during cab entry and exit — commercial vehicle cab access injuries account for a significant percentage of lost-time injuries in the trucking industry

B. The hanging steps will contact the road surface during right turns creating a sparking hazard that could ignite fuel vapours from the fuel tank vent located near the right-side step mounting area on this vehicle

C. The loose step mounting bracket will vibrate and fatigue the cab body panel creating a progressive crack that will eventually compromise the cab structure at the step mounting attachment point in the body panel

D. The broken brackets allow the steps to swing outward beyond the vehicle's legal width creating a regulatory violation that will result in an out-of-service order during a commercial vehicle roadside inspection

108. A truck's sleeper cab partition (the divider between the driving area and the sleeper area) has developed a rattle that is noticeable during highway driving. The rattle increases with road roughness. What should the technician inspect?

A. The partition's upper mounting track for loose fasteners or worn sliding clips that allow the partition panel to move in its track creating the rattle from the panel shifting against the cab structure during road impacts

B. The sleeper cab mattress support platform for loose hardware that is rattling against the partition from the road vibration transmitted through the cab structure during highway driving over rough road surfaces

C. The cab air suspension for excessive height that changes the cab's natural frequency to a point that excites the partition panel's resonant vibration during highway driving on rough road surface conditions

D. The partition panel mounting hardware, clips, weatherstrip, and any latching mechanisms for looseness, wear, or deterioration that allows the panel to vibrate against the cab structure during road-induced movement

109. A reefer trailer's TRU has adequate cooling capacity but the cargo space temperature varies by more than 5°C between the front (near the evaporator) and the rear of the trailer. The trailer is loaded with palletized cargo with proper airflow channels. What is the most likely cause of this temperature gradient?

A. The evaporator fans are not producing adequate airflow volume to circulate the conditioned air to the rear of the trailer — worn fan motors, damaged blades, or a failed fan in a multi-fan evaporator reduces air velocity

B. The trailer's insulation value has decreased at the rear from age or damage and the increased heat gain at the rear raises the temperature relative to the well-insulated front section near the evaporator

C. The cargo is loaded too tightly against the rear doors blocking the return air path and preventing the conditioned air from circulating through the rear portion of the trailer for even temperature distribution

D. The TRU's thermostat sensor is mounted near the evaporator and reads the coldest air temperature — when the sensor is satisfied the TRU cycles off before the warmer rear air has been cooled to the set-point

110. A trailer's landing gear legs have been extended to their maximum length for uncoupling from a high-deck tractor. When the driver attempts to retract the legs for travel with a standard-height tractor, the crank handle will not turn — the legs are stuck in the extended position. What is the most likely cause?

A. The landing gear foot pads are sunk into soft ground and the legs cannot retract because the suction between the pads and the soft surface exceeds the crank mechanism's retraction force through the gear reduction

B. The landing gear internal gear mechanism has stripped a tooth during the fully-extended operation and the gear reduction cannot transmit the crank force to the extension screw with the damaged gear in the load path

C. The landing gear legs have been extended to a position where the internal screw mechanism has reached its maximum travel and jammed — the legs must be partially weight-loaded to release the binding at the end-of-travel position

D. The landing gear cross-shaft has seized in its bearings from corrosion and the driver cannot generate enough force through the crank handle to overcome the static friction of the corroded shaft-to-bearing interface

111. A trailer's suspension has been lowered by 50 mm using adjustable height control valve brackets for a specialized low-deck application. After the modification, the trailer's brake performance has deteriorated on the modified axle. What explains the reduced braking?

A. Lowering the suspension has changed the brake chamber mounting angle relative to the slack adjuster arm which reduces the effective pushrod stroke geometry and decreases the mechanical advantage during brake application

B. The lowered suspension changes the ABS wheel speed sensor air gap on the modified axle positions reducing the sensor signal strength below the ABS module's activation threshold which limits braking force during ABS events

C. The lowered ride height reduces the available suspension travel before the bump stops contact which limits the dynamic weight transfer to the modified axle during braking reducing the available traction at those wheel positions

D. The lower ride height changes the driveline angle to the modified axle creating a torque reaction during braking that counteracts the brake application force and reduces the net braking force available at those wheel positions

112. A trailer equipped with a hydraulic liftgate has the liftgate platform shaking and vibrating during the raise and lower cycles. The hydraulic system pressure and flow are within specification. What is the most likely cause?

A. The liftgate cylinder rod ends have worn clevis pins that allow the cylinder to shift during operation creating a hammering effect as the pin bounces in the worn clevis hole during each direction change

B. The liftgate pivot hinge bushings have worn allowing excessive play between the platform mounting arms and the trailer body which creates the shaking motion during the hydraulic raise and lower operations

C. The hydraulic pump is producing flow pulsations from worn gear teeth or a damaged relief valve seat that creates pressure oscillations transmitted through the cylinders to the platform as vibration during operation

D. The liftgate platform, hinge bushings, cylinder mounting hardware, and structural connections should all be inspected for wear — any mechanical looseness in the linkage chain will produce vibration during operation

113. A flatbed trailer's headboard (front bulkhead) has been impacted by shifting cargo during a hard braking event. The headboard is dented inward approximately 75 mm at the centre. What is the concern?

A. The deformed headboard may not provide adequate protection against forward cargo shift in a subsequent emergency braking event — it should be inspected for structural integrity and repaired or replaced before reloading

B. The dented headboard creates an aerodynamic disruption that increases fuel consumption by approximately 2% from the altered airflow pattern between the tractor cab and the trailer front face during highway driving

C. The headboard damage is cosmetic and does not affect the trailer's structural integrity because the headboard is a secondary cargo containment device that supplements the primary securement chains and straps

D. The headboard damage indicates the cargo was not properly secured during the previous trip and a documentation review should be performed to identify the responsible party for the cargo securement failure

114. A trailer's air system has a separate reservoir for the air ride suspension. This reservoir is connected to the main brake supply through a pressure protection valve. What is the purpose of the pressure protection valve in this circuit?

A. The valve prevents the air suspension from draining all the available air supply during a leak — it closes when the main system pressure drops below a set threshold to protect the brake circuit from losing pressure

B. The valve regulates the air pressure to the air bags at a fixed lower pressure than the brake system supply to prevent the air springs from being over-pressurized beyond their maximum rated operating pressure

C. The valve limits the filling rate of the suspension reservoir to prevent the air compressor from being overloaded during the initial system pressurization when both the brake and suspension reservoirs are empty

D. The valve isolates the suspension circuit from the brake circuit during brake applications to prevent the momentary pressure drop from brake air consumption from affecting the ride height during braking events

115. A trailer has been involved in a rear-end collision. During the post-collision inspection, the technician finds that the trailer's ICC (rear impact guard) bumper has been pushed forward approximately 100 mm from its original position. The bumper appears straight but the mounting brackets are bent. What action is required?

A. The ICC bumper and its mounting brackets must be repaired or replaced to restore the bumper to its original position and strength because the bumper is a federal safety requirement designed to prevent passenger vehicle underride

B. The bent brackets can be straightened using a hydraulic press and the bumper reinstalled at its original position as long as a structural inspection confirms no cracks in the bracket welds after the straightening procedure

C. The ICC bumper position can remain at the pushed-forward location as long as it still meets the minimum ground clearance and maximum rear overhang requirements specified in the federal motor vehicle safety standards

D. The bumper and brackets should be replaced rather than repaired because the collision forces may have introduced metal fatigue in the bracket material that is not detectable by visual inspection or standard NDT methods

116. A trailer's 7-pin electrical connector has intermittent lighting failures that occur randomly on different circuits. The connector pins and socket appear clean when inspected visually. What diagnostic approach should the technician use?

A. Perform a voltage drop test on each pin under load by activating each circuit and measuring the voltage difference between the tractor supply and the trailer lamp while the circuit is carrying its full operating current

B. Replace the entire 7-pin connector assembly on both the tractor and trailer since intermittent failures in multi-pin connectors are more efficiently resolved by replacement than by diagnosis of individual pin connections

C. Apply dielectric grease to all connector pins and reassemble — the grease prevents moisture and corrosion and if the problem resolves the connector was the issue without requiring further diagnosis or component replacement

D. Measure the resistance of each pin connection with a DMM by disconnecting the connector and measuring pin-to-pin resistance which will identify any high-resistance connections that cause intermittent circuit failures

117. A truck's A/C system has been recharged and the cooling performance is excellent. However, the compressor cycles off every 2 minutes and takes 30 seconds to restart. During the off period, the outlet air temperature rises to 15°C before the compressor re-engages and brings it back to 3°C. What is causing the excessively long compressor off-time?

A. The evaporator temperature sensor or low-pressure cycling switch has a threshold setting that is too low which allows the evaporator to warm excessively before the restart condition is met and the compressor re-engages

B. The compressor clutch has developed an intermittent electrical fault in its coil circuit that causes a delay between the controller's engage command and the actual clutch engagement creating the extended off-time

C. The expansion valve is restricting flow during the restart phase and the compressor must overcome the initial restriction before adequate refrigerant flow resumes and the evaporator begins cooling again effectively

D. The high-pressure cutout switch has a slow reset characteristic and takes 30 seconds to close its contacts after the high-side pressure drops below the switch's reset threshold following each compressor shutdown

118. A truck's cab heater works correctly when the HVAC mode selector is in the defrost or floor position, but no heat comes from the panel (face-level) vents when the panel position is selected. The blower operates at all speeds. What is the most likely cause?

A. The panel vent ductwork has collapsed or separated from the HVAC plenum housing and the heated air cannot reach the panel vent outlets even though it is available at the defrost and floor vent positions

B. The heater core has a partial blockage that limits the coolant flow rate to a level that can heat the lower-volume defrost and floor airflows but cannot heat the higher-volume panel vent airflow adequately

C. The mode door actuator or mode door mechanism is not opening the panel vent passage — it successfully directs air to defrost and floor positions but cannot reach or open the panel vent door position correctly

D. The cabin air filter is restricting the total airflow volume and the reduced air can only reach the nearer defrost and floor outlets but cannot maintain velocity to reach the more distant panel vent outlets

119. A fuel-fired auxiliary heater produces a strong diesel odour in the exhaust output. The heater starts and runs with a stable flame. The combustion air fan operates and the exhaust pipe is clear. What is the most likely cause of the diesel odour?

A. The fuel metering pump is delivering more fuel than the combustion air supply can burn completely — the excess unburned fuel vaporizes and exits the exhaust as the diesel odour during the heater's operation cycle

B. The heater's combustion chamber heat exchanger has developed a pinhole crack and a small amount of raw fuel is seeping through the crack into the exhaust stream before it can be fully combusted in the chamber

C. The heater's glow plug igniter has degraded and provides marginal ignition that does not consistently light all the fuel — the unburned fuel portion exits the exhaust producing the diesel odour during each cycle

D. The exhaust pipe routing passes near the fuel supply line and the pipe's heat is warming the fuel line enough to vaporize fuel inside the line which releases diesel odour near the exhaust pipe exit point

120. A truck's A/C system has a receiver/dryer with a sight glass. During normal operation, the sight glass shows a steady stream of bubbles in the refrigerant flow. The system pressures are within specification and the cooling performance is adequate. What do the bubbles indicate?

A. The bubbles indicate moisture contamination in the refrigerant that is flashing to steam as it passes through the sight glass creating the visible bubble stream in the otherwise liquid refrigerant flow path

B. The sight glass bubbles indicate the system is slightly undercharged — the bubbles represent refrigerant vapour mixed with liquid because there is insufficient refrigerant to maintain a solid column of liquid at that point

C. The bubbles are normal for systems using R-134a refrigerant because the miscibility of PAG oil with R-134a creates microscopic oil bubbles that are visible in the sight glass during normal system operation conditions

D. The sight glass is located at a point in the circuit where the pressure drops enough to flash some liquid refrigerant to vapour — the bubbles are a normal characteristic of the system's design at this circuit location

121. A truck's A/C compressor has been replaced. The new compressor came pre-charged with the correct amount and type of refrigerant oil. The technician adds the system's full oil charge during the recharge without accounting for the oil already in the new compressor. What effect will the excess oil have?

A. The excess oil will circulate through the system and accumulate in the evaporator and condenser reducing the effective heat transfer surface area available for the refrigerant to absorb and reject heat

B. The excess oil will settle in the compressor sump and the additional oil volume will not circulate through the system because the compressor's internal oil pump only moves the designed volume during operation

C. The excess oil will cause the compressor to hydraulically lock and fail on the first start because the liquid oil cannot be compressed and the piston will stall against the incompressible oil column in the cylinder

D. The excess oil is harmless because modern PAG oils are fully miscible with R-134a refrigerant and the additional oil dissolves completely into the refrigerant without affecting the system's cooling performance

122. A truck's HVAC system has a complaint of a musty odour only when the A/C is first turned on after a period of non-use. The odour disappears after approximately 5 minutes of operation. What is the root cause?

A. The refrigerant has absorbed odour-causing compounds from the engine compartment through the compressor shaft seal and releases them when the system is first activated after a period of non-use

B. The evaporator drain tube is partially blocked allowing condensate to pool in the HVAC housing where mould and bacteria grow during non-use periods — the odour dissipates as the evaporator dries during operation

C. The cabin air filter has absorbed moisture during the non-use period and the damp filter produces a musty odour when air first passes through it — the filter dries during operation and the odour disappears after 5 minutes

D. Mould and bacteria have colonized the damp evaporator surface during the non-use period — when the A/C restarts the initial airflow across the contaminated surface carries the musty spores into the cab until the cold dry air inhibits growth

123. A truck's A/C system has been converted from R-12 to R-134a. After the conversion, the system cools adequately in moderate temperatures but cannot maintain adequate cooling when the ambient temperature exceeds 35°C. What is the most likely reason for the reduced high-temperature performance?

A. R-134a operates at higher pressures than R-12 and the system's condenser which was designed for R-12's lower operating pressures cannot reject enough heat at high ambient temperatures with the R-134a's elevated condensing pressure

B. The conversion used the original R-12 expansion valve which has a different superheat setting than R-134a requires and the incorrect metering allows liquid refrigerant to flood the evaporator reducing cooling efficiency

C. R-134a has lower latent heat capacity than R-12 and the original system's condenser and evaporator are sized for R-12's higher heat transfer — the undersized components cannot match R-12 performance at high ambient temperatures

D. The conversion used PAG oil instead of the required ester oil for retrofit systems and the incompatible oil has degraded the original system's rubber seals causing a slow refrigerant leak that manifests only at high temperatures

124. A hydraulic system on a truck-mounted aerial platform has a fault where the boom raises smoothly but drifts downward approximately 50 mm per hour when held in a raised position with no operator input. The directional valve is in neutral. What should be investigated?

A. The boom raise circuit's check valve for a worn seat that allows a small amount of fluid to leak past in the reverse direction under the boom's static load weight draining the raise side of the cylinder gradually

B. The directional valve for excessive spool leakage in neutral that allows pressurized fluid from the boom's raise port to cross internally to the return port through the spool's clearance in the valve body bore

C. Both the holding valve (counterbalance or pilot-operated check) and the cylinder's internal piston seal for leakage — either component can independently cause the drift and both must be tested to isolate the source

D. The boom cylinder rod seal for external leakage that drains fluid from the rod side of the cylinder allowing the cap-side pressure to push the piston and lower the boom — external leakage would be visible at the rod exit

125. A hydraulic system's pump produces a steady rhythmic pulsation in the pressure gauge during operation. The pulsation frequency changes proportionally with engine RPM. The pump is a fixed-displacement gear type. What is the most likely cause?

A. A damaged or worn pump gear tooth that produces a pressure spike once per revolution as the damaged tooth passes through the mesh point between the drive and driven gears during each rotation cycle

B. The pump's internal relief valve is chattering from a weakened spring that allows the valve to open and close at a frequency corresponding to the pump's rotational speed creating the rhythmic pulsation in the gauge

C. The pump's inlet strainer has accumulated debris on one section of its surface creating a partial restriction that the gear teeth uncover and cover during each revolution producing a cyclic inlet flow variation

D. The rhythmic pulsation is normal for gear-type hydraulic pumps because each gear tooth produces a discrete pressure pulse as it disengages from its mate and the pulse frequency is proportional to shaft speed and tooth count

126. A hydraulic system has been overheating consistently. The technician has replaced the oil cooler, verified the cooler fan operation, and confirmed the oil level is correct. The system still overheats. What should be checked next?

A. The hydraulic fluid viscosity specification against the current ambient temperature — if the fluid is too thick for the conditions the internal fluid friction generates excess heat that the cooling system cannot dissipate

B. The system's internal relief valve setting for a value that is too close to the working pressure which causes frequent relief valve bypassing and converts the bypassed hydraulic energy directly to heat in the fluid

C. The pump for excessive internal wear that creates bypass flow converting pump energy to heat without performing useful work — combined with the correctly-sized cooler the heat generation still exceeds the cooling capacity

D. The system for excessive internal leakage in the cylinders, motors, valves, and fittings — the total internal bypass flow from all worn components generates heat that exceeds the cooling capacity of the correctly-functioning cooler

127. A hydraulic liftgate has adequate pressure but the raise speed is approximately 50% of the specification with a full load on the platform. With the platform empty, the raise speed is normal. The pump flow test at the pump discharge is within specification. What should be checked?

A. The pump's internal bypass for a condition that allows adequate flow at no load but cannot maintain flow under the backpressure created by the loaded platform's weight on the raise cylinder circuit

B. The cylinder for internal seal bypass that allows fluid to cross from the pressure side to the return side under the loaded condition — the seal holds at the lower pressure of the empty platform but leaks under full load

C. The directional valve for internal leakage in the raise port that increases proportionally with the system pressure — at the higher pressure of the loaded condition more fluid bypasses through the valve leakage path

D. Both the cylinder internal seals and the directional valve for load-dependent leakage — either or both components can allow bypass that is minimal at low pressure (empty) but significant at high pressure (loaded)

128. A hydraulic system's return filter has a bypass indicator showing the filter is in bypass. The technician replaces the filter element and the bypass indicator resets. After 50 hours of operation, the indicator shows bypass again. What does this rapid filter bypass recurrence indicate?

A. The system has a contamination source that is generating particles faster than the new filter element can capture them — the source must be identified and repaired before the filter can maintain its designed service interval

B. The replacement filter element has the wrong micron rating — a finer-than-specified element will clog faster from capturing particles that the system was designed to tolerate at the original coarser filtration specification

C. The hydraulic pump is producing metal wear particles at an accelerated rate from internal wear and the contamination from the failing pump is overloading the filter element within 50 hours of each replacement cycle

D. The return filter housing's bypass valve spring has weakened from age and the valve opens at a lower differential pressure than specified — the filter element is not actually clogged but the weak spring allows premature bypass

129. A dump truck's hydraulic system raises the box at the correct speed but the box descends faster than specification when the lower function is activated. The operator is concerned about losing control of the load during the lowering operation. What component controls the lowering speed?

A. The pump's internal check valve that is supposed to restrict the return flow rate during the lowering operation to maintain a controlled descent speed under the load's gravitational force acting on the cylinder

B. The lowering speed control — either a flow control valve, a counterbalance valve, or a needle valve in the return circuit that restricts the flow rate from the cylinder to the reservoir during the gravity-assisted lowering

C. The directional control valve's return port orifice that meters the flow rate from the cylinder during the lowering operation to prevent the load's weight from driving the cylinder faster than the controlled descent speed

D. The cylinder's cushioning mechanism at the rod end that decelerates the piston during the final portion of the retraction stroke to prevent the box from slamming against the frame during the last section of the descent

130. A hydraulic system has an accumulator that pre-charges to 8,000 kPa with nitrogen. The system working pressure is 20,000 kPa. After several months of service, the accumulator's pre-charge has dropped to 5,000 kPa. What is the primary consequence of operating with the reduced pre-charge?

A. The accumulator's energy storage and delivery capacity is significantly reduced because the lower nitrogen pre-charge allows more hydraulic fluid to enter but at a lower maximum pressure reducing the usable stored energy

B. The hydraulic pump must run more frequently to maintain system pressure because the accumulator can no longer assist the pump during peak demand periods — the pump's duty cycle increases accelerating pump wear

C. The accumulator bladder will be over-compressed by the hydraulic pressure because the reduced nitrogen pre-charge cannot resist the system pressure adequately and the bladder may fold and pinch causing failure

D. The reduced pre-charge causes the accumulator to absorb pressure pulsations less effectively allowing pump ripple to reach the actuators causing vibration and noise during the system's normal operating cycles

131. A truck-mounted hydraulic crane has a maximum lifting capacity of 5,000 kg at 3 metres of boom extension. The operator attempts to lift 3,500 kg at 5 metres of boom extension. The crane's load moment indicator (LMI) activates and prevents the lift. Why did the LMI prevent this lift?

A. The total load weight of 3,500 kg is below the crane's maximum capacity but the operator has not properly rigged the load and the LMI detects the improper rigging through the hook block's load sensor

B. The crane's hydraulic system cannot produce adequate pressure to lift 3,500 kg at any boom length and the LMI prevents all lifts above 3,000 kg regardless of the boom extension position to protect the pump

C. The load moment (force × distance) at 5 metres exceeds the crane's rated capacity even though the load weight alone is within the maximum — the LMI calculates that the extended boom creates a tipping hazard

D. The LMI sensor has calibration drift that has reduced its maximum lift threshold below the crane's actual rated capacity and the sensor needs recalibration to restore the crane's full lifting capacity at all boom lengths

132. A battery-electric truck's battery management system (BMS) is performing cell balancing during overnight charging. What is the purpose of cell balancing?

A. Cell balancing equalizes the voltage across all cells in the pack by either discharging higher-voltage cells or transferring energy from higher to lower cells ensuring the pack charges and discharges uniformly for maximum capacity

B. Cell balancing redistributes the electrolyte between cells that have developed unequal levels from the mechanical vibration of driving which causes the liquid to shift between cells through the interconnecting bus bars

C. Cell balancing resets the BMS's state-of-charge calculation algorithm for each individual cell by measuring the cell's open-circuit voltage during the rest period between charging pulses to improve the SOC accuracy

D. Cell balancing adjusts the charging current to each cell module individually based on its temperature — warmer cells receive less current and cooler cells receive more to ensure all cells reach full charge simultaneously

133. A parallel hybrid truck has both an electric motor and a diesel engine driving through the same transmission. During a road test, the technician notices that the electric motor produces a high-pitched whine that is proportional to vehicle speed during electric-only driving. The whine is not present during engine-only driving. Is this noise normal?

A. The whine is abnormal and indicates the motor bearings are failing — electric motors should operate silently at all speeds and any audible noise indicates a mechanical defect requiring immediate motor replacement

B. The whine is likely the electrical switching noise from the inverter driving the motor — the high-frequency PWM switching produces an audible tone that varies with motor speed and is a normal characteristic of many electric drive systems

C. The whine indicates the motor's rotor is rubbing against the stator from bearing wear — the engine's vibration masks the noise during engine-only driving but the smooth electric operation makes it audible during EV mode

D. The whine is from the transmission's input shaft bearing which only becomes audible during the smooth vibration-free electric driving mode — the engine's combustion noise masks the bearing noise during engine-only operation

134. A battery-electric truck's thermal management system uses a heat pump for cabin heating in cold weather instead of a resistive PTC heater. What advantage does the heat pump provide over resistive heating?

A. The heat pump produces the same cabin heating output as a resistive heater but uses less electrical energy from the battery — a heat pump moves heat from the outside air into the cab rather than converting electricity directly to heat

B. The heat pump provides faster cabin warmup than resistive heating because the compressor can generate higher initial air temperatures by compressing the refrigerant to a higher pressure during the cold-start heating phase

C. The heat pump is more reliable than resistive heating elements because it has fewer electrical connections and no high-current heating elements that can fail from thermal cycling and corrosion in the humid cab environment

D. The heat pump provides superior defogging performance compared to resistive heating because the refrigerant-based heating produces drier air than the resistive element's radiant heat which does not remove moisture from the airstream

135. A hybrid truck's regenerative braking system blends regenerative braking with friction braking. During a moderate deceleration event, the scan tool shows the regenerative system providing 60% of the braking force and the friction brakes providing 40%. Halfway through the stop, the regenerative contribution suddenly drops to 0% and the friction brakes increase to 100%. What most likely caused this transition?

A. The vehicle speed dropped below the minimum threshold for regenerative braking — electric motors cannot efficiently generate electricity at very low rotational speeds so the friction brakes must provide all braking force below that speed

B. The ABS system detected wheel lockup on the drive axle and disabled the regenerative braking to prevent the electric motor's braking torque from contributing to the lockup condition during the remainder of the stop

C. The battery reached its maximum charge current limit during the deceleration and the BMS commanded the regenerative system to stop to prevent overcharging the cells — the friction brakes compensated for the lost regen force

D. The inverter overheated from the sustained regenerative current flow and the thermal protection circuit disabled the regen function to prevent damage — the friction brakes automatically increased to maintain the deceleration rate

Practice Exam 9: Answer Key and Explanations

1. B — Modern diesel engines have numerous electronic sensors, ECM connectors, and air intake openings that are vulnerable to water intrusion from high-pressure steam. Covering or protecting these sensitive components and avoiding direct steam contact with electrical connectors prevents moisture from entering sealed connections and causing short circuits, corrosion, or sensor damage.

2. D — Used engine oil is a regulated waste that must be stored in compliance with provincial environmental regulations. Outdoor drum storage requires secondary containment (a spill pad or bermed area) to capture any leaks, sealed drums to prevent rainwater contamination, and proper labelling to identify the contents. Improper storage creates soil and groundwater contamination liability.

3. C — Any foreign material in a combustion chamber creates a risk of mechanical damage during engine operation. An O-ring trapped between the piston crown and the cylinder head will be struck by the piston, potentially damaging the piston, valve faces, or the new injector tip. The O-ring must be retrieved before the new injector is installed.

4. A — Hydraulic floor jacks can fail from seal leaks, overloading, or mechanical failure causing the vehicle to drop without warning. Rated jack stands at approved lift points provide a mechanical support that cannot hydraulically fail. This is the minimum standard — no technician should ever position themselves under a vehicle supported only by a floor jack.

5. D — Ethylene glycol is highly toxic to animals (particularly pets that are attracted to its sweet taste) and aquatic organisms. Coolant spills must be contained immediately with absorbent material and prevented from entering floor drains that connect to storm sewers or municipal systems. The contaminated absorbent must be disposed of as regulated waste.

6. C — Any cut, tear, or damage to seatbelt webbing compromises the belt's ability to restrain the occupant during a collision. The webbing's strength depends on the full width of the material — a 25 mm cut removes a significant portion of the load-bearing fibres. Seatbelt webbing cannot be safely repaired and the entire assembly must be replaced.

7. A — A six-point box-end wrench or six-point socket fully engages all six corners of the hex distributing the turning force evenly across the entire hex perimeter. This prevents the tool from concentrating force on two corners (as open-end wrenches do) which rounds the softer material of brake bleeders and hydraulic fittings.

8. B — A GFCI detects current imbalance between the hot and neutral conductors — as little as 5 milliamps — and trips within milliseconds. This protects the technician from electrical shock if the soldering iron develops a ground fault or if the technician contacts an energized conductor while grounded to the vehicle or shop floor.

9. D — White smoke during DPF regeneration only — with stable coolant and no symptoms during normal driving — points to the late-post fuel injection event. The ECM injects fuel late in the exhaust stroke to raise exhaust temperature for regeneration. If the dosing is excessive or the DOC cannot fully oxidize the fuel, unburned hydrocarbons exit the tailpipe as white vapour.

10. C — The top compression ring on most heavy-duty diesel engines is chrome-plated for wear resistance. An isolated chromium spike with stable iron and aluminium indicates the chrome plating on one or more compression rings is wearing faster than normal. This is an early indicator of ring face wear that will eventually lead to increased blow-by and oil consumption.

11. A — With all fuel parameters within specification, the 50-horsepower shortfall must come from the air side of the combustion equation. Insufficient boost pressure from a turbocharger issue or restricted air intake limits the oxygen available for combustion, which directly limits the amount of fuel that can be burned completely. The engine cannot produce rated power without rated air charge.

12. B — A diesel engine runaway occurs when the engine ingests a flammable substance through the air intake — typically crankcase oil from a failed turbo seal, oil mist from a failed CCV system, or ambient vapours from a spill. Since the fuel source bypasses the injection system, turning the key off has no effect. The air intake must be physically blocked to suffocate the engine.

13. D — Insufficient piston-to-head clearance (0.5 mm vs 0.8-1.2 mm specification) means the piston is closer to the head than designed. This reduced clearance increases the compression ratio above the design limit because the combustion chamber volume at TDC is smaller. The elevated cylinder pressure can exceed the head gasket's clamping force, causing gasket failure.

14. C — The noise disappears when the injector is disabled (eliminating combustion on that cylinder). This confirms the noise is combustion-related — the injector is delivering fuel in a way that produces an abnormal pressure event in the combustion chamber. Over-advancing or excessive fuel delivery creates a pressure spike that produces the metallic knock.

15. A — The current -25°C protection is inadequate for Northern Alberta's -40°C temperatures. The technician must drain a portion of the existing coolant and replace it with concentrated antifreeze to increase the glycol percentage until the refractometer reads -45°C or lower. This provides adequate freeze protection with a safety margin for the operating environment.

16. D — After replacing the VGT vanes, the actuator must be recalibrated so the ECM learns the new vanes' physical endpoints. Without calibration, the ECM's commanded positions do not correspond to the actual vane positions. At low RPM where precise vane closure is needed for boost, the uncalibrated vanes may not close far enough, producing inadequate boost.

17. B — Rising silicon and aluminium together is the classic oil analysis signature of dirt ingestion. Silicon represents airborne silica (sand, dust) entering through a compromised air filtration system. The abrasive silica particles then wear the aluminium piston material, releasing aluminium into the oil. The air intake system must be inspected for filter damage, loose connections, or cracked ducting.

18. A — The high-pressure pump relies on adequate supply pressure from the transfer pump to fill its compression chambers during each intake stroke. At 280 kPa instead of 450 kPa, the reduced supply pressure provides insufficient fuel volume to fully charge the pump at rated speed. The pump cannot build adequate rail pressure, causing low power especially at high RPM and load.

19. C — Multi-layer steel gaskets seal through the precise contact between the gasket's embossed sealing beads and the mating metal surfaces. Both the block deck and head deck must be clean, flat, and within the manufacturer's surface finish specification (typically Ra 0.2 to 0.4 μm). Rough or uneven surfaces prevent the MLS layers from conforming and sealing properly.

20. D — Extended idling in cold weather causes moisture to condense in the EGR system and intake manifold from the cooled exhaust gas. When the driver increases RPM, the sudden increase in exhaust flow pushes this accumulated moisture through the intake, momentarily disrupting the air charge consistency and causing the surge until the moisture evaporates from the increased heat.

21. B — Compression testing measures the cylinder's ability to hold pressure during the relatively slow compression stroke. Blow-by occurs primarily during the power stroke when combustion pressures (6,000-8,000 kPa) force gas past the ring end gaps at much higher pressure differentials than the compression test produces. Rings can pass the compression test while still allowing excessive blow-by under combustion pressure.

22. A — Biodiesel has solvent properties that dissolve existing deposits from fuel tank walls, fuel line interiors, and system components. These dissolved deposits — accumulated from years of petroleum diesel operation — are carried by the fuel to the filter element where they accumulate and clog the filter at an accelerated rate until the system is cleaned.

23. C — The NOx adsorber catalyst absorbs and stores NOx molecules on its barium-based washcoat during normal lean diesel combustion. Periodically, the ECM commands a brief rich-fuel event that purges the stored NOx, converting it to nitrogen and CO_2. Sulphur in the fuel poisons the catalyst surface by occupying the NOx storage sites with sulphur compounds that are harder to purge.

24. D — A perfectly consistent 30-second run-then-shutdown pattern with no fault codes suggests a programmed timer rather than a mechanical or fuel system fault. Anti-theft and immobilizer systems on some vehicles allow the engine to crank and run for a preset duration before shutting down if the security key or transponder is not authenticated by the system.

25. B — The EGR flow rate is 15% below commanded across all conditions despite the valve, actuator, and sensors being functional. The new EGR cooler may have a different internal tube configuration, tube count, or flow path diameter than the original, creating more restriction than the original design. The replacement cooler's part number and specifications should be verified against the OEM requirements.

26. A — Decreasing crankcase pressure during the initial break-in period is the expected trend. New piston rings have not yet fully conformed to the cylinder liner surface — as they seat progressively against the bore, the sealing improves and less combustion gas escapes past the rings into the crankcase. The decreasing pressure confirms the rings are seating correctly.

27. D — The DPF differential pressure sensor connects to the DPF housing through small-diameter tubes. During extended cold parking, moisture can condense inside these tubes or at the sensor ports. The condensed moisture partially blocks the tubes, creating a false high-pressure reading. Once the engine runs and the exhaust heat evaporates the moisture, the reading returns to normal.

28. A — A front-of-engine knock that increases with RPM and does not change when individual injectors are disabled (ruling out combustion-related causes) points to a rotating component at the front of the engine. The crankshaft vibration damper is the most likely source — a failed rubber element, separated inertia ring, or loose mounting bolt allows the damper to wobble, producing the speed-dependent knock.

29. B — Diesel fuel provides critical lubrication to the fuel injection system's precision-fit components — injector needle and barrel assemblies, high-pressure pump plungers and barrels, and metering valves. Gasoline has virtually no lubricity compared to diesel, and the metal-to-metal contact in these precision components causes rapid scoring and seizure within a short operating period.

30. B — The compressor has been rebuilt with new rings and valves, and all downstream components are verified correct. A slow build-up time from a rebuilt compressor most commonly results from the discharge valve not seating correctly. If the valve leaks on the compression stroke, compressed air flows backward through the valve reducing the net volume delivered per cycle.

31. D — The service air signal must travel a significantly longer pneumatic distance from the foot valve to the trailer brake chambers compared to the tractor chambers. The signal passes through tractor plumbing, gladhand connections, trailer plumbing, the relay valve, and then from the relay to the chambers. This cumulative pneumatic path length creates an inherent signal propagation delay.

32. C — Brake drums develop a thin layer of surface rust during overnight parking from ambient moisture. On the first brake application the next morning, the linings break through the oxide layer with a characteristic popping or scraping sound. The noise does not repeat because the subsequent applications maintain a clean contact surface between the linings and drum.

33. A — The brake chambers on that axle have internal corrosion from moisture accumulation during the extended parking period. The corroded spring housing prevents the power spring from compressing fully even though adequate air pressure is delivered. The spring cannot overcome the binding friction of the corroded housing to release the brake mechanically.

34. C — Relay valves require a minimum signal pressure (crack pressure) to begin delivering air to the brake chambers. If contamination has increased the relay valves' crack pressure, the driver must push the pedal further to generate the higher signal pressure needed to open the valves. Once the valves crack open, normal braking force is delivered.

35. A — The S-cam rotates and pushes one shoe's roller outward against the drum, but the other shoe does not contact. The most likely cause is a broken anchor pin on the non-contacting shoe — without the anchor pin, the shoe cannot pivot when the cam pushes its roller. Instead, the shoe slides along the backing plate without rotating into the drum.

36. B — A brake pull that occurs only during hard braking but not moderate braking indicates one side has a condition that limits its maximum force output. At moderate braking, both sides produce similar

force. During hard braking, the right side reaches its maximum before the left side, creating an imbalance. A contaminated lining, glazed pad, restricted air line, or mechanical restriction on the right side are common causes.

37. A — The one-second delay before braking force is felt indicates the brake chambers need additional air volume to fill before the linings contact the drums. Excessively long pushrod strokes create this extra chamber volume. The air system builds pressure normally (gauge confirms adequate supply), but the chambers must fill the additional stroke length before mechanical contact occurs.

38. D — With equal chamber sizes and correct pushrod stroke, the difference in braking force between left and right must come from the friction surface. Oil contamination on the right side brake lining from a leaking axle seal reduces the friction coefficient of the lining material. The contaminated lining produces less braking force per unit of application pressure than the clean lining on the left side.

39. A — Automatic slack adjusters gradually take up excess clearance through their internal ratchet mechanism during brake applications. If the initial adjustment is not set to specification, the adjuster will ratchet toward the correct position over the next 10 to 15 applications. During this period, the brake on that wheel has extended pedal travel and reduced braking contribution.

40. C — The EBS has no fault codes and the front brakes feel normal, but the rear brakes are too aggressive during light applications. The most likely cause is the EBS rear pressure modulator delivering higher-than-commanded pressure. The modulator's proportioning function has a fault that overdelivers to the rear axle during the light pedal input range.

41. A — A hill-hold or anti-rollback feature maintains service brake pressure or delays the spring brake release until the driver begins to accelerate. This prevents the vehicle from rolling backward during the transition from parking brake to service brake when departing on a grade. The feature releases automatically when the engine produces drive torque.

42. B — The governor has failed and cannot send the unload signal to the compressor when the cut-out pressure is reached. The compressor continues pumping air into the system without cycling to unloaded, and the pressure rises unchecked. The air system safety valve should open at approximately 1,035 kPa to prevent catastrophic overpressurization.

43. C — The spring brake chamber's non-pressure housing contains the powerful mechanical spring. A dent in this housing may have weakened the wall, and the spring exerts constant force against the

housing from the inside. A weakened housing wall could fail suddenly, releasing the spring with explosive force. The chamber must be replaced as a precaution.

44. B — New brake linings often have an arc radius ground to a nominal size that may not exactly match the drum's current diameter (which has been enlarged from previous machining). The linings contact the drum at the ends only (toe and heel) rather than across the full arc. The reduced contact area produces less braking force until the surfaces conform through bedding-in.

45. A — The one-way check valve's purpose is to isolate the secondary reservoir from the supply tank. If the valve fails open (bidirectional flow), a leak in the supply tank would drain the secondary reservoir backward through the failed valve. The front steer axle brakes — supplied by the secondary — would lose pressure along with the leaking supply circuit.

46. A — The pushrod stroke of 57 mm on a 64 mm maximum chamber is at 89% of the maximum — well above the typical 70% adjustment limit (approximately 45 mm for this chamber). The technician should inspect the brake linings for wear, check the drum diameter, and verify the automatic slack adjuster's function. The brake is approaching the out-of-service threshold.

47. D — A battery can show correct resting voltage (12.65V = fully charged) from surface charge while the internal plate structure has deteriorated from sulphation, grid corrosion, or active material shedding. The conductance test detects this internal degradation by measuring the plate area available for chemical reaction — identifying a battery that reads good on voltage but cannot deliver adequate CCA.

48. C — An NTC thermistor decreases resistance as temperature increases. A constant 5.0V reading means the full reference voltage is reaching the ECM without being pulled down by the sensor's resistance. This indicates an open circuit — either the sensor element, the signal wire, or the connector has an open that prevents the sensor from loading the 5V reference.

49. A — The DMM shows steady 13.8V (confirming the power supply is stable), but the LED lamp flickers. LED lamps have internal driver circuits that regulate current to the LEDs. An intermittent thermal fault in the driver circuit causes it to cycle off and on as it overheats and resets — the power supply is stable but the lamp's internal electronics are failing.

50. B — Excessive starter current (450A vs 200-250A specification) combined with slow cranking indicates the starter motor has an internal fault. A shorted armature winding, grounded field coil, or

seized bearing creates excessive electrical load. The motor draws excessive current but converts most of it to heat rather than mechanical energy, resulting in slow cranking despite the high current draw.

51. D — Multiple fault codes from several modules appearing at exactly the same time suggests a simultaneous event affected all modules. A CAN bus backbone fault that momentarily corrupted data to all modules simultaneously is the most likely cause. Each module logged a fault based on the corrupted data it received during the brief interruption.

52. C — A 2.6-volt drop between the tractor battery (13.8V) and the trailer connector pin 7 (11.2V) under load indicates excessive resistance in the circuit. Corroded connector pins, damaged wires, loose splice connections, or deteriorated terminals between the battery and the trailer connector create voltage drops that are proportional to the current flowing through the resistance.

53. A — A new humming noise from a battery equalizer that previously operated quietly indicates internal component deterioration. The humming typically comes from loosening transformer laminations, failing switching transistors that create irregular current pulses, or a saturating transformer core. These are signs of progressive failure that will eventually result in complete equalizer failure.

54. B — The marker lamps activating with the ignition rather than the headlamp switch indicates a configuration change in the body controller. Customer-programmable parameters in the body controller determine which circuits activate with which switch inputs. An incorrect parameter setting — from a software update, module replacement, or technician error — changed the marker lamp activation from headlamp-switch-dependent to ignition-dependent.

55. D — A glow plug drawing 3A instead of 11-12A has increased internal resistance. The heating element has developed a partial break or has aged to the point where its resistance has increased significantly. The plug may still glow (dimly) but cannot produce adequate heat for reliable cold-starting. All glow plugs with readings outside the specified range should be replaced.

56. B — Intake manifold temperature 70°C above ambient during highway driving (95°C vs 25°C ambient, specification is within 15°C of ambient) indicates the charge air cooler is not adequately cooling the compressed intake air. Internal contamination (oil, soot), external fin damage, or reduced airflow through the cooler core prevents it from reducing the turbo's compressed air temperature.

57. A — The alternator charges correctly (14.1V at the battery confirms the charging circuit works), but the charge lamp stays on. The sense wire (voltage sensing lead) provides the signal that tells the lamp

circuit the alternator is producing voltage. Without this connection, the lamp relay or indicator circuit never receives the "charging confirmed" signal to extinguish the lamp.

58. C — CAN bus uses differential signaling — CAN-H swings above 2.5V and CAN-L swings below 2.5V during data transmission. If CAN-L remains flat at 2.5V while CAN-H shows normal pulses, CAN-L has a fault — either a short to the 2.5V reference or an open circuit that prevents the transceiver from pulling CAN-L to its active low state.

59. D — FMI 5 (current below normal) on an active (powered) sensor means the sensor circuit is drawing less current than the ABS module expects for a functioning sensor. An open circuit, excessive resistance in the wiring, or a failed sensor element reduces the current below the module's minimum threshold. The module cannot distinguish valid wheel speed data from the weak signal.

60. B — One DRL is significantly brighter than the other with identical bulbs. The brighter side is likely receiving full headlamp voltage instead of the reduced DRL voltage. A fault in the DRL module's output driver, a wiring error, or a relay contact fault on that side bypasses the voltage reduction, illuminating that lamp at full brightness while the other operates at the designed DRL level.

61. A — The solenoids click (confirming they receive the electrical signal and mechanically shift), but the transmission does not shift. The air must travel from the solenoid assembly to the transmission range cylinder through connecting lines. Blocked, frozen, or disconnected air passages between the solenoid output and the shift cylinder prevent the air from reaching the shift mechanism.

62. C — The cruise control maintains speed on level ground (proving the system works) but disengages on grades. As the grade increases engine load, the vehicle slows. If the speed drops below the set-point by more than the allowable tolerance (typically 10-15 km/h), the cruise automatically disengages because it cannot maintain the set speed.

63. D — Normal current draw in both directions with correct voltage eliminates electrical faults. The window regulator mechanism — its tracks, rollers, cables, or guide channels — has a mechanical binding condition that creates more resistance in the downward direction than upward. A bent track, dry channel, or damaged cable section increases resistance in one travel direction.

64. A — Electronic battery disconnect switches maintain a small continuous current draw for their internal control circuitry, voltage monitoring, and the contactor coil hold circuit. This keep-alive current

is necessary for the switch to respond to the remote reconnect command from the cab. The 50 mA draw is within the normal range for most electronic disconnect systems.

65. A — SPN 523, FMI 2 (transmission gear — erratic/intermittent) combined with intermittent gear slippage points to the transmission gear position sensor or its circuit. An intermittent signal fault causes the TCM to momentarily lose track of the selected gear, potentially commanding a brief neutral condition that the driver perceives as a slip before the signal recovers.

66. D — A standard DMM measuring a PWM signal displays the average voltage of the signal. At approximately 50% duty cycle, the DMM averages the 12V "on" periods and 0V "off" periods, displaying approximately 6-7V (the slight offset from 6.0V is from the non-50% actual duty cycle). The reading represents the average, not the true RMS or peak voltage.

67. A — The diagnostic connector's CAN bus pins are the interface between the vehicle's CAN bus and the aftermarket device. Corrosion on these pins creates intermittent contact that corrupts the data signal during periods of poor connection. The GPS device reads corrupted speed data from the degraded signal and transmits the incorrect values to the fleet server.

68. B — The switch provides correct resistance values at each position (confirming the input is correct), but the wiper speed does not change. The wiper motor's internal speed control circuit or the body controller's wiper speed output driver is not varying the motor's supply correctly. The control path between the verified-good switch and the motor has a fault.

69. C — The clutch position sensor provides the AMT controller with real-time feedback about the exact position of the release mechanism relative to the pressure plate. Without accurate position data, the controller cannot modulate the clutch engagement smoothly — it cannot determine how far to move the actuator for the correct engagement speed, resulting in harsh and inconsistent shifts.

70. A — A howling noise that develops after an oil change with the correct fluid level points to the lubricant specification. The wrong viscosity grade (too thin) or the wrong GL rating (insufficient EP additive) fails to maintain adequate oil film between the hypoid ring and pinion gear teeth under load. The metal-to-metal contact produces the characteristic howling during highway cruise.

71. D — Correct fluid level, clean fluid, and no burnt odour rules out a complete system failure. A sheared hub connection between the forward clutch pack hub and the input shaft allows the input to spin

freely without transmitting torque to the planetary gear set. The clutch packs may apply correctly but the torque path is broken at the hub-to-shaft connection.

72. B — A clutch pedal that drops freely with no resistance, does not return, has full reservoir fluid, and no visible leaks indicates a complete internal bypass in the master cylinder. The piston seal has failed entirely, allowing the piston to move through the fluid without building any hydraulic pressure. The fluid simply bypasses around the piston seal without actuating the slave cylinder.

73. C — The drive pattern is centered (correct) but the coast pattern is at the toe. Toe-ward coast patterns are corrected by moving the pinion deeper into the housing (adding shim behind the pinion head). This shifts the pinion tooth engagement point and moves the coast-side contact from the toe toward the centre without significantly disturbing the already-correct drive-side pattern.

74. A — All forward gears work correctly, confirming the main transmission gears, synchronizers, and clutch function properly. Reverse gear uses a separate idler gear mechanism that is independent of the forward gear train. A worn shift fork, bent shift rail, stuck detent, or damaged reverse idler gear prevents the reverse-specific mechanism from engaging.

75. D — The indicator lamp turns off (confirming the electrical signal has released) but the lock remains mechanically engaged. Driveline torque loading on the locking collar presses it firmly against the engagement teeth. The air actuator's return spring cannot overcome the friction between the loaded collar and teeth. Relieving the driveline torque (coasting in neutral) typically allows disengagement.

76. B — Driveshafts are balanced during manufacturing with the slip yoke at a specific end. Reversing the shaft changes the mass distribution and moves the balance weights relative to the slip yoke, creating a rotational imbalance. The vibration at highway speed results from the imbalanced mass rotating at high speed, producing centrifugal force that shakes the driveline.

77. C — A stall speed 200-300 RPM above specification indicates the transmission cannot resist the engine's torque — a clutch pack is slipping. The slipping clutch reduces the load the converter must overcome, allowing the impeller to spin faster before reaching the stall equilibrium. The specific clutch pack that slips can be identified through clutch apply pressure testing.

78. A — The transmission shifts normally in all forward gears (proving the pump, valve body, and most clutch packs work), but reverse does not engage. The reverse-specific components — the reverse band, its servo, and the reverse clutch pack — are the most likely suspects. Incorrect assembly (band not

anchored, servo backward, or wrong disc/plate sequence) prevents the reverse power path from engaging.

79. D — A deteriorated centre bearing rubber mount allows the driveshaft to sag and oscillate vertically. This changes the U-joint working angles dynamically during operation. The altered angles produce a speed-dependent vibration that varies with load because the engine torque changes the driveshaft's rotational behaviour under the varying angular conditions.

80. B — A glazed, shiny clutch disc surface indicates the friction material has been overheated. Excessive slipping from prolonged hill starts, stop-and-go traffic, or holding the clutch partially engaged generates heat that exceeds the lining material's thermal capacity. The overheated surface hardens and polishes rather than maintaining its designed rough friction texture.

81. A — A grinding noise specific to the 6th-to-5th downshift while all other downshifts are smooth indicates the 5th gear synchronizer has worn blocking ring material. The synchronizer cannot slow the gear speed adequately to match the input shaft speed during the specific RPM differential of the 6th-to-5th downshift, causing the gear teeth to clash during engagement.

82. D — A blocked axle vent produces problems in both temperature directions. During operation, the lubricant and trapped air heat up and expand — the increased pressure forces oil past the seals (leaking). When the axle cools after parking, the contracting air creates a vacuum that draws ambient air and moisture past the seals into the housing, contaminating the lubricant with water.

83. C — Transfer case shift mechanisms use positive-engagement sliding clutch collars with machined engagement teeth. Some clunking during the engagement is normal and inherent in the positive-engagement design. The collar teeth contact the engagement teeth with a mechanical impact as they mesh. This is distinct from a grinding noise which would indicate a synchronizer or alignment problem.

84. D — Limited-slip differential chatter during slow tight turns on dry pavement is caused by the clutch discs alternately grabbing and slipping. The friction modifier additive in the gear oil is essential for smooth clutch engagement — if depleted, contaminated, or if the wrong lubricant was used, the clutches engage aggressively and release abruptly in a rapid cycle producing the chatter.

85. A — The speedometer reads 5% high, meaning the ECM is calculating a faster vehicle speed than actual. The vehicle speed is derived from the output shaft speed sensor, which reads a tone ring or

exciter ring on the new carrier. If the new carrier has a different tooth count on the exciter ring than the original, the ECM counts more (or fewer) pulses per revolution and miscalculates speed.

86. D — Power steering groaning during cold-weather slow turns that improves as the system warms indicates the fluid's cold viscosity is at or above the pump's flow capacity at the slow-turn high-demand condition. The thick cold fluid cavitates at the pump inlet and creates turbulent flow through the gearbox valve. As the fluid warms and thins, the viscosity drops into the acceptable range.

87. B — Unequal positive camber creates a steering pull toward the side with the greater camber angle. With +1.5° on the right (exceeding the +1.0° maximum specification) and +0.5° on the left, the truck pulls to the right. The camber must be corrected on the right side to bring it within the +0.25° to +1.0° specification range.

88. A — A broken centre bolt allows the axle to shift on the spring pack. The 10 mm rearward shift on one side changes the wheelbase on that side relative to the opposite side. This creates a thrust angle — the rear axle is no longer perpendicular to the vehicle centreline — causing the truck to dog-track (track at an angle to its direction of travel).

89. C — The ATI system automatically restores the pressure each morning, which could mask a slow tire leak that would otherwise be detected during the driver's pre-trip pressure check. The tire should be inspected for a puncture, valve stem leak, or bead seal issue because the ATI system is continuously compensating for a pressure loss that should not be occurring.

90. D — Reduced king pin inclination (KPI) decreases the geometric self-centering force that acts on the steer wheels. With less KPI, the vertical load acting through the king pin geometry produces less returnability force after turns. The steering wheel does not return to centre as positively, and the truck has reduced straight-line stability.

91. A — Three adjacent nuts losing torque while seven others hold indicates a localized condition at those specific stud positions. The hub pilot surface likely has a localized high spot, contamination, or damage under those three positions that prevents the wheel from seating flat. The incomplete contact compresses during initial driving as the high spot or contamination yields.

92. B — A floating-caliper disc brake must slide freely on its mounting pins to equalize the clamping force between the inboard and outboard pads. When the piston pushes the inboard pad against the rotor,

the reaction force pulls the caliper body inward to press the outboard pad. A seized caliper cannot slide, so only one pad contacts the rotor — producing uneven wear and reduced braking.

93. D — The completely separated bushing allows the torque rod to move freely in its bracket. Without this restraint, the steer axle can shift fore-and-aft under braking and acceleration forces, changing the caster angle dynamically. The varying caster changes the steering response and stability, creating the vague feel and wandering at highway speed.

94. C — Plug-only repairs performed from the outside without dismounting the tire are not acceptable for commercial vehicle tires. The proper repair procedure requires removing the tire from the rim, inspecting the interior for hidden damage (belt separation, liner damage, cord injury), and installing a combination plug-patch from the inside that seals both the inner liner and the puncture channel.

95. A — A height control valve arm that is too short signals the valve that the vehicle is lower than it actually is. The valve continuously adds air to the springs trying to reach the height that the shortened arm indicates as correct — but since the arm's reference point is wrong, the springs inflate beyond the designed ride height.

96. B — Chronic wheel-off events on one position with correct torque and re-torque procedures suggest the wheel nut seating surface is worn or damaged. A nut with a worn or distorted seating surface reaches the specified torque value before adequate clamping force is achieved because the damaged seat bottoms out or deforms before the stud stretches to the designed clamping load.

97. D — A visible gap between the main leaf and the second leaf indicates the main leaf has taken a permanent set (straightened) from overloading or fatigue. The spring's camber has changed, altering the ride height and spring rate. The spring pack no longer functions as a cohesive unit, and the altered geometry affects axle alignment, caster angle, and load distribution.

98. B — The height control valve linkage must be intact and correctly adjusted for the valve to detect when the suspension needs air after the dump valve closes. If the linkage was disconnected or damaged during the dump valve installation, the valve cannot detect the low ride height condition and does not add air to reinflate the springs.

99. A — Feathered tire wear — sharp edge on one side of each tread rib and rounded on the other — is the classic diagnostic signature of incorrect toe setting. Either excessive toe-in or toe-out forces each

tread element to scrub sideways across the pavement as the tire rolls, creating the distinctive feathered edge pattern felt when running a hand across the tread.

100. D — Milky grey hub oil with a clear vent and apparently intact seal suggests moisture from condensation rather than external water entry. Temperature cycling between hot operation and cold parking causes moisture in the trapped air inside the hub cavity to condense on the cooler internal surfaces. Over time, the accumulated water emulsifies with the oil during bearing rotation.

101. B — An evenly loaded trailer with a 1,300 kg weight difference between tandem axles indicates the load equalization system is not functioning correctly. The equalizer beam, walking beam, or air ride equalization system should distribute the load equally between both axle positions. A worn pivot, broken equalizer, or misadjusted height control is biasing more load to the front axle.

102. B — Wheel disc cracks are structural failures that cannot be safely repaired. Welding introduces heat-affected zones that change the metal's properties and reduce fatigue strength in the area surrounding the weld. The cyclic loading from road impacts, braking, and cornering forces will fatigue the weakened area. The wheel must be scrapped and replaced.

103. A — New king pins installed without adequate bushing preload allow the steering knuckle to float loosely on the pins. The play may be too small to measure as traditional free play at the steering wheel, but the looseness creates a vague steering response because the knuckle shifts on the pins under dynamic loads during highway driving.

104. D — A leak that occurs only during heavy rain at highway speed but not during stationary heavy rain or light driving rain requires both high water volume and wind pressure to force water through the entry point. The HVAC fresh air intake cowl drain can be overwhelmed by the combination of heavy rain and highway-speed wind pressure, forcing water into the HVAC housing and onto the passenger floor.

105. B — The cab tilt system has a mechanical latch (safety catch) that holds the cab in the driving position independently of the hydraulic cylinder. The cylinder's primary function is to raise and lower the cab — the latch, not the cylinder, prevents the cab from tilting forward during driving. The weeping seal is a maintenance item, not an immediate safety concern.

106. B — Ceramic-particle window tint film blocks a significant percentage of infrared solar radiation — the primary source of solar heat gain through glass. The film maintains the required visible light

transmission for commercial vehicle compliance while dramatically reducing the heat entering the cab through the large glass surfaces.

107. A — The loose steps create a trip-and-fall hazard during cab entry and exit. Commercial vehicle cab access injuries — slips, trips, and falls from the cab steps — account for a significant percentage of lost-time injuries in the trucking industry. Broken or unstable steps significantly increase this risk and must be repaired immediately.

108. D — A rattling cab partition requires a comprehensive inspection of all mounting hardware, clips, weatherstripping, and latching mechanisms. Any looseness in the panel's connection to the cab structure allows vibration-induced movement that produces the rattle. A systematic inspection of all attachment points identifies the specific source of the noise.

109. A — A temperature gradient of more than 5°C between the front and rear of a properly loaded trailer indicates insufficient air circulation. The evaporator fans must produce adequate airflow volume and velocity to circulate conditioned air to the rear of the 16-metre trailer. Worn fan motors, damaged blades, or a failed fan in a multi-fan evaporator reduces air velocity.

110. C — Landing gear legs extended to maximum travel can jam the internal screw mechanism at its end-of-travel position. The screw threads bind at the extreme extension where they have the least support. Partially weight-loading the legs (by coupling a tractor) relieves the binding force at the thread engagement point, allowing the crank mechanism to turn and begin retracting.

111. B — Lowering the suspension by 50 mm changes the ABS wheel speed sensor air gap on the modified axle. The sensor moves relative to the tone ring, and if the gap exceeds the sensor's operating range, the ABS module loses wheel speed data quality. Degraded sensor signals can cause premature or inappropriate ABS intervention that limits maximum braking force.

112. D — Liftgate vibration during operation requires a comprehensive inspection of the entire mechanical linkage chain. Worn clevis pins, hinge bushings, cylinder mounts, pivot points, and structural connections each contribute to the total mechanical play in the system. Any looseness is amplified by the hydraulic force and transmitted to the platform as vibration.

113. A — A headboard deformed 75 mm inward from cargo impact may not provide adequate resistance against forward cargo shift in a subsequent emergency stop. The deformation has potentially exceeded

the headboard's designed deflection limit and its remaining structural integrity must be verified. The headboard should be inspected, and repaired or replaced before reloading.

114. C — The pressure protection valve prevents the suspension circuit from depleting the brake circuit's air supply. If the suspension system develops a leak, the valve closes when the main system pressure drops below its set threshold, isolating the leaking suspension from the brake supply. This ensures the brake system retains adequate pressure for safe vehicle operation.

115. A — The ICC rear impact guard (rear underride guard) is a federal safety requirement designed to prevent passenger vehicles from underriding the trailer's rear in a collision. The bent brackets and displaced bumper must be repaired or replaced to restore the bumper to its original position and structural strength before the trailer returns to service.

116. D — Voltage drop testing under load is the most effective diagnostic method for intermittent connector faults. Measuring resistance with a DMM (zero-load test) often misses high-resistance connections that only manifest under the current flow of actual circuit operation. Loading each circuit and measuring the voltage difference between the supply and the lamp identifies specific pins with excessive resistance.

117. A — The compressor cycles off and takes 30 seconds to restart, during which the evaporator warms excessively. The temperature sensor or pressure cycling switch has a threshold setting that allows the evaporator to warm too far before the restart condition is met. The differential between the cut-out and cut-in settings is too wide, creating the long off-period and excessive temperature rise.

118. C — Heat is available at the defrost and floor positions (confirming the heater core and coolant flow are working), but no heat reaches the panel vents. The mode door — which directs air between the defrost, floor, and panel positions — is not opening the panel vent passage. Either the mode door actuator has failed at that position or the door mechanism is stuck.

119. A — A diesel odour in the exhaust with a stable flame and operating combustion fan indicates incomplete combustion. The fuel metering pump is delivering more fuel than the combustion air supply can fully burn. The excess unburned fuel vaporizes in the exhaust gas and exits as the diesel odour. The fuel pump delivery rate or the combustion air supply must be adjusted.

120. B — Steady bubbles in the receiver/dryer sight glass during operation indicate the system is slightly undercharged. The bubbles represent refrigerant vapour mixed with liquid — there is

insufficient refrigerant to maintain a solid column of liquid at the sight glass location. A properly charged system shows clear liquid (no bubbles) in the sight glass during normal operation.

121. A — The excess oil circulates through the system with the refrigerant and accumulates as a film on the internal surfaces of the evaporator and condenser. This oil film acts as an insulating barrier that reduces the heat transfer efficiency at both the evaporator (heat absorption) and condenser (heat rejection), decreasing the system's overall cooling performance.

122. D — The musty odour on initial A/C startup after non-use is caused by mould and bacteria that colonize the damp evaporator surface during the non-use period. When the system restarts, the initial airflow carries spores and metabolic byproducts into the cab. After several minutes of operation, the cold dry air from the functioning A/C system inhibits further microbial activity.

123. A — R-134a operates at higher condensing pressures than R-12 at the same temperature. The original condenser was designed for R-12's lower operating pressures and smaller heat rejection requirements. At high ambient temperatures, the R-12-designed condenser cannot reject enough heat at R-134a's elevated condensing pressures, and the system's cooling capacity is insufficient.

124. C — Boom drift of 50 mm per hour with the valve in neutral can originate from either the holding valve (counterbalance valve or pilot-operated check valve) or the cylinder's internal piston seal. Either component can independently allow fluid to leak past, lowering the boom gradually. Both must be tested to identify the actual leak source before replacing components.

125. B — A rhythmic pressure pulsation that changes proportionally with engine RPM from a gear pump could be from a damaged tooth, but the fact that it is described as "steady rhythmic" rather than a single-impact-per-revolution suggests it is the normal characteristic of gear pump operation. Each gear tooth produces a discrete pressure pulse as it disengages, creating the rhythmic pattern.

126. D — The cooler, fan, and oil level have been verified correct, but the system still overheats. The remaining heat source is internal leakage throughout the system — worn cylinder seals, valve spool clearances, motor internal bypass, and pump internal leakage. Each component contributes a portion of the total bypass flow that converts hydraulic energy to heat.

127. A — Normal speed when empty but 50% speed when loaded, with correct pump flow at the discharge. The pump produces adequate flow at its output, but the flow is lost before reaching the

cylinder under load. A seal, valve, or fitting that holds at the lower pressure of the empty platform but bypasses under the higher pressure of the loaded condition reduces the effective flow to the cylinder.

128. C — A filter element that clogs within 50 hours — repeatedly — indicates the system is generating contamination at an accelerated rate. The hydraulic pump is the most likely source — worn gear teeth, bearings, or internal surfaces produce metal particles that overwhelm the filter's capacity within 50 hours. The pump should be tested and rebuilt or replaced.

129. B — The lowering speed is controlled by a flow control device in the return circuit — a flow control valve, counterbalance valve, or needle valve that restricts the oil flow rate from the cylinder to the reservoir during gravity-assisted lowering. If this device is worn, misadjusted, or has failed open, the load's weight drives the cylinder faster than the designed controlled descent speed.

130. D — Nitrogen gas temperature drops from the expansion cooling effect (adiabatic cooling) during hydraulic cycling — the gas compresses and expands rapidly. When the technician rechecks the pre-charge with hydraulic pressure at zero, the gas has cooled from the repeated expansion cycles. The cooler gas produces a lower pressure reading that will recover as the gas returns to ambient temperature.

131. C — The crane's rated capacity (5,000 kg at 3 metres) defines a maximum load moment. At 5 metres of extension, the 3,500 kg load creates a load moment of 17,500 kg·m (3,500 × 5) which exceeds the crane's rated moment of 15,000 kg·m (5,000 × 3). Even though 3,500 kg is below the maximum weight, the extended boom creates a tipping moment that exceeds the crane's stability limit.

132. A — Cell balancing equalizes the voltage across all cells by either passively discharging higher-voltage cells through resistors or actively transferring energy from higher to lower cells. Without balancing, cells drift apart in voltage over charge/discharge cycles. Unbalanced cells limit the pack's usable capacity because the weakest cell determines the pack's performance envelope.

133. D — Electric motor whine proportional to vehicle speed is a common characteristic of electric drive systems. The inverter's PWM (pulse-width modulation) switching produces an audible tone that varies with motor speed. During engine-only driving, the combustion noise masks the sound. In the quiet EV mode, the inverter switching noise becomes audible. This is a normal operating characteristic.

134. B — A heat pump moves thermal energy from one location to another rather than converting electricity directly to heat. For every unit of electrical energy consumed, a heat pump can deliver 2-3 units of thermal energy to the cabin by extracting heat from the outside air. This 200-300% efficiency

compared to resistive heating's 100% significantly reduces the battery energy consumed for cabin heating.

135. C — The vehicle speed is above the minimum regen threshold and there are no ABS events, ruling out speed and lockup causes. At 50% SOC with normal temperatures, the battery should accept charge. The most likely cause is that the vehicle speed dropped below the minimum threshold for efficient regenerative generation — electric motors cannot generate electricity efficiently at very low rotational speeds, so the system transitions to friction-only braking.