

PRACTICE EXAM 8: RED SEAL TRUCK AND TRANSPORT MECHANIC SIMULATION (135 QUESTIONS)

1. A technician is preparing to remove the fuel tank on a truck that has been involved in a side collision. The tank is dented but does not appear to be leaking. Before loosening any tank mounting hardware, what is the most critical safety precaution?
- A. Position a catch pan under the tank to collect any fuel that spills when the mounting straps are loosened and the tank shifts
 - B. Ensure the truck's batteries are fully charged so the fuel transfer pump can be used to empty the tank before it is removed
 - C. Disconnect the battery cables and ensure no ignition sources are present because the damaged tank may release flammable vapours when disturbed
 - D. Drain the coolant system because collision damage to the fuel tank area may have also damaged the coolant lines that run nearby
2. A fleet maintenance shop has implemented a formal tool control program requiring technicians to account for all tools before and after each job. What is the primary safety purpose of this program?
- A. To prevent tools from being left inside or on the vehicle where they could cause damage, create a fire hazard, or fall onto the roadway during vehicle operation
 - B. To reduce the shop's tool replacement budget by tracking individual tool loss rates and charging technicians for tools that are not returned at end of shift
 - C. To comply with the provincial labour code requirement that all shops maintain an inventory of tools with serial numbers for regulatory audit purposes
 - D. To ensure each technician has the correct tools for their assigned work orders reducing the time spent searching for tools between job assignments each day

3. A technician discovers during a PM inspection that the truck's steering column universal joint has noticeable play. The driver has not reported any steering concerns. What should the technician do?

A. Note the finding on the PM report as an informational item and schedule the repair for the next major service interval since the driver has no complaint

B. Document the finding on the work order, notify the fleet manager that the steering has a defect requiring repair, and recommend the vehicle not be dispatched until corrected

C. Verbally inform the driver of the finding and advise them to report any steering changes during their next trip so the condition can be monitored for progression

D. Adjust the universal joint to remove the play and road test the vehicle to verify the adjustment has restored the steering to normal feel and response characteristics

4. A newly hired technician asks why the shop requires a hot work permit before using a cutting torch anywhere in the facility. What is the correct explanation?

A. The hot work permit documents the type and duration of torch work for the shop's insurance carrier to maintain the facility's fire coverage policy requirements

B. The permit identifies the trained fire watch person who is legally required to remain on site for 24 hours after any torch work is completed in the facility

C. The hot work permit satisfies the provincial occupational health authority's requirement that all flame-producing activities be pre-approved by a government inspector

D. The permit ensures a formal risk assessment is completed before hot work begins — verifying flammables are removed, fire suppression is available, and a fire watch is assigned

5. A technician needs to lift a heavy truck transmission (approximately 250 kg) from the workbench to the transmission jack. The shop has a floor crane (engine hoist) available. What is the correct procedure?

A. Two technicians should lift the transmission manually using proper lifting technique to avoid the delay of setting up the floor crane for such a relatively light component

- B. Slide the transmission from the workbench onto the jack using a sheet of cardboard as a slider to reduce friction and control the transfer without mechanical lifting equipment
- C. Use the floor crane with a rated sling or chain to lift the transmission and lower it onto the transmission jack in a controlled manner within the crane's rated capacity
- D. Tilt the transmission on its edge and roll it across the workbench onto the jack which supports the weight progressively as the unit transfers between the two surfaces

6. A technician accidentally contacts a rotating PTO shaft with their sleeve. The sleeve is immediately caught and begins wrapping around the shaft. What does this incident demonstrate about PTO safety?

- A. PTO shafts rotate at high speed with tremendous torque and any contact with clothing, hair, or body parts results in instantaneous entanglement that causes severe injury or death
- B. The PTO shaft guard was correctly installed but the technician's sleeve extended beyond the guard's coverage area which indicates the guard should be extended to cover more of the shaft
- C. The PTO should be equipped with a breakaway coupling that disengages when resistance from an entangled object exceeds the coupling's rated shear force to prevent injury during contact
- D. The incident demonstrates that technicians should wear short-sleeved shirts year-round when working near PTO equipment regardless of weather conditions to prevent sleeve entanglement risk

7. A shop foreman discovers that an apprentice has been using a damaged extension cord with exposed copper wiring to power a trouble light inside a truck cab. What specific electrical hazard does this present?

- A. The exposed copper will corrode from the cab's humidity and eventually cause a voltage drop that dims the trouble light below the minimum brightness needed for inspection work
- B. The trouble light's transformer may overheat from the resistance of the damaged cord section and trip the shop's main circuit breaker interrupting power to other equipment
- C. The extension cord's damage may cause a ground fault that trips the shop's ground fault circuit interrupter breaker preventing other technicians from using electrical tools on the same circuit

D. The exposed conductors create an electrocution risk and a fire hazard — the technician could contact the exposed wire and the damaged insulation could arc against the truck's metal surfaces

8. A technician is measuring the bore of a cylinder liner using a dial bore gauge. The first measurement is taken 25 mm below the top of the liner (top of ring travel area). The second measurement is taken 25 mm above the bottom of the liner. Why are measurements taken at these two specific locations?

A. These locations represent the unworn reference surfaces of the liner that have never contacted the piston rings and provide baseline dimensions for comparison to the worn areas

B. These two measurements capture the maximum and minimum bore diameters which occur at the top of ring travel (maximum wear) and the bottom of ring travel (minimum wear) to calculate liner taper

C. These locations are the OEM-specified measurement points that correspond to the positions where the piston achieves maximum side thrust against the liner wall during the power stroke

D. These measurements determine whether the liner has shifted position in the block bore during engine operation by comparing the bore diameter at the top fixation point to the bottom support point

9. A heavy-duty diesel engine's exhaust manifold bolts on one bank have been replaced three times in the past year. Each time, the new bolts break within 2 to 3 months. The bolts are the correct grade and are torqued to specification. What underlying condition is causing the repeated bolt failure?

A. The exhaust manifold is warped from repeated thermal cycling and the distorted flange surface creates uneven clamping stress that concentrates at specific bolt locations causing cyclic fatigue failure

B. The bolt holes in the cylinder head have been over-tapped and the reduced thread engagement allows the bolts to stretch beyond their elastic limit during thermal expansion of the manifold assembly

C. The engine's EGR system is creating excessive exhaust backpressure that vibrates the manifold at a frequency matching the bolt material's fatigue resonance point causing accelerated cyclic failure

D. The exhaust manifold gasket material is too compressible and the bolts lose clamping force as the gasket compresses further during each thermal cycle until the bolts fatigue from the repeated loading

10. A diesel engine equipped with a variable geometry turbocharger produces adequate boost pressure at full load but the exhaust gas temperature is 75°C higher than the fleet average for identical trucks

operating the same route. All other engine parameters are within specification. What could cause the elevated EGT?

A. The VGT vanes are stuck in a partially closed position at full load which increases exhaust backpressure and forces the engine to work harder against the restricted exhaust flow raising the EGT

B. The charge air cooler has a reduced cooling efficiency from internal contamination that raises the intake manifold temperature and the hotter intake charge produces higher combustion and exhaust temperatures

C. The VGT vanes are opening too far at full load reducing exhaust backpressure below the optimum level which allows the combustion gases to exit the cylinder too quickly carrying more heat into the exhaust

D. The engine's coolant temperature is running 5°C above the fleet average from a partially restricted radiator which transfers the additional engine heat to the exhaust stream raising the EGT proportionally

11. A technician is performing a crankcase pressure test on a heavy-duty diesel engine using a water manometer connected to the oil fill cap opening. The reading shows 125 mm of water column (positive pressure). The OEM specification maximum is 75 mm. Before diagnosing ring or liner wear, what should the technician verify?

A. The engine oil level is not overfilled because an overfilled crankcase allows the crankshaft counterweights to contact the oil surface which aerates the oil and creates pressure in the crankcase

B. The intake manifold pressure sensor reading is not falsely high because the ECM would reduce engine power and alter combustion characteristics that increase blow-by past the piston rings at all loads

C. The turbocharger oil drain line is not restricted because a blocked drain backs oil up in the turbo housing and the excess oil carried into the intake creates additional crankcase pressure from the consumed oil

D. The crankcase ventilation system is not restricted because a plugged CCV filter, frozen breather tube, or blocked vent line prevents normal gas escape and creates elevated crankcase pressure readings

12. A heavy-duty diesel engine's radiator has been replaced with a new unit. After installation, the engine operates at the correct temperature during normal driving but overheats when pulling a loaded

trailer up a sustained grade. The old radiator did not have this problem. What should the technician check?

- A. The new radiator cap for an incorrect pressure rating that allows the coolant to boil at a lower temperature under the heavy load condition reducing the cooling system's heat rejection capacity
- B. The replacement radiator's core design — it may have fewer tubes, thinner fins, or a smaller frontal area than the original which reduces its heat rejection capacity below what is needed for sustained heavy loads
- C. The engine thermostat for a sticking condition that was coincidentally introduced during the radiator replacement and is preventing full coolant flow through the new radiator core at high engine loads
- D. The coolant mixture ratio for an incorrect concentration that was used when refilling the new radiator because an excessively high glycol concentration reduces the coolant's heat transfer efficiency

13. A diesel engine has been disassembled for overhaul. The technician inspects the main bearing inserts and finds that bearing number 4 (the thrust bearing position) has significantly more wear on the flange surfaces than any other main bearing. What caused this accelerated thrust face wear?

- A. Excessive crankshaft end play from a previous rebuild where the thrust bearing was not properly sized allowed the crankshaft to shuttle axially wearing the thrust flanges faster than the journal surfaces
- B. The engine was operated with incorrect oil viscosity that was too thin to maintain an adequate oil film on the thrust bearing flanges during the high-axial-load conditions of clutch engagement
- C. The flywheel bolt torque was incorrectly set during the previous rebuild and the resulting flywheel wobble created a cyclic axial load on the crankshaft that concentrated wear on the thrust bearing flanges
- D. The number 4 main bearing oil supply hole was partially blocked by casting debris that reduced oil flow to the thrust bearing flanges while the journal surfaces received adequate lubrication from the main gallery

14. A truck's DEF system has a fault code indicating the DEF dosing valve is not injecting the commanded volume. The DEF pump pressure reads within specification and the DEF fluid quality is correct. The scan tool actuator test commands the dosing valve open but no increase in flow is observed. What is the most likely cause?

- A. The DEF supply line between the pump and the dosing valve has a partial blockage from crystallized urea that restricts the flow volume below the commanded delivery rate during injection events
- B. The DEF pump pressure sensor has drifted low and the actual pump pressure is below the minimum needed for the dosing valve to deliver the correct spray pattern into the exhaust stream
- C. The exhaust gas temperature at the dosing valve location is too high and the excessive heat is vaporizing the DEF before it exits the valve nozzle creating a vapour lock that blocks liquid flow
- D. The DEF dosing valve itself is clogged with crystallized urea deposits that have blocked the nozzle orifice preventing the fluid from being injected into the exhaust stream despite adequate pump pressure

15. A common rail diesel engine intermittently produces a single loud knock from one cylinder during cold starts that disappears within 30 seconds. No fault codes are stored. The engine operates normally once warm. What is the most likely cause?

- A. A sticky injector on that cylinder has a delayed opening during cold starts allowing fuel to accumulate before igniting causing a single detonation event until the injector warms and responds normally
- B. The piston pin on that cylinder has excessive clearance that produces a knock at cold start when the piston and pin have maximum clearance from thermal contraction before warmup closes the gap
- C. The injector calibration code for that cylinder is incorrect and the ECM over-fuels that cylinder during the cold-start enrichment strategy causing a momentary knock until the enrichment period expires
- D. A cylinder head bolt on that cylinder has lost torque from thermal cycling and the head gasket seeps compression during cold start until thermal expansion closes the gap and seals the gasket once warm

16. A diesel engine's fuel water separator has a sight glass that shows water accumulation at the full-water level. The drain valve is opened and approximately 500 ml of water is drained. After draining, the engine runs but hesitates under load. What should the technician do next?

- A. Drain the fuel tank completely and inspect it for corrosion that may be producing rust particles that are blocking the fuel filter element downstream of the water separator

B. Bleed air from the fuel system because opening the water separator drain valve introduced air into the fuel supply circuit that causes the hesitation from air interrupting fuel delivery

C. Replace the fuel filter element because water passing through the filter may have caused the cellulose media to swell and partially block which restricts fuel flow under high-demand conditions

D. Test the fuel for bacterial contamination because large quantities of water in the separator indicate conditions favourable for diesel fuel biological growth that produces filter-clogging biomass

17. A heavy-duty diesel engine has a persistent SPN 102 (boost pressure) fault code. The turbocharger has been replaced, the charge air cooler has been pressure tested (no leaks), and all intake piping clamps have been verified tight. Boost pressure at full load is 15 kPa below specification. What overlooked component could account for the remaining shortfall?

A. The air intake restriction indicator on the air filter housing showing a reading in the service zone — a partially restricted air filter limits the air volume available to the turbocharger compressor inlet

B. The fuel pressure regulator returning excessive fuel to the tank which reduces the energy available for combustion and limits the exhaust gas energy driving the turbocharger turbine at full load

C. The EGR valve opening slightly at full load when it should be fully closed — the recirculated exhaust displaces fresh air in the intake manifold and reduces the effective boost from the turbocharger

D. The exhaust gas recirculation cooler having a partial internal restriction that creates backpressure in the exhaust system upstream of the turbocharger turbine reducing exhaust energy available

18. A diesel engine equipped with a DPF and SCR aftertreatment system has a fault code for DPF soot load exceeding the maximum threshold. The engine has entered a derate condition. The DPF has been recently cleaned by a professional DPF cleaning service. What should the technician investigate?

A. Whether the DPF was properly reinstalled after cleaning — incorrect orientation, a missing gasket, or loose clamps could allow exhaust to bypass the filter reducing backpressure but not capturing soot

B. The engine oil consumption rate because excessive oil entering the combustion chambers produces ash that accumulates in the DPF and is misread as soot by the differential pressure sensor

C. The fuel injection system for timing faults or injector problems that produce excessive soot during normal combustion faster than the passive and active regeneration systems can burn it off

D. The DPF differential pressure sensor and its connecting tubes for contamination, pinching, or sensor failure that produces a false soot load reading even though the DPF was recently cleaned and is actually clear

19. A heavy-duty diesel engine has had its cylinder head resurfaced and reinstalled. During the first run after reassembly, the engine develops a coolant leak at the head gasket on the exhaust side between cylinders 3 and 4. The head bolts are verified at the correct torque. What is the most probable cause?

A. The head gasket was installed with the wrong side facing up — multi-layer steel head gaskets are directional and installing them inverted changes the sealing bead profile at critical combustion sealing areas

B. The exhaust manifold was reinstalled before the head bolts were torqued in the correct sequence causing the manifold's clamping force to distort the head locally at the gasket failure location

C. The cylinder head was resurfaced beyond the manufacturer's maximum allowable limit and the reduced head thickness has changed the combustion sealing pressure at the gasket fire ring between those cylinders

D. The block deck surface was not checked for flatness before the head was reinstalled and a localized high spot or warpage on the block surface prevents the gasket from sealing uniformly at that location

20. A truck driver reports a sudden loss of engine power accompanied by black smoke. The scan tool shows the turbo boost pressure has dropped to nearly atmospheric. The technician inspects the engine compartment and finds the charge air cooler outlet boot has blown off its connection. What caused the sudden power loss?

A. The disconnected boot allows all compressed boost air to escape before reaching the intake manifold so the engine operates on atmospheric air only — producing the same effect as a naturally aspirated engine

B. The blown boot introduces unfiltered air into the intake manifold contaminating the cylinders with debris that immediately scores the liners and reduces compression below the combustion threshold

C. The ECM detected the sudden boost loss and activated an immediate fuel derate to protect the engine from the lean combustion condition that would occur if full fuel were injected with no boost pressure

D. The disconnected boot allows exhaust gas from the EGR system to escape before reaching the intake manifold so the engine cannot maintain the correct air-to-fuel ratio and produces black smoke from overfuelling

21. An engine oil analysis trending report for a fleet of identical trucks shows one truck consistently produces iron wear metal readings 40% higher than the fleet average at every sample interval. The engine has been in service for 200,000 km. All other parameters (oil changes, fuel quality, operating conditions) match the fleet. What should the fleet manager investigate?

A. The specific engine's air filtration system for a subtle leak that is allowing a small amount of unfiltered abrasive dust to enter the engine consistently accelerating wear across all iron-containing components

B. The engine oil brand used in that specific truck for a formulation difference from the fleet standard that provides less anti-wear protection to the iron components compared to the standard fleet oil

C. The engine's coolant condition because acidic coolant from depleted inhibitors can corrode the iron cylinder liners from the waterside creating iron contamination that enters the oil through liner porosity

D. The fuel injector calibration codes for that engine because incorrect codes cause combustion variability that produces higher cylinder pressures on some strokes accelerating ring and liner wear unevenly

22. A heavy-duty diesel engine has developed a rough idle that gradually worsened over 50,000 km. No fault codes are present. Injector contribution data shows all cylinders are balanced. Compression test results are within specification. What engine condition can cause a gradually worsening rough idle without setting codes and without affecting injector balance or compression?

A. Worn engine mounts that increasingly allow the engine to rock on its frame mounting points transmitting normal firing impulses to the cab as perceived roughness rather than actual combustion irregularity

B. A gradually increasing valve train noise from worn cam followers or rocker arm bushings that the driver perceives as rough idle even though the combustion events are balanced and consistent across all cylinders

C. A progressively worsening torsional vibration from a deteriorating crankshaft vibration damper that allows the crankshaft to oscillate at its natural frequency which the driver perceives as rough idle behaviour

D. Worn engine mounts that transmit increasingly more engine vibration to the cab structure rather than isolating it — the engine's idle quality has not actually changed but the vibration reaching the driver has increased

23. A diesel engine equipped with an SCR system has the DEF fluid freezing in the tank during cold weather operation. The DEF tank heater is not functioning. At what approximate temperature does DEF begin to freeze?

A. DEF freezes at approximately 0°C (32°F) which is the same freezing point as pure water since the urea concentration does not significantly affect the mixture's freeze point

B. DEF freezes at approximately -25°C (-13°F) because the high urea concentration provides significant freeze point depression similar to an antifreeze solution in the cooling system

C. DEF freezes at approximately -11°C (12°F) because the 32.5% urea solution has a eutectic freezing point that is lower than water but higher than most engine coolant mixtures

D. DEF freezes at approximately -40°C (-40°F) because the urea in solution acts as a natural antifreeze that provides protection equivalent to a 50/50 ethylene glycol coolant mixture

24. A diesel engine's fuel injector return flow test shows that five of six injectors return 30 to 35 ml/min at idle. Injector number 2 returns 85 ml/min. What effect is this excessive return flow having on the engine's operation?

A. Cylinder number 2 is overfuelling because the excessive return flow indicates the injector's needle valve is stuck open delivering more fuel than the ECM commands on each injection event

B. The fuel rail pressure is dropping because injector number 2 is draining fuel from the rail faster than the high-pressure pump can replace it, reducing fuel delivery to all six cylinders and causing low power

C. Cylinder number 2 is running lean because the excessive return flow represents fuel that bypasses the injection nozzle and returns to the tank rather than being injected into the combustion chamber

D. The excessive return flow is pressurizing the fuel return circuit above the fuel tank's vent capacity causing the return fuel to back up and create a hydraulic lock in the return manifold

25. A heavy-duty diesel engine has had its injectors replaced. After installing the new injectors, the technician must perform an "injector learn" or "injector code" procedure using the scan tool. What happens if the technician skips this step and runs the engine with the default codes from the old injectors?

A. The engine will not start because the ECM requires the correct injector codes to calculate the initial fuel delivery parameters needed for the starting fuel quantity during the cranking event

B. The engine may run rough, produce unbalanced cylinder contribution, generate elevated emissions, and potentially set fault codes because the ECM is applying incorrect correction factors for the new injectors

C. The engine will run normally because the injector codes only affect the cold-start fuelling strategy and have no influence on the ECM's fuel delivery calculations during normal warm engine operation

D. The engine will derate to 50% power as a protection strategy because the ECM detects a mismatch between the stored codes and the new injectors' actual delivery characteristics during operation

26. A diesel engine has an unusual condition where it runs normally at all speeds except at exactly 1,400 RPM, where it develops a noticeable vibration. The vibration is not present at 1,300 RPM or 1,500 RPM. What type of vibration problem does this narrow-band speed sensitivity suggest?

A. A crankshaft main bearing has developed clearance that allows the crankshaft to move in a specific harmonic pattern at the frequency corresponding to 1,400 RPM engine speed

B. An injector is misfiring intermittently and the misfire frequency happens to align with 1,400 RPM creating a noticeable vibration at that specific speed that is not perceptible at other engine speeds

C. The exhaust system has a resonance point at the frequency corresponding to 1,400 RPM that amplifies normal exhaust pulsation into a perceptible vibration transmitted through the frame to the cab

D. A resonance condition exists where a component's natural frequency matches the engine's firing frequency at 1,400 RPM — such as a deteriorating vibration damper, loose accessory bracket, or worn mount

27. A technician is checking the nozzle opening pressure on a mechanically governed diesel fuel injector using a pop tester. The specified opening pressure is 250 bar. The actual reading is 210 bar. What effect does this low opening pressure have on engine operation?

A. The injector will deliver fuel at a higher injection rate because the nozzle opens earlier in the injection event when the pump pressure is lower than the design threshold for correct atomization timing

B. The injector will produce a coarser spray pattern with larger fuel droplets because the lower opening pressure does not atomize the fuel as finely as the design pressure creating incomplete combustion

C. The injector will deliver less fuel per injection event because the nozzle opens before the pump reaches the pressure needed to overcome the fuel's resistance to flow through the nozzle orifice holes

D. The injector will produce a normal spray pattern but the injection timing will be retarded because the pump must build additional pressure before the nozzle reaches its higher-than-normal opening threshold

28. A heavy-duty diesel engine is being tested with a scan tool after an injector replacement. The technician performs a relative compression test (cranking RPM variation test) using the scan tool's built-in function. The results show cylinders 1 through 5 at 200 to 210 RPM per revolution but cylinder 6 shows 230 RPM. What does the higher RPM on cylinder 6 indicate?

A. Cylinder 6 has higher compression than the others which accelerates the crankshaft more during its compression stroke than the other cylinders producing the higher momentary RPM reading

B. Cylinder 6 has a heavy flywheel counterweight positioned at its firing position that adds rotational momentum during the scan tool's cranking test producing the artificially higher RPM value

C. Cylinder 6 has a mechanical advance in its injection timing that fires slightly earlier than the other cylinders adding a combustion push during cranking that increases the RPM at that cylinder position

D. Cylinder 6 has lower compression than the others which offers less resistance to the crankshaft during its compression stroke allowing the starter to accelerate the crankshaft faster at that position

29. A diesel engine equipped with a crankcase ventilation system routes crankcase gases back into the intake manifold for reburning. After 300,000 km, the intake manifold is heavily coated with a sticky oil-soot mixture. What operational problem does this intake contamination cause?

- A. The contamination reduces the effective cross-sectional area of the intake ports restricting airflow to the cylinders and reducing volumetric efficiency which decreases engine power and increases emissions
- B. The oil-soot mixture insulates the intake manifold temperature sensor from the actual air temperature causing the ECM to miscalculate the air density and inject incorrect fuel quantities at all operating conditions
- C. The contamination absorbs moisture from the incoming air creating a corrosive mixture that attacks the intake valve seats and causes accelerated valve recession that progressively reduces compression
- D. The sticky residue acts as a thermal insulator on the manifold walls preventing the charge air cooler from effectively reducing the intake air temperature before it enters the combustion chambers

30. A truck's air compressor has been replaced with a remanufactured unit. After installation, the system builds pressure normally but the air dryer cycles much more frequently than before — purging every minute instead of the previous 4 to 5 minute interval. What is the most likely cause?

- A. The remanufactured compressor has oversized pistons that displace more air per revolution than the original unit and the increased output volume fills the reservoirs faster triggering earlier governor cut-out
- B. The air dryer desiccant cartridge was not replaced during the compressor installation and the saturated old cartridge cannot absorb moisture effectively requiring more frequent regeneration purge cycles
- C. The remanufactured compressor has a higher oil carry-over rate than the original and the excess oil is saturating the air dryer desiccant more rapidly triggering frequent purge cycles to clear the contamination
- D. The governor cut-in and cut-out settings have shifted during the compressor installation creating a narrower pressure band that causes the system to cycle between loaded and unloaded states more frequently

31. A tractor-trailer combination's trailer brakes apply with a noticeable delay compared to the tractor brakes during synchronized pedal application. The tractor brakes respond instantly but the trailer brakes lag by approximately 0.5 seconds. All components have been inspected and are functioning correctly. What explains this inherent delay?

A. The service air signal must travel from the foot valve through the tractor plumbing, through the gladhand connection, through the trailer plumbing to the relay valve, and then from the relay to the chambers — the cumulative distance creates an inherent pneumatic signal delay

B. The trailer ABS module introduces an intentional 0.5-second delay in the brake application signal to verify wheel speed data before allowing full brake pressure to reach the trailer brake chambers

C. The trailer relay valve has a built-in delay spring that prevents immediate response to the service signal pressure to avoid trailer brake lockup during rapid pedal applications by the driver

D. The trailer's one-way check valves between the supply reservoir and the service circuit add resistance to the air flow path that delays the pressure delivery to the brake chambers during each application

32. A truck's S-cam drum brake produces a loud snapping or popping noise during the first brake application after the vehicle has been parked overnight. The noise does not repeat on subsequent applications. What is the most likely cause?

A. The brake shoe return springs have weakened from heat and age and cannot retract the shoes from the drum surface smoothly producing a snap as they release from the overnight parking contact position

B. The automatic slack adjuster's internal ratchet mechanism advances one click during the first application after parking to compensate for the overnight thermal contraction of the brake drum diameter

C. The brake drum has developed a light coating of surface rust overnight and the brake shoes break through this rust layer on the first application producing the characteristic snapping or popping sound

D. The S-cam shaft has seized slightly in its bushings overnight from moisture and the first application breaks the cam free producing a snap that does not repeat because the cam is now free-moving

33. A loaded truck is performing a controlled stop from 90 km/h on dry pavement. The driver applies moderate brake pressure and the stop is smooth and straight with no ABS activation. Immediately after the stop, the driver checks the brake drum temperatures and finds the front steer axle drums significantly hotter than the rear drive axle drums. What does this indicate?

A. The front brakes are doing more work than they should and the brake proportioning needs to be adjusted to shift more braking effort to the rear axle for balanced temperature distribution

B. The front brakes are performing correctly — during a forward-moving deceleration event dynamic weight transfer loads the front axle more heavily so the front brakes do more work and generate more heat

C. The rear brake automatic slack adjusters have over-adjusted allowing the rear linings to drag slightly which pre-heats the rear drums and makes them appear cooler relative to the front during the controlled stop

D. The ABS system is reducing rear brake pressure to prevent rear axle lockup during every stop regardless of ABS activation which shifts a disproportionate share of the braking effort to the front axle

34. A truck's air system has a check valve installed between the air compressor discharge and the supply (wet) tank. This check valve has failed in the closed position. What symptom will this produce?

A. The air dryer will not receive any compressed air from the compressor because the closed check valve blocks all airflow from the compressor to the downstream system including the dryer

B. The air system will build pressure normally but the compressor will not unload because the governor signal cannot reach the compressor through the blocked check valve circuit from the supply tank

C. The air compressor will build pressure between itself and the closed valve but no air will reach the supply tank or any downstream component — the system will not build pressure on the vehicle's gauges

D. The supply tank will slowly lose pressure because the closed check valve prevents the compressor from replenishing the air that is normally consumed by brake applications and system leaks

35. An air disc brake caliper on a steer axle has been replaced. During the first road test, the driver reports the steering pulls to the right when braking. The left steer axle disc brake was not serviced. What installation error on the right side could cause this pull?

A. The new caliper was installed with the bleed screw at the bottom instead of the top trapping air in the caliper bore that compresses during application delaying the right brake's response compared to the left

B. The brake pad retaining hardware was installed incorrectly allowing the pads to shift position in the caliper bracket changing the effective contact area and reducing the right side braking force during application

C. The new caliper's piston is a slightly larger diameter than the original which applies more force on the right side than the left pulling the vehicle to the right during every braking event from the force imbalance

D. The caliper mounting bolts were not torqued to specification and the caliper shifts on its bracket during braking allowing the pads to misalign with the rotor and reducing the braking force on the right side

36. A truck's air tank drain is opened during a PM inspection and approximately 250 ml of oil is collected along with the normal water drainage. What is the primary consequence of this oil contamination beyond the immediate air system effects?

A. The oil contaminates rubber components throughout the air system — brake chamber diaphragms, valve seals, and air bag rubber degrade from petroleum contact causing premature failure of these components

B. The oil contamination causes the air pressure gauges to read inaccurately because the oil film on the gauge Bourdon tube changes the tube's elasticity and response characteristics during pressure fluctuations

C. The oil creates a fire hazard in the air system because the compressed air temperature during the compressor's discharge stroke can exceed the flash point of the engine oil creating an ignition risk

D. The oil forms a coating inside the air lines that increases the static friction of the air flowing through the system which slows the brake application response time by creating resistance to air movement

37. A trailer's ABS has a fault code for "configuration error — axle count mismatch." The trailer has three axles but the ABS module is programmed for a two-axle configuration. What should the technician do?

A. Replace the ABS module with one that is factory-programmed for a three-axle trailer configuration since ABS modules cannot be reprogrammed to a different axle count after the initial factory setup

B. Reprogram the module to recognize the wheel speed sensors for all three axles using the trailer ABS manufacturer's software to ensure ABS modulation is available on all axle positions during braking

C. Add a third wheel speed sensor to the ABS module's unused input channel and the module will automatically detect the new sensor and reconfigure itself for three-axle operation without programming

D. Reconfigure the ABS module to the correct three-axle count using the manufacturer's diagnostic software or replace the module with one configured for the correct number of axles

38. A truck equipped with automatic traction control (ATC) spins one drive wheel briefly during acceleration from a stop on a wet road. The ATC activates and the wheel spin stops. What actions did the ATC system take to control the wheel spin?

A. The ATC applied the brake on the spinning wheel and may have reduced engine torque — braking the spinning wheel transfers torque to the wheel with traction through the differential while reducing engine output prevents further spin

B. The ATC locked the inter-axle differential electronically to distribute torque equally between the front and rear drive axles preventing either axle from receiving disproportionate torque during the acceleration event

C. The ATC increased the idle speed to smooth the engine's torque delivery during the low-speed acceleration event which prevents the abrupt torque spike that initially caused the drive wheel to break traction

D. The ATC activated the vehicle's electronic stability control to modulate the steering angle while simultaneously reducing engine power to prevent the spinning wheel from affecting the vehicle's directional stability

39. A heavy-duty truck's front drum brakes are being converted to disc brakes as an aftermarket upgrade. What advantage does this conversion provide for the front steer axle specifically?

A. Disc brakes on the steer axle reduce unsprung weight which improves steering response and reduces the impact forces transmitted through the king pins and steering linkage during road surface impacts

B. Disc brakes produce more initial braking force than drum brakes which is critical for the steer axle because it carries the lightest load and needs the most aggressive braking to contribute its share of stopping force

C. Disc brakes on the steer axle provide more consistent braking with better fade resistance and more predictable brake response which is critical for maintaining directional control during emergency braking events

D. Disc brakes on the steer axle are self-adjusting through the caliper piston's automatic retraction which eliminates the need for automatic slack adjusters that frequently fail and cause steer axle out-of-adjustment conditions

40. A trailer's ABS warning lamp flashes continuously rather than illuminating steadily. According to most trailer ABS systems, what does a flashing lamp indicate versus a steady lamp?

A. A flashing lamp indicates the ABS system is functioning normally and is performing its continuous self-diagnostic monitoring cycle during vehicle operation at speeds above the minimum activation threshold

B. A flashing lamp indicates the ABS module is communicating a specific diagnostic trouble code through the flash pattern — the technician should count the flashes to identify the fault code being reported

C. A flashing lamp indicates the ABS system has detected a marginal condition that has not yet caused a full fault code but is approaching the threshold where ABS function will be disabled on the next activation

D. A flashing lamp indicates the trailer ABS power supply voltage is fluctuating between the minimum operating threshold and normal which causes the lamp to cycle with the voltage variation from the tractor supply

41. A truck's spring brake on one rear wheel applies normally when the parking brake valve is pulled but does not fully release when the valve is pushed in. The air gauge shows full system pressure and all other spring brakes release correctly. What is the most likely cause?

A. The parking brake valve has a partially blocked internal port for the specific circuit feeding that spring brake chamber preventing full supply pressure from reaching the spring section

B. The quick-release valve for the rear axle spring brakes has a stuck exhaust that is venting supply pressure before it reaches the affected chamber preventing the spring from fully compressing

C. The brake drum on that wheel is slightly out-of-round creating a mechanical interference point that prevents the brake shoes from fully retracting even though the spring brake chamber fully releases

D. The spring brake chamber on that wheel has a restricted supply port, a damaged diaphragm, or a weak spring that prevents the chamber from fully compressing the spring when supply air is delivered

42. A truck's brake system uses an air-over-hydraulic booster on the front axle. The booster converts air pressure from the brake system into hydraulic pressure for hydraulic disc brake calipers on the steer axle. During an inspection, the technician finds that the hydraulic fluid reservoir on the booster is low. What should be checked?

- A. The hydraulic brake calipers, lines, and the booster unit itself for external hydraulic fluid leaks that have caused the fluid level to drop below the minimum operating level in the booster reservoir
- B. The air-to-hydraulic booster's internal piston seal for a failure that allows hydraulic fluid to cross into the air side of the booster and be expelled through the air exhaust port during brake release
- C. The brake pad wear on the front calipers because as the pads wear the caliper pistons extend further into the bores displacing more fluid from the reservoir to fill the increased piston bore volume
- D. The hydraulic fluid for contamination with air system moisture that has crossed through the booster piston seal and mixed with the brake fluid reducing its volume through chemical reaction and evaporation

43. A driver is performing a pre-trip air brake test. After building full system pressure, the driver makes a full brake application and holds the pedal down for one minute. During this hold, the gauges show a pressure drop of 24 kPa (3.5 psi). The vehicle is a straight truck (no trailer). What is the assessment?

- A. The pressure drop exceeds the maximum allowable rate and the vehicle has a leak in the brake application circuit that must be found and repaired before the vehicle can be dispatched
- B. The pressure drop is within the maximum allowable rate for a straight truck with brakes applied and the vehicle passes this portion of the pre-trip air brake test for single-vehicle operation
- C. The pressure drop is acceptable only if the vehicle will be operating without a trailer — if a trailer is connected the combined leak rate must be recalculated against the combination specification
- D. The pressure drop test is invalid because the pedal was held for one minute instead of the required two minutes specified for a complete brake application leak rate assessment on a straight truck

44. A truck's rear axle brake drum has been machined to remove scoring. After the machining, the technician reinstalls the drum and adjusts the brakes. During the first several stops, the driver reports the rear brakes produce a groaning noise. What is the cause?

- A. The machined drum surface has a spiral tool mark pattern from the lathe that creates a harmonic vibration with the new brake lining surface during the initial bedding-in contact period after machining
- B. The brake lining arc does not match the newly machined drum's larger diameter — the linings contact the drum at the toe and heel only which produces the groaning noise until the surfaces conform
- C. The drum was machined with a dull cutting tool that left a rough surface finish with torn metal rather than a clean-cut surface producing a noise from the rough metal-to-lining contact during braking
- D. The brake shoe return springs were weakened by the heat generated during the machining process and their reduced tension allows the shoes to flutter against the drum surface during light brake applications

45. A truck's air compressor is cycling too frequently — loading and unloading every 15 to 20 seconds. The air system has no leaks and the governor settings have been verified at the correct cut-in and cut-out pressures. What else could cause this rapid cycling?

- A. The air dryer purge valve is stuck partially open and continuously vents a small amount of air from the supply tank keeping the pressure near the governor's cut-in setting and triggering frequent compressor loading
- B. The air compressor's unloader mechanism is not fully unloading the compressor during the unloaded phase allowing the compressor to continue building pressure slowly and reaching cut-out faster than normal
- C. The secondary reservoir's one-way check valve is leaking backward allowing air from the secondary to bleed back through the supply tank and out through a small restriction creating the pressure cycling
- D. The governor's unloader signal line has a restriction that delays the unload signal to the compressor causing the compressor to overshoot cut-out before unloading and then undershoot cut-in before reloading

46. A tractor-trailer combination has completed a successful coupling. The driver pushes in the trailer supply valve (red button) and the trailer air system begins to charge. However, the trailer spring brakes do not release even after the trailer gauges show full supply pressure. What is the most likely cause?

- A. The trailer relay valve has a stuck internal piston that prevents the supply air from reaching the spring brake chambers through the relay's spring brake delivery port during the charging sequence

B. The tractor protection valve did not fully open when the trailer supply valve was pushed in and is restricting the supply pressure to a level below the spring brake release threshold for the trailer

C. The trailer spring brake chambers are equipped with a manual lockout feature that was engaged during the last disconnection and must be manually reset before the spring brakes will respond to air pressure

D. The spring brake relay valve or the spring brake circuit in the trailer has a fault that prevents the supply air from reaching the spring brake chambers to compress the springs and release the brakes

47. A truck's engine ECM communicates with the instrument cluster over the J1939 CAN bus. The cluster displays all gauge readings correctly except the engine oil pressure gauge which reads zero while the scan tool shows 310 kPa. What is the most likely cause?

A. The engine oil pressure sending unit has failed and is not producing a signal for the ECM to broadcast on the CAN bus to the instrument cluster gauge

B. The CAN bus has a partial failure that corrupts only the oil pressure data parameter while transmitting all other engine parameters correctly to the cluster

C. The instrument cluster's oil pressure gauge stepper motor or the internal circuitry that drives the oil pressure gauge specifically has failed while all other gauge drivers function normally

D. The ECM is broadcasting the oil pressure data in a different PGN (parameter group number) than the cluster is programmed to receive for the oil pressure display function

48. A truck has an aftermarket LED taillight kit installed to replace the original incandescent bulbs. After installation, the turn signals flash at the correct rate but the emergency (hazard) flashers do not function at all — pressing the hazard switch produces no flashing on any lamp. What is the most likely cause?

A. The LED taillight kit is missing the load resistors needed for the hazard flasher circuit which operates on a different circuit path than the turn signal flasher on this vehicle configuration

B. The hazard flasher module is a separate unit from the turn signal flasher on this vehicle and the LED conversion has affected the hazard circuit's load detection while the turn signal circuit works correctly

C. The LED lamps draw so little current that the hazard flasher's thermal element cannot heat enough to cycle the contacts — the hazard and turn circuits use the same flasher but different activation thresholds

D. The emergency flasher switch has coincidentally failed at the same time as the LED installation creating a false association between the LED conversion and the hazard flasher malfunction condition

49. A truck's alternator has been tested and produces 14.2 volts and 130 amps. The alternator is rated at 160 amps. The belt is tight and the wiring is clean. Should the technician be concerned that the alternator is only producing 130 amps?

A. No — the alternator produces only the current demanded by the loads and the battery charging requirement at that moment and 130 amps represents the current demand not the alternator's maximum capacity

B. Yes — a 160-amp alternator should produce at least 150 amps during a full output test and the 30-amp shortfall indicates internal wear that will worsen and should be addressed before it fails completely

C. No — alternators only produce their rated output at maximum engine RPM and the test was likely conducted at idle or moderate RPM which limits the alternator to approximately 80% of its rated output

D. Yes — the alternator's 30-amp deficit indicates that one of the three stator phase windings has increased resistance which reduces the maximum output by approximately one-sixth of the rated capacity

50. A truck's scan tool shows a J1939 CAN bus diagnostic trouble code — SPN 639, FMI 14 (special instructions). This FMI indicates the module detected a condition that requires referencing the manufacturer's service information for interpretation. What should the technician do?

A. Clear the code and road test the vehicle — FMI 14 is an informational code that does not indicate a fault and will not return if the condition was temporary during the module's last power cycle

B. Replace the module that set the code because FMI 14 indicates an internal hardware failure that cannot be diagnosed or repaired through external testing of the module's input and output circuits

C. Ignore the code because FMI 14 codes are generated during module software updates and are residual artifacts that do not affect vehicle operation or indicate any actual fault in the system

D. Access the module manufacturer's service information to determine the specific meaning of this SPN/FMI combination for the affected module because FMI 14 requires manufacturer-specific interpretation

51. A truck has a parasitic battery drain that the technician has isolated to the trailer connector circuit by pulling fuses. The tractor is not connected to any trailer. The seven-pin connector socket on the tractor appears clean and dry. What could be causing the drain through this circuit?

A. A corroded pin inside the socket is acting as a semiconductor junction creating a small but constant current path between two pins that drains the battery through the trailer wiring harness connections

B. The trailer connector socket's internal wiring is damaged and one of the hot wires (marker, tail, or ABS power) is contacting the socket's metal body creating a low-resistance path to ground

C. The body controller is maintaining a small standby current on the trailer auxiliary pin to provide instant power to the trailer ABS when a trailer is connected reducing the ABS power-up delay time

D. The seven-pin connector socket has moisture intrusion that creates a conductive path between the powered pins and the ground pin allowing a small continuous current to flow through the wet contamination

52. A heavy-duty truck has two batteries connected in parallel. The technician notices that one battery's case is significantly hotter than the other during normal operation. Both batteries are the same age and specification. What does the temperature difference indicate?

A. The hotter battery has a lower internal resistance which causes it to accept more charging current than the cooler battery and the higher current flow generates proportionally more heat in the hotter battery

B. The cooler battery has a failed cell that increases its internal resistance causing the hotter battery to carry a disproportionate share of both the charging and load current generating more heat from the increased workload

C. The hotter battery is positioned closer to a heat source (exhaust manifold, turbocharger, or hot engine surface) and the elevated temperature is from external heat radiation rather than internal battery chemistry

D. The alternator is producing an unbalanced output that delivers more current to one battery terminal than the other and the uneven distribution causes one battery to work harder and generate more heat

53. A truck's engine ECM has set a fault code for the crankshaft position sensor — SPN 190, FMI 8 (abnormal frequency, period, or pulse width). The engine runs but intermittently misfires and hesitates. What condition produces an FMI 8 on the CKP sensor?

A. The sensor air gap has increased from bearing wear allowing the sensor to occasionally miss a tooth passage creating gaps in the signal that the ECM interprets as abnormal pulse characteristics

B. The sensor is detecting the correct number of teeth per revolution but the pulse characteristics (width, amplitude, or timing) are inconsistent with what the ECM expects from the known tooth pattern

C. The engine has lost one cylinder's contribution to rotation and the resulting speed variation creates a non-uniform pulse train that the ECM cannot reconcile with the expected firing interval pattern

D. The sensor's output voltage has dropped below the ECM's minimum detection threshold from cable resistance and the ECM can only detect some of the teeth creating an abnormal frequency reading

54. A truck's headlamp leveling system automatically adjusts the headlamp aim based on the vehicle's loading condition. The rear of the truck is loaded heavily and the headlamps are aimed too high — blinding oncoming traffic. What input does the leveling system use to determine the correct headlamp angle?

A. The vehicle speed signal from the ABS module which the leveling controller uses to estimate the aerodynamic loading on the front and rear suspension and calculate the body pitch angle accordingly

B. The windshield wiper switch position because the leveling system assumes rainy conditions when wipers are active and lowers the headlamps to reduce glare from the wet road surface reflection

C. The engine load percentage from the ECM which the leveling controller interprets as an indicator of the vehicle's gross weight and adjusts the headlamp angle based on the estimated payload weight

D. Suspension height sensors on the front and rear axles that measure the vehicle's body pitch angle — when the rear drops from loading the system tilts the headlamps downward to maintain the correct beam pattern

55. A truck's windshield wiper motor park switch has been replaced. After the replacement, the wipers park correctly but the intermittent wiper mode no longer functions — the wipers sweep once and then stop instead of repeating. What was likely disturbed during the park switch replacement?

A. The intermittent wiper timing circuit's ground connection passes through the park switch assembly and was not reconnected during the park switch replacement which disables the intermittent timing function

B. The park switch was installed 180 degrees out of phase and the reversed timing signal from the switch is misinterpreted by the intermittent timer as a continuous park command after each single wiper sweep

C. The wiper motor's intermittent relay was accidentally disconnected during the park switch replacement and the relay must be reconnected to restore the timing pulse that triggers each intermittent sweep cycle

D. The park switch wiring connector has a pin that also carries the intermittent timer signal and the pin was bent during reassembly creating an open circuit in the intermittent function while the park works normally

56. A truck's engine ECM receives its primary power through a fused circuit from the battery. The ECM also has a separate keep-alive memory power wire. If the keep-alive wire develops an open circuit, what information is lost?

A. The engine calibration file and the injector trim codes are erased requiring the technician to reprogram the ECM with the correct files before the engine can restart and operate correctly

B. The engine will not crank because the keep-alive circuit also powers the starter relay control coil and without this power the relay cannot energize to connect the battery to the starter motor circuit

C. The adaptive fuel trim values, learned idle parameters, and trip/maintenance data are lost — the ECM must relearn these values through a driving cycle which may cause temporary rough operation

D. The ECM loses all stored fault codes (both active and inactive) and the diagnostic history is erased requiring the technician to recreate the fault conditions to re-establish the diagnostic record for each code

57. A truck's LED headlamp assembly draws 35 watts per lamp. The original halogen headlamp drew 55 watts per lamp. The truck has two headlamps on the low-beam circuit. What is the current draw reduction on the low-beam circuit at 12 volts after the LED conversion?

A. The LED conversion reduces the low-beam circuit current draw by 5.5 amps which is the difference between the two halogen lamps at 9.2 amps total and the two LED lamps at approximately 5.8 amps total

B. The LED conversion reduces the low-beam circuit current draw by approximately 3.3 amps — from 9.2 amps for two halogen lamps to approximately 5.8 amps for two LED lamps at the 12-volt system voltage

C. The LED conversion reduces the current draw by approximately 1.7 amps per lamp for a total reduction of 3.4 amps across both low-beam circuits at the nominal 12-volt system operating voltage

D. The LED conversion has no effect on the circuit current draw because the headlamp relay limits the current to a fixed value regardless of the lamp type installed in the headlamp housing assembly

58. A truck's body controller receives the brake light switch signal and activates the brake lamp output circuit. The brake lights remain on continuously even when the brake pedal is released. The brake light switch has been tested and opens correctly when the pedal is released. What is the most likely cause?

A. The brake lamp wiring has a short to battery voltage downstream of the body controller that bypasses the controller's output driver and directly powers the brake lamps at all times regardless of switch state

B. The body controller's brake lamp output circuit has an internal fault that keeps the output driver in the energized state regardless of the brake light switch input signal from the pedal switch assembly

C. The brake lamp fuse has been replaced with a higher amperage fuse that allows excess current to flow through the circuit keeping the lamp filaments illuminated even with the switch contacts open

D. The body controller has latched the brake lamp output on due to a software fault — the controller received a valid brake-on signal but failed to process the subsequent brake-off signal when the pedal was released

59. A truck's starter motor has been rebuilt. After installation, the starter engages and cranks the engine but makes a grinding noise during the engagement. Once the engine starts and the key is released, the noise stops. What is the most likely cause?

A. The starter drive gear (pinion) or the flywheel ring gear has damaged teeth at the engagement point and the teeth do not mesh smoothly during the initial engagement before the motor begins turning

B. The starter was shimmed incorrectly during installation and the drive gear is not achieving the correct mesh depth with the flywheel ring gear creating a grinding contact during the engagement phase

C. The starter solenoid plunger is not extending the drive gear far enough into the ring gear before the motor circuit closes causing the spinning drive gear to grind against the ring gear teeth during engagement

D. The flywheel ring gear has worn teeth from years of service and the rebuilt starter's new drive gear teeth cannot mesh properly with the worn ring gear profile creating a grinding noise during every engagement

60. A truck has two identical alternators in a dual-alternator configuration. Alternator 1 charges the main vehicle batteries and Alternator 2 charges the auxiliary liftgate batteries. Both alternators are belt-driven from the same engine. Alternator 1 produces 14.2 volts but Alternator 2 produces only 12.8 volts. Both belts are tight. What should be checked on Alternator 2?

A. The auxiliary battery bank for a dead cell that is pulling the voltage down preventing Alternator 2 from reaching its regulated output despite the alternator producing adequate current output

B. The alternator drive pulley ratio for Alternator 2 because a larger pulley on the alternator would reduce its rotational speed below the minimum needed to produce full voltage at the current engine RPM

C. The voltage regulator and field circuit of Alternator 2 for a fault that limits the field current below the level needed to produce the correct output voltage at the current speed and electrical load condition

D. The belt tensioner for Alternator 2 because even though the belt appears tight the tensioner may not be applying adequate force under load and the belt slips during the alternator's full-output operating condition

61. A truck's multiplexed body electrical system uses a gateway module to translate data between the J1939 CAN bus and the body CAN bus. The gateway module has failed. What symptoms would the driver experience?

A. The engine would not start because the gateway translates the start command from the body CAN (where the ignition switch resides) to the J1939 CAN (where the engine ECM resides) during the start sequence

B. The instrument cluster gauges and warning lamps for engine parameters would stop functioning because the engine data on J1939 cannot reach the cluster on the body CAN without the gateway translating between buses

C. The vehicle would operate normally because the engine ECM and transmission TCM communicate directly on the J1939 bus and do not require the gateway for their essential powertrain control functions

D. All vehicle electrical systems would fail simultaneously because the gateway provides power distribution to all modules on both CAN buses and its failure cuts power to every electronic module on the vehicle

62. A truck's scan tool shows a fault code for the accelerator pedal position sensor — SPN 91, FMI 14 (special instructions). The technician clears the code and it returns immediately. The pedal operates smoothly with no dead spots and the signal voltage sweeps linearly from 0.5V to 4.5V. What should the technician do?

A. Replace the accelerator pedal assembly because FMI 14 indicates an internal sensor calibration fault that cannot be detected through external voltage testing of the sensor's output signal characteristics

B. Perform a pedal position sensor calibration procedure using the scan tool — the ECM may need to learn the new sensor's minimum and maximum voltage range if the sensor or ECM was recently replaced

C. Check the pedal position sensor wiring for an intermittent connection that produces a signal glitch too brief to appear on the DMM but is captured by the ECM's high-speed sampling of the sensor input circuit

D. Access the manufacturer's service information for the specific SPN 91, FMI 14 code interpretation because FMI 14 requires manufacturer-specific diagnostic procedures that cannot be determined from general code definitions

63. A truck's electric fuel pump provides 450 kPa of fuel pressure to the engine's fuel rail. A pressure gauge installed at the rail shows 420 kPa. The fuel filter has been recently replaced and the pump outlet pressure tests at 455 kPa at the pump. Where is the 30 kPa pressure loss occurring?

A. In the fuel line and fittings between the pump and the fuel rail — the cumulative resistance to flow through the lines, fittings, filter, and any connections creates a 30 kPa pressure drop under normal flow conditions

B. At the fuel pressure regulator which is bypassing excess fuel back to the tank to maintain the commanded rail pressure at a point 30 kPa below the pump's maximum delivery pressure output

C. Inside the fuel rail itself where the six injector return circuits collectively leak enough fuel to drop the pressure 30 kPa from the supply pressure before the pump can replenish the lost volume adequately

D. At the fuel filter despite being recently replaced — the new filter element has a tighter micron rating than the original and creates additional restriction that was not present with the previous filter specification

64. A truck's battery disconnect switch is turned off nightly by the driver. Recently, the driver has noticed that the engine takes longer to crank on the first start of each morning — approximately 5 seconds of cranking versus the normal 2 seconds. The batteries test fully charged after each overnight period. What has changed?

A. The battery cables have developed internal corrosion that increases resistance during the first cranking attempt each morning until the heat of current flow reduces the resistance for subsequent starts

B. The batteries are aging and their CCA capacity has decreased to the point where the first cold start of the day requires longer cranking but the batteries still pass the conductance test due to test methodology

C. The disconnect switch has developed internal resistance from wear and corrosion at its contacts that creates a voltage drop under the heavy current of starter motor cranking reducing the effective voltage

D. The engine's injectors require a longer fuel system priming period because the fuel drains back to the tank through the injector return lines overnight when the fuel system is depressurized by the battery disconnect

65. A truck's CAN bus has been tested and the backbone resistance reads 40 ohms between CAN-H and CAN-L with the ignition off and all modules connected. The specification is approximately 60 ohms. What does the 40-ohm reading indicate?

A. One of the two 120-ohm terminating resistors has failed open increasing the parallel combination value above the normal 60-ohm specification creating signal reflection issues on the bus

B. There is an additional resistance source connected in parallel with the two terminating resistors — possibly an aftermarket module or a damaged wire creating a third current path on the bus backbone

C. The CAN bus wiring has a partial short between CAN-H and CAN-L that is adding a parallel resistance path and pulling the overall termination value below the normal 60-ohm specification reading

D. The 40-ohm reading indicates that one or more modules have not fully entered sleep mode and their internal CAN transceiver resistance is adding to the bus termination value creating the lower reading

66. A truck's auxiliary power outlet (12V accessory socket) has been replaced after the original melted from an overloaded accessory. The replacement socket is rated at 15 amps. The circuit fuse is 20 amps. What is the safety concern with this configuration?

A. The 15-amp socket will overheat and potentially melt if a 20-amp load is connected because the 20-amp fuse allows more current than the socket is rated to handle before the fuse blows to protect the circuit

B. The 20-amp fuse should be reduced to a 15-amp fuse to match the socket's rating — the circuit protection device must protect the weakest component which is now the 15-amp socket rather than the wiring

C. The replacement socket will function correctly because the 5-amp difference between the fuse and socket rating is within the standard safety margin for automotive accessory circuits in commercial vehicles

D. The fuse and socket ratings are compatible because the fuse protects the wiring (which is rated for 20 amps) and the socket's 15-amp rating refers to its continuous load capacity not its momentary peak rating

67. A truck's scan tool displays live data showing the engine coolant level sensor reads "low" but the coolant level is verified as full at the surge tank. The sensor is mounted in the surge tank below the coolant surface. What should the technician check?

A. The coolant level sensor probe for contamination from coolant additive deposits, scale, or debris that is insulating the probe from the coolant and preventing it from detecting the coolant contact with its surface

B. The coolant level sensor wiring for a short to ground that pulls the signal voltage to zero which the ECM interprets as a low-coolant condition regardless of the actual coolant level in the surge tank

C. The surge tank for internal baffling damage that has shifted the sensor position relative to the coolant surface level creating a false low reading when the tank is actually at the correct fill level

D. The coolant deaeration system for excessive air entrainment that creates an air pocket around the sensor probe even though the overall coolant level in the surge tank is at the correct fill mark position

68. A truck's multiplex body control system has a feature where the marker lamps automatically dim to 50% brightness when the headlamps are turned on. A driver complains that the marker lamps are too dim at night. The technician verifies this is a designed feature, not a fault. How should the technician respond?

A. Reprogram the body controller to eliminate the dimming feature since the driver finds it objectionable and the full-brightness markers provide better vehicle visibility during nighttime highway operation

B. Explain the feature to the driver and verify the dimming percentage matches the manufacturer's specification — if the dimming exceeds the designed percentage then investigate the body controller's output circuit

C. Install higher-wattage marker lamp bulbs that produce acceptable brightness at the 50% dimmed level while maintaining the designed dimming feature for the system's original design intent and functionality

D. The marker lamp dimming feature should not be modified because it is designed to reduce glare and visual distraction for the driver and other motorists — the driver should be informed of the design purpose

69. A truck equipped with a hydraulic clutch actuation system has a gradual loss of clutch pedal height over the past 30,000 km. The clutch reservoir fluid level has dropped but no external leaks are visible. Where is the fluid going?

A. The clutch master cylinder internal seals are leaking fluid past the piston and the fluid is entering the brake booster vacuum circuit through a shared master cylinder casting between the clutch and brake systems

B. The clutch slave cylinder seal is leaking fluid internally into the bell housing where it drips onto the clutch disc and evaporates from the friction heat generated during clutch engagement and disengagement cycles

C. The clutch master cylinder compensating port is blocked by sediment and the fluid is being forced past the rear piston seal during each pedal stroke accumulating behind the piston where it is not visible externally

D. The clutch slave cylinder pushrod seal is leaking fluid that drips inside the bell housing onto the clutch disc which contaminates the friction surfaces and explains both the fluid loss and increasing clutch slip

70. A truck's 10-speed manual transmission intermittently jumps out of 5th gear during coast (deceleration in gear). All other gears hold normally. The clutch adjustment is correct. What is the most likely cause?

A. The synchronizer blocking ring for 5th gear has worn and the reduced friction surface allows the gear to disengage under the coast-loading condition when the torque direction reverses through the gear mesh

B. The engine mounts have softened allowing the engine-transmission assembly to shift under the coast deceleration force which changes the shift linkage geometry enough to pull the lever out of the 5th gear position

C. The 5th gear mainshaft gear has a worn engagement dog that does not fully engage the sliding clutch collar allowing the gear to back out of engagement under the reverse-torque loading of deceleration in gear

D. The 5th gear shift rail detent mechanism has a worn detent notch or weakened detent spring that cannot hold the shift fork in the fully engaged position against the reverse-torque loading of deceleration coast

71. A truck's automatic transmission has a harsh 2-3 upshift but all other shifts are smooth. The fluid level and condition are correct. The scan tool shows the shift time for the 2-3 shift is 0.3 seconds while all other shift times are 0.6 to 0.8 seconds. What does the faster-than-normal 2-3 shift time indicate?

A. The clutch pack that engages for 3rd gear is applying too quickly — either from excessive apply pressure, a failed accumulator piston that should cushion the apply, or a worn cushion spring in the apply circuit

B. The off-going clutch pack that releases for the 2-3 shift is releasing too slowly creating an overlap condition where both the 2nd and 3rd gear clutch packs are momentarily applied simultaneously

C. The torque converter lockup clutch is accidentally engaging during the 2-3 shift event creating a direct mechanical connection that produces the harsh sensation and the shortened shift time measurement

D. The TCM is commanding a faster shift because the engine torque management is not reducing engine power quickly enough during the 2-3 shift and the TCM compensates by shortening the clutch apply time

72. A truck equipped with a two-speed rear axle has a complaint of noise from the rear axle in the low-speed range but not in the high-speed range. The axle lubricant level is correct. What component is specific to the two-speed function that could produce noise in only one range?

A. The ring and pinion gear set because the low-speed range loads the gear teeth on a different contact surface than the high-speed range and wear on one surface produces noise only in that range

B. The shift motor that actuates the two-speed mechanism is continuing to apply force after the shift is complete causing the shift collar to bind against the engagement dogs and produce noise during low-range operation

C. The two-speed shift sliding clutch, its engagement dogs, or the specific gear set that provides the low-range reduction — these components are only loaded during low-range operation and produce noise when worn

D. The wheel bearings on both sides of the axle because the lower wheel speed in the low range allows bearing noise to be heard that is masked by wind and road noise at the higher wheel speed of the high range

73. A drive axle pinion bearing preload has been set during a ring and pinion installation. The technician measures the pinion rotating torque with a beam torque wrench at the pinion nut. The reading is 3.4 Nm. The OEM specification for new bearings is 1.7 to 3.4 Nm. Is this preload acceptable?

A. No — the preload should be set to the middle of the range (approximately 2.5 Nm) to provide a safety margin on both the loose and tight sides of the specification range during normal thermal cycling

B. The preload is at the upper limit of the specification which is acceptable for new bearings but should be rechecked after 500 km of operation to verify the preload has not increased further from bearing seating

C. No — the upper limit of 3.4 Nm is the specification for used bearings only and new bearings require a preload setting of 1.0 to 2.0 Nm because new bearing surfaces have higher initial friction than worn surfaces

D. The preload should be reduced because at the upper limit there is no margin for the preload to increase from thermal expansion during operation which could overload the bearings and cause premature failure

74. A truck's transmission cooler lines run from the transmission to an external cooler mounted in front of the radiator. One cooler line has developed a small crack that leaks fluid. The technician repairs the crack with a compression fitting. Is this an acceptable repair for a transmission cooler line?

A. A compression fitting is an acceptable temporary repair that allows the vehicle to operate until a permanent replacement line can be fabricated and installed at the next scheduled service interval

B. Compression fittings should not be used on transmission cooler lines because the pulsating pressure from the transmission pump can fatigue the fitting over time causing it to crack and leak under vibration

C. Compression fittings are only acceptable if the line operates below 345 kPa (50 psi) and transmission cooler lines typically operate at 200 to 400 kPa which places them at the upper limit of acceptability

D. A compression fitting repair is not recommended — the line should be replaced or repaired with a proper flare or braze joint that can withstand the vibration, pressure cycling, and temperature range of the application

75. A truck's clutch release bearing is making a continuous noise at idle that disappears when the clutch pedal is depressed. What does this noise pattern indicate?

A. The release bearing is in constant contact with the pressure plate fingers and the noise is from the dry bearing running against the rotating fingers — depressing the pedal loads the bearing which quiets it

B. The clutch disc hub is rattling on the transmission input shaft splines at idle because there is no clamping load on the disc — the rattle stops when the clutch is disengaged because the disc stops spinning

C. The transmission input shaft bearing is worn and produces noise when the shaft is loaded by the clutch engagement — disengaging the clutch unloads the bearing and the noise stops from the reduced force

D. The release bearing is worn but not yet in contact with the pressure plate fingers — the noise is from the worn bearing vibrating in its guide sleeve at engine idle frequency and the pedal push stabilizes it

76. A truck has an unusual clutch symptom — the pedal effort is normal and the clutch engages correctly, but there is a 1-second delay between releasing the clutch pedal and the vehicle beginning to move. What is the most likely cause?

A. The clutch hydraulic system has a delayed response from a restricted master cylinder compensating port that slows the fluid return when the pedal is released delaying the clutch disc contact with the flywheel

B. The clutch disc damper springs have weakened excessively and the disc hub rotates relative to the friction surface absorbing the engine torque for approximately one second before the springs compress and transmit power

C. The transmission input shaft bearing has developed excessive radial play that allows the shaft to wobble during the engagement transition creating a brief period where the disc and flywheel are not parallel and cannot couple

D. The flywheel has developed a warped friction surface that contacts the clutch disc at only a few high points initially and requires approximately one second to generate enough friction force to begin accelerating the vehicle

77. A truck's automatic transmission has a persistent "check transmission" lamp with a fault code for the transmission fluid temperature sensor reading -40°C continuously. The transmission fluid is at normal operating temperature. What is the most likely cause?

A. The transmission fluid temperature sensor probe has broken off inside the transmission and the exposed wiring is reading the temperature of the air above the fluid surface rather than the fluid temperature itself

B. The sensor's signal wire has an open circuit — on many systems an open NTC temperature sensor circuit reads as the coldest possible temperature because the ECM/TCM interprets the maximum voltage as minimum temperature

C. The TCM has a software calibration error that interprets the sensor's resistance value incorrectly — the sensor is functioning but the calibration tables in the TCM convert the resistance to -40°C from a mapping error

D. The transmission fluid itself has a chemical composition problem that changes the sensor's resistance response curve — the sensor reads the correct resistance but the fluid's properties produce a false temperature reading

78. A truck's driveshaft has been balanced and is vibration-free at all speeds. However, a vibration appears only when the engine brake (compression brake) is activated at highway speed. What is causing this vibration?

A. The engine brake changes the crankshaft's torsional vibration characteristics and the altered torsional pulses excite the driveline at a frequency that was not present during normal powered driving conditions

B. The engine brake creates a negative torque through the driveline that reverses the loading on the U-joint bearing caps from their normal orientation creating a vibration from the bearing cap clearance reversal

C. The compression brake exhaust pulses create a vibration in the exhaust system that resonates through the frame and is transmitted to the cab at a frequency the driver perceives as a driveline vibration

D. The engine brake activates the exhaust butterfly valve which restricts exhaust flow and changes the turbocharger speed creating an imbalance force in the turbo shaft that transmits through the engine to the driveline

79. A truck's differential lock indicator lamp illuminates when the lock switch is pressed but the inter-axle differential does not actually engage. Air pressure is confirmed at the lock actuator. What is the most likely cause?

A. The indicator lamp switch is activated by the air pressure reaching the actuator circuit — it confirms air arrived at the actuator but does not confirm the actuator physically moved the locking mechanism into engagement

B. The inter-axle differential has a worn shift fork that flexes under the actuator's air pressure force instead of rigidly pushing the locking collar into engagement — the air arrives but the mechanical force is insufficient

C. The lock actuator diaphragm has a small hole that allows enough air to activate the pressure switch for the indicator but not enough sustained pressure to push the locking collar into full engagement position

D. The lock engagement mechanism inside the differential housing is corroded, seized, or mechanically obstructed and the actuator cannot overcome the resistance despite receiving adequate air pressure from the supply

80. A truck has a two-piece driveshaft with a centre bearing. The front section of the driveshaft turns freely by hand but the rear section is stiff and difficult to rotate. Both U-joints are smooth with no roughness. What is causing the rear section to be stiff?

A. The transmission output shaft bearing has seized partially and its resistance is transmitted through the front driveshaft section and the centre bearing to the rear section making it feel stiff from the resistance

B. The rear axle pinion bearing preload is set too tight creating excessive resistance that must be overcome to rotate the rear driveshaft section through the pinion gear engagement in the differential housing

C. The centre bearing rubber isolator has seized to the bearing housing from age, heat, and oil contamination creating friction that resists the rear driveshaft's rotation independently from the front section movement

D. The drive axle lubricant has thickened from cold temperature or from being the wrong viscosity grade and the thick oil's resistance to the ring gear churning makes the rear driveshaft section stiff to rotate by hand

81. A truck equipped with a single-disc clutch has a complaint of gear rattle at idle in neutral. The rattle stops when the clutch pedal is slightly depressed (approximately 10 mm). What is causing this rattle?

A. The transmission input shaft and countershaft gears rattle from the engine's torsional pulses at idle because no drive load clamps the gear teeth together — slightly disengaging the clutch reduces the torsional input

B. The clutch disc damper springs are resonating at the engine idle frequency transmitting amplified torsional pulses to the transmission gear teeth — slight pedal depression shifts the resonance point and stops the rattle

C. The flywheel has developed a crack that changes the engine's torsional vibration characteristics at idle and the altered vibration pattern drives the transmission gears into a rattling contact condition at that specific frequency

D. The clutch release bearing is vibrating against the pressure plate finger tips at idle and the slight pedal depression pushes the bearing firmly against the fingers stabilizing the contact and eliminating the vibration

82. A truck's tandem drive axle has the inter-axle differential lock engaged. The truck is turning in a parking lot on dry pavement and a loud popping noise is heard from the rear axle area. What is causing this noise?

A. The locked inter-axle differential is preventing the front and rear axles from turning at different speeds during the turn and the tires are alternately breaking and regaining traction producing the popping noise

B. The ring and pinion gears in one axle are being overloaded by the locked differential condition and the excessive tooth loading is causing the gear teeth to deflect and rebound producing the audible popping sound

C. The locked differential is forcing both axles to turn at the same speed but the outer wheels must travel further than the inner wheels during the turn creating driveline windup that releases as audible popping

D. The inter-axle lock mechanism is slipping intermittently under the high torque loads created by the locked differential during the tight turn and each slip event produces a loud pop as the lock re-engages

83. A truck's automatic transmission produces a whining noise that is present in all gear ranges including Park and Neutral with the engine running. The noise pitch changes only with engine RPM, not with vehicle speed or gear selection. What is the most probable source?

A. The transmission oil pump, which is driven by the torque converter housing and rotates at engine speed in all gear positions including Park and Neutral whenever the engine is running

B. The torque converter stator one-way clutch which is loaded in all operating conditions and produces a speed-dependent whine as the stator reacts the fluid forces from the impeller to the turbine at all speeds

C. The transmission output shaft bearing which rotates at engine speed through the planetary gear train in all gear positions and produces a whine proportional to the shaft's rotational speed under all conditions

D. The governor circuit in the valve body that sends fluid through its orifice at a flow rate proportional to engine speed creating a whistle-like noise as the fluid passes through the governor's calibrated restriction

84. A drive axle's ring gear has been replaced but the original pinion gear was reused because it showed no signs of wear. After 5,000 km, the new ring gear shows premature wear on the tooth faces. What is the most probable cause of this accelerated wear?

A. Ring and pinion gears are manufactured and lapped as matched sets — reusing the old pinion with a new ring gear creates a contact pattern mismatch that causes concentrated loading and accelerated wear on the new gear

B. The new ring gear material is softer than the original because the replacement was an aftermarket gear made from a lower grade of steel that cannot withstand the same contact stresses as the OEM original gear set

C. The carrier bearing shim pack was not readjusted when the new ring gear was installed and the incorrect backlash setting creates a gear mesh that loads the new ring gear teeth at the wrong contact position

D. The drive axle lubricant was not changed when the new ring gear was installed and the worn metal particles from the original gear set are now acting as abrasive contaminants that accelerate wear on the new surfaces

85. A truck equipped with a compression brake has the brake adjusted to the manufacturer's specification on all six cylinders. During operation, the compression brake produces noticeably uneven retarding force — the engine feels like it is surging or hunting during compression brake operation rather than providing smooth, consistent deceleration. What should be checked?

A. The engine valve lash on all cylinders because incorrect exhaust valve lash affects the compression brake's ability to release compressed air consistently across all cylinders producing uneven retarding pulses

B. The compression brake solenoid valve actuation timing for each cylinder group because an incorrect timing relationship between the groups produces an asymmetric braking pattern that feels like surging

C. The exhaust valve lash on all cylinders — since the compression brake operates by opening the exhaust valves the lash setting directly determines when and how far each exhaust valve opens during the brake event and uneven lash produces uneven retarding

D. The engine oil pressure at the compression brake slave pistons because low oil pressure from a worn pump or restricted gallery cannot actuate all slave pistons consistently creating intermittent operation across the cylinders

86. A truck's power steering return hose has developed a restriction from internal deterioration — the inner liner has collapsed partially. What symptom will this restricted return hose produce?

A. The steering will feel stiff during turns because the restricted return line creates backpressure inside the gearbox that opposes the power piston's assist force during the steering input by the driver

B. The steering will feel stiff and the power steering pump may whine because the restricted return prevents adequate fluid from returning to the reservoir creating a low-fluid-level condition at the pump inlet

C. The steering will feel normal during turns but the steering wheel will not self-centre after completing a turn because the restricted return flow prevents the gearbox spool valve from neutralizing quickly

D. The steering effort will increase progressively during a series of turns because the restricted return causes the fluid to heat up and the hot thinned fluid provides less hydraulic assist through the gearbox piston

87. A truck has excessive play in the steering that cannot be eliminated by adjusting the steering gearbox. All external linkage components and king pins are within specification. What internal gearbox condition is the most likely cause?

A. The worm shaft bearing preload is too loose allowing the input shaft to float axially in the gearbox housing and move the ball nut without positively engaging the sector gear teeth during steering input

B. The recirculating ball circuit has worn balls that are undersized from use creating excessive clearance between the worm shaft grooves and the ball nut's internal groove that the balls no longer fill precisely

C. The sector shaft bushing in the gearbox housing has worn allowing the sector shaft to shift radially when loaded which moves the pitman arm connection point and introduces play that mimics linkage wear

D. The recirculating ball mechanism — worn balls, enlarged worm shaft grooves, or worn ball nut teeth — has exceeded the range of the sector shaft adjustment and cannot be corrected by the external adjustment

88. A truck's frame has two longitudinal cracks — one on each side rail — at the same location relative to the cab-to-frame mounting bracket. The cracks originate at the bolt holes where the cab mount bracket attaches to the frame. What is the most likely cause?

A. The cab mount rubber isolators have failed and the rigid metal-to-metal contact between the cab and frame transmits every road impact force directly into the frame at the bolt holes causing fatigue cracking

B. The cab mounting bracket bolts were over-torqued during the last cab tilt service compressing the frame rail flange beyond its elastic limit and initiating cracks at the stress-concentrated bolt hole locations

C. The frame rails have a manufacturing defect in the steel composition at that location which is a known recall issue that the manufacturer has identified and published a technical service bulletin to address

D. The truck has been consistently overloaded beyond its GVWR and the concentrated load transfer from the cab to the frame through the mounting brackets has exceeded the frame's fatigue life at those bolt locations

89. A truck's steer tire has been run over a deep pothole at highway speed. The tire appears undamaged externally — no visible cuts, bulges, or deformation. The tire maintains inflation pressure normally. Should the tire be inspected further?

A. The tire does not need further inspection because the maintained pressure and normal external appearance confirm no internal damage occurred from the pothole impact at the highway speed encountered

B. The tire must be removed from the rim and internally inspected because high-speed pothole impacts can cause internal sidewall bruising, belt separation initiation, or cord damage not visible from the exterior

C. The tire should be inspected further only if the vehicle develops a vibration or pull within the next 500 km — if no symptoms develop the pothole impact did not cause any damage requiring investigation

D. The tire must be replaced immediately regardless of its external condition because any steer tire that has been subjected to a pothole impact at highway speed is considered structurally compromised

90. A trailer's suspension uses rubber helper springs that engage only when the suspension approaches full compression. The driver reports that the ride becomes extremely harsh when the trailer is loaded to capacity. What is the most likely cause of the harsh ride at full load?

A. The helper springs are designed to be harsh — they provide a progressive spring rate that increases dramatically as the suspension compresses and this increased stiffness produces the harsh ride at full load

B. The rubber helper springs have hardened from age, heat cycling, and ozone exposure and their increased stiffness engages earlier in the suspension travel than designed producing the harsh ride at lower loads than intended

C. The trailer's air ride bags have lost capacity from age and are compressing to the helper spring engagement point at a load level below the design intent — causing the helpers to engage during normal loading conditions

D. The helper springs have been replaced with an incorrect durometer (hardness) rating that is significantly stiffer than the original specification causing the suspension to bottom harshly during full-load compression

91. A fifth wheel plate has been replaced with a new unit. After installation, the driver reports that the tractor-trailer combination makes a loud clunking noise during acceleration and braking that was not present with the old fifth wheel. What should the technician check?

A. The new fifth wheel's locking jaw mechanism for correct engagement — the jaw springs, pivot pins, and secondary lock may need adjustment to achieve the tight king pin capture that eliminates coupling movement

B. The new fifth wheel mounting bolts for correct torque — loose mounting allows the plate to shift on its bracket during torque reversals producing the clunking noise during each acceleration and braking transition

C. The trailer king pin for wear that was accommodated by the worn old fifth wheel but creates excessive play with the new fifth wheel's tighter jaw and plate dimensions producing clunking in the new coupling

D. The new fifth wheel plate height relative to the trailer upper coupler plate — if the new plate is a different height than the original the coupling geometry changes and the king pin loading angle produces the noise

92. A truck's wheel bearing end play has been adjusted to 0.003 inches (0.076 mm). The OEM specification is 0.001 to 0.005 inches. After 1,000 km of operation, the technician rechecks the end play and it reads 0.008 inches (0.203 mm). What is the most likely cause of this rapid increase in end play?

A. The adjusting nut lockwire or cotter pin was not installed and the nut has backed off from the bearing's rotational forces allowing the end play to increase from the initial setting to the current looser condition

B. The bearing races have seated further into the hub bores during the initial 1,000 km of service and the races have shifted axially as the press fit settles under the dynamic loading of normal vehicle operation

C. The bearings were contaminated with debris during the adjustment process and the abrasive particles have rapidly worn the roller surfaces and races increasing the internal clearance within the bearing assembly

D. The wheel seal was installed with too much interference on the spindle which created a drag force on the inner bearing that gradually walked the adjusting nut counterclockwise loosening the preload over 1,000 km

93. A truck equipped with a rear air ride suspension has one trailing arm bushing that has developed severe cracking and deterioration. The driver has not reported any handling complaints. Beyond the obvious bushing replacement, what should the technician inspect?

A. The trailing arm itself for stress cracks or fatigue damage that may have developed from the bushing's deterioration allowing excessive movement at the axle-to-frame connection during normal driving operations

B. The drive axle alignment because the deteriorated bushing has allowed that side of the axle to shift position during driving creating a thrust angle error that may have altered the vehicle's tracking and tire wear

C. The air springs on both sides for damage because the deteriorated bushing may have allowed the air spring to contact other suspension components during full compression creating rub marks or wear spots

D. The shock absorber on that side for premature wear because the deteriorated bushing changes the effective damper length and angle during suspension travel which accelerates the shock absorber's internal wear

94. A truck's tire has been retreaded (recapped). During a pre-trip inspection, the technician notices that the retread cap is separating from the casing at one edge — a 100 mm section of the tread edge is lifting away from the tire body. What action is required?

A. Apply a tire repair adhesive to the separating edge and clamp it in place with a hose clamp until the adhesive cures then return the tire to service with a notation to monitor the repair at subsequent inspections

B. Move the retreaded tire from its current drive axle position to a trailer axle position where the lower speed and reduced drive torque will reduce the stress on the separating tread cap during continued service

C. Remove the tire from service immediately because a separating retread cap will progressively detach from the casing during driving creating a road debris hazard and leaving the casing running on the road surface

D. Continue to operate the tire but limit the vehicle speed to 80 km/h until the tread cap can be professionally re-bonded at a retread facility during the next scheduled service appointment for this vehicle

95. A truck's hub-piloted wheel has been installed with a lug nut that has the wrong seat type — a cone-seat nut is used on a hub-piloted application that requires a flange-seat nut. What problem does this incorrect nut type create?

A. The cone-seat nut cannot properly clamp the flat mounting surface of the hub-piloted wheel and the resulting incomplete clamping allows the wheel to shift, elongate the stud holes, and potentially separate during driving

B. The cone-seat nut will over-torque the stud because its tapered surface concentrates the clamping force on a smaller area than the flange nut creating a higher effective stress per unit area at the stud threads

C. The cone-seat nut contacts the wheel at a single line around the taper rather than a flat flange surface creating a rocking point that allows the nut to loosen from vibration and the wheel may separate during operation

D. The cone-seat nut requires a different socket size than the flange-seat nut and the technician may inadvertently damage the nut using the wrong socket which strips the hex and prevents proper torque verification

96. A truck's leaf spring has been replaced on the front steer axle. After the replacement, the truck's ride height on the replaced side is 15 mm higher than the other side. The new spring is the correct part number. What should the technician do?

A. The height difference is normal for a new spring versus the opposite side's original spring that has taken a permanent set — the new spring will settle to match the other side within 5,000 to 10,000 km of driving

B. Add a shim between the spring and the axle pad on the higher side to lower the ride height to match the opposite side and restore the vehicle's lateral balance for even weight distribution across the axle

C. Replace the spring on the opposite side as well to ensure both sides have identical ride height and spring rate characteristics for balanced handling, braking, and even tire wear across the steer axle

D. Adjust the spring's U-bolt torque to a slightly higher value on the high side to compress the new spring's extra camber and bring the ride height into alignment with the opposite side's existing height dimension

97. A truck's power steering hose has ruptured and all the fluid has leaked out. The driver drove the truck approximately 5 km to the shop with no power steering assist. Beyond replacing the hose and refilling the fluid, what should the technician inspect?

A. The steering gearbox for internal damage from running without lubrication and hydraulic assist for the 5 km drive which may have scored the internal spool valve, worm shaft, or sector shaft bearing surfaces

B. The steer tires for flat-spotted wear from the increased steering effort that caused the driver to make abrupt steering corrections with excessive force during the 5 km drive without power steering assist

C. The power steering pump for damage from running dry — the pump received no lubrication from the fluid during the 5 km drive and the internal components may have scored, seized, or overheated from dry operation

D. The steering column flexible coupling for damage from the increased torque the driver applied through the steering wheel to overcome the lack of power assist during the 5 km drive to the shop

98. A trailer equipped with a steerable axle has developed a dog-tracking condition — the trailer tracks at an angle to the tractor's path. The tandem axle alignment is verified as correct. What should be checked on the steerable axle?

A. The steering knuckle pivot bushings on the steerable axle for wear that allows the wheels to toe-out under driving loads creating a thrust angle that pushes the trailer's rear end to one side during straight driving

B. The steerable axle's self-centering mechanism for a failed spring, worn bushing, or contaminated pivot that prevents the axle from returning to the straight-ahead position after completing a turn maneuver

C. The trailer fifth wheel coupling for excessive play that allows the trailer to pivot on the king pin to an angle that the steerable axle interprets as a turning input and responds by steering in the wrong direction

D. The steerable axle's maximum steering angle limiter for a misadjustment that allows the axle to deflect beyond its design range during normal straight driving creating a persistent dog-tracking condition

99. A truck's steering wheel vibrates at a specific speed (approximately 100 km/h) and the vibration disappears below 90 km/h and above 110 km/h. The steer tires are balanced and the alignment is correct. King pins, tie rod ends, and wheel bearings are all within specification. What should the technician check?

A. The steer tire condition for a separated belt or flat spot that creates a once-per-revolution force imbalance at the specific speed matching the steering system's resonant frequency for the vibration to manifest

B. The driveshaft for a balance condition or U-joint working angle error that produces a vibration at the specific speed and is misidentified as a steering vibration because it is felt through the steering wheel as feedback

C. The brake rotors for lateral runout that creates a once-per-revolution steering input at the speed where the rotor's runout frequency matches the steering system's natural oscillation frequency for resonance

D. The steering damper for internal failure that allows the steer axle to oscillate at its natural frequency when excited by road surface irregularities at the specific speed where the excitation frequency matches the resonance

100. A truck equipped with disc brakes on all positions has had the brake pads replaced on the front steer axle. After the pad replacement, the driver reports the brake pedal travels further than before the service. The brakes stop the vehicle normally once engaged. What is the most likely cause?

A. The brake caliper pistons were pushed fully into their bores during the pad replacement and must travel the full distance back to contact the new pads before braking force is generated creating the extra pedal travel

B. The brake fluid absorbed moisture during the service when the caliper pistons were retracted and the moisture has reduced the fluid's boiling point causing vapour lock that extends the pedal travel before engagement

C. The new brake pads are a different compound than the original and their surface finish requires a break-in period during which the pedal travel is longer until the pads develop full contact with the rotor surface

D. The brake system was bled of air during the pad replacement service and the residual air in the caliper bore compresses during the first several applications creating the extra pedal travel until the air purges naturally

101. A truck's hub oil bath system has been serviced and refilled to the correct level. The technician uses the wrong oil specification — SAE 80W-90 gear oil instead of the specified SAE 50 weight hub oil. What effect will this incorrect oil have?

A. The heavier gear oil will provide superior bearing protection due to its higher viscosity and enhanced extreme-pressure additive package compared to the specified lighter-weight hub oil product

B. The heavier gear oil may cause the hub seals to leak because the higher viscosity creates more internal pressure during operation from the increased resistance to flow past the bearing assemblies and seal lips

C. The heavier gear oil generates more internal friction in the hub assembly causing elevated bearing temperatures that accelerate seal deterioration and may lead to bearing failure from oil breakdown at the higher temperature

D. The gear oil's sulphur-phosphorus extreme-pressure additives may chemically attack the bronze bearing cage material causing it to weaken and the cage may disintegrate releasing the rollers inside the hub assembly

102. A truck equipped with air suspension has the ride height set 25 mm lower than specification to improve fuel economy through reduced aerodynamic drag. During a hard braking event, the front air bags bottom out on the bump stops. What is the consequence?

A. Bottoming out on the bump stops during hard braking momentarily transfers the braking force directly through the rigid bump stop to the frame without the air spring's cushioning which can crack the frame at the stop mount

B. The bump stop contact creates a sudden increase in the front axle's vertical load transfer during braking which increases the front tire traction beyond what the ABS system is calibrated to manage for that axle

C. Bottoming out on the bump stops momentarily unloads the front tires because the rigid stop reverses the frame's motion direction bouncing the frame upward which causes momentary loss of steering control

D. The rigid bump stop contact produces a harsh jarring force that may damage the cab contents, loosen cab mounting hardware, and the sudden load transfer may affect the braking force distribution and vehicle stability

103. A trailer's ABS wheel speed sensor has been replaced. The technician must set the sensor air gap. The OEM specification is 0.5 to 1.0 mm. The technician sets the gap at 0.3 mm — tighter than specification. What problem could this tight air gap cause?

A. The sensor may contact the tone ring during wheel rotation from thermal expansion, bearing play, or suspension deflection — the contact will damage the sensor tip and potentially break teeth off the tone ring

B. The tighter air gap will produce a stronger signal voltage than the ABS module expects which could cause the module to misinterpret the signal amplitude as a faster wheel speed than the actual rotation rate

C. The sensor at 0.3 mm will function correctly and the tighter gap actually improves signal quality at low wheel speeds providing better ABS performance during slow-speed braking on slippery surfaces

D. The tighter gap creates a magnetic drag on the tone ring that slows the wheel rotation on that position creating a wheel speed differential that the ABS module may interpret as an impending lockup condition

104. A truck cab equipped with a tilt mechanism has a safety latch that prevents the cab from tilting forward during normal driving. During a PM inspection, the technician tests the safety latch by pulling the release handle — the latch releases with almost no resistance. What does this easy release indicate?

A. The safety latch is functioning correctly and the easy release is the designed operating characteristic that allows the driver to release the latch with minimal effort for frequent engine compartment access

B. The latch mechanism is properly lubricated and the easy release demonstrates good maintenance practices that keep the cab tilt system operating smoothly for efficient servicing of the engine compartment

C. The safety latch return spring has weakened or broken and the latch may not fully engage during driving which could allow the cab to unlatch and tilt forward in the event of a hard braking or collision event

D. The safety latch spring, engagement detent, or the striker alignment has deteriorated — the latch should require significant effort to release indicating it is positively engaged and will hold during driving forces

105. A truck driver reports that the sleeper cab bunk mattress is damp every morning despite no visible water leaks in the cab. The HVAC system is functioning normally. What is the most likely cause of the moisture?

A. The driver's body heat and respiration produce moisture that condenses on the cab's cold wall and ceiling surfaces overnight and drips onto the mattress in the enclosed sleeper compartment during cold weather

B. The cab's sound insulation material behind the wall panels has absorbed moisture from road spray over time and is slowly releasing it into the sleeper compartment through the panel joints during overnight parking

C. The mattress foam material has reached its end of life and is chemically breaking down releasing moisture from the decomposing foam cells that makes the surface damp despite no external water source

D. The HVAC evaporator drain is clogged and the condensate from the A/C operation during the previous day's driving is slowly draining into the sleeper compartment from the HVAC housing during overnight parking

106. A truck cab has excessive road noise that has worsened over the past year. The tires are the correct specification and in good condition. The cab seals appear intact when visually inspected. What should the technician investigate as a source of the gradually increasing noise?

A. The exhaust system for a leak that has developed over the past year producing noise that enters the cab through the floor panels and firewall penetrations as the leak has progressively worsened in size

B. The cab floor insulation and sound-deadening material for deterioration from moisture, age, and vibration that has gradually reduced its noise-attenuation effectiveness allowing more road noise to enter the cab

C. The cab mounting isolators for hardening and compression set that has reduced their vibration-damping capacity allowing more road-induced structural noise to transmit from the frame through the mounts to the cab

D. The alternator for a bearing noise that has gradually worsened over the past year and is transmitting through the engine block and cab mounts to the cab interior where the driver perceives it as road noise

107. A truck's windshield replacement was performed by a mobile glass service. Within one week, the driver reports a wind noise from the windshield area at highway speed that was not present with the old windshield. What is the most probable installation defect?

A. The windshield adhesive was not allowed to cure for the manufacturer-specified time before the vehicle was driven and the partially cured adhesive has shifted from highway wind pressure creating a gap in the seal

B. The replacement windshield glass is a slightly different thickness than the original which changes the glass-to-frame relationship and creates a gap that allows wind noise to enter at highway speed airflow rates

C. The mobile glass service did not properly clean and prime the frame surface before applying the adhesive and the bond has partially failed allowing a section of the windshield perimeter to separate from the frame

D. The replacement windshield is the correct part number but was manufactured at a different factory with slightly different curvature dimensions that create gaps between the glass edge and the cab frame at specific points

108. A truck's cab-over-engine design requires the cab to tilt for engine access. After tilting the cab for an oil change, the technician lowers the cab and the cab tilt warning lamp on the dashboard remains illuminated even though the cab appears to be fully latched. What should the technician check?

A. The cab tilt hydraulic system for a low fluid level that prevents the cab from reaching its fully seated position on the frame even though the latch appears to be engaged from a visual inspection of the mechanism

B. The cab latch sensing switch or its wiring for a fault — the cab may be properly latched but the switch that signals the dashboard lamp may be misadjusted, damaged, or have a faulty electrical connection to the lamp circuit

C. The cab tilt latch mechanism for partial engagement that appears correct visually but has not reached the full-lock position that activates the sensing switch and extinguishes the warning lamp on the dashboard

D. The cab latch switch, the latch mechanism itself, and the cab seating position — the warning lamp indicates the cab is not confirmed in the fully locked driving position and any of these could prevent full engagement confirmation

109. A refrigerated trailer's cargo space temperature is holding steady at the -18°C set-point during highway driving. However, during overnight parking with the TRU running on diesel, the temperature gradually rises to -14°C by morning. The TRU runs continuously overnight. What should be investigated?

- A. The TRU diesel engine for a governor fault that limits the overnight RPM below the level needed to drive the compressor at full capacity during the static no-airflow overnight parking condition
- B. The trailer's insulation value, door seals, and the TRU's overnight cooling capacity — static parking eliminates the ram airflow across the condenser reducing its heat rejection capacity compared to highway driving
- C. The TRU compressor for a valve plate leak that worsens as the compressor heats up during continuous overnight operation and the leak increases the compressor's internal bypass reducing cooling capacity
- D. The trailer cargo for product temperature changes because frozen products that were loaded at -18°C are releasing stored thermal energy overnight that was masked during the day by the highway wind cooling effect

110. A trailer's landing gear crank handle operation has become progressively harder to turn over the past several months. Both legs extend and retract but require significantly more effort than when the landing gear was new. What maintenance has been neglected?

- A. The landing gear internal gear reduction mechanism and the extension sleeve surfaces have not been lubricated and the dry metal-to-metal contact creates progressive friction that makes cranking increasingly difficult
- B. The landing gear foot pads have accumulated asphalt and debris that prevents them from sliding smoothly on the ground surface during deployment adding resistance to the crank handle rotation during operation
- C. The landing gear cross-shaft bearings have worn from service and the shaft wobbles in the housing bores creating a binding condition that progressively worsens as the bearing surfaces deteriorate over time
- D. The landing gear mounting brackets have loosened on the trailer frame and the slight misalignment between the crank mechanism and the leg extension sleeve creates a progressive binding as the brackets shift further

111. A trailer's brake system has been serviced and the brake shoes replaced. After the service, the trailer brakes lock up during the first light brake application. The brake adjustment was set to the manufacturer's specification. What is the most probable cause?

- A. The new brake shoes were installed with the primary (shorter) shoe in the trailing position and the secondary (longer) shoe in the leading position reversing the designed force distribution during braking
- B. The brake shoe return springs were not replaced with the brake shoes and the old weakened springs cannot retract the new shoes from the drum surface after the application pressure is released
- C. The new brake linings have a higher-than-specification friction coefficient that grabs the drum surface aggressively during the initial break-in period before the surfaces conform and the friction stabilizes
- D. The brake drum was not inspected for an out-of-round condition before the new shoes were installed and the drum's irregular surface creates intermittent full-contact that produces aggressive braking behaviour

112. A van trailer's nose (front wall) has developed frost on the interior surface during winter highway driving. The trailer is not refrigerated — it is a standard dry van. What is causing the frost formation?

- A. The trailer's front wall insulation has been damaged by forklift impact and the cold outside air is penetrating through the compromised insulation contacting the warm moist interior air and creating frost
- B. Moisture-laden air entering the trailer through the door seals during loading is freezing on the cold front wall surface because the nose is exposed to direct wind chill from the highway speed airflow during driving
- C. The cargo inside the trailer is releasing moisture (from wet pallets, produce packaging, or hygroscopic materials) that migrates to the coldest surface — the nose — and freezes from the wind chill exposure
- D. The trailer's front wall construction includes a vapour barrier that has failed allowing warm moist air from inside the cargo space to contact the cold outer wall surface where it condenses and freezes during winter driving

113. A trailer's ABS system has been upgraded from a 2S/1M configuration (two sensors, one modulator) to a 4S/2M configuration (four sensors, two modulators). What improvement does the upgraded configuration provide?

A. The 4S/2M system can detect individual wheel speed variations on each axle and modulate each side independently providing better anti-lock control than the 2S/1M system that modulates both sides together

B. The 4S/2M system provides ABS protection on all four wheel positions simultaneously while the 2S/1M system can only protect two wheel positions at a time by alternating between the axles during each braking event

C. The 4S/2M system adds traction control capability to the trailer brakes in addition to anti-lock braking while the 2S/1M system only provides basic anti-lock protection without traction control functionality

D. The 4S/2M system is required for trailers exceeding 15,000 kg gross weight while the 2S/1M system is only certified for trailers below 15,000 kg — the upgrade brings the trailer into compliance with weight regulations

114. A flatbed trailer equipped with winch-type securement devices has one winch that will not hold tension — the strap slowly loosens after being tightened. The ratchet mechanism appears to engage but does not hold. What is the most likely cause?

A. The ratchet gear teeth are worn and the pawl cannot engage deeply enough to prevent reverse rotation under the load tension creating a gradual release that allows the strap to slowly loosen during transport

B. The winch drum has expanded from heat exposure and the ratchet pawl's engagement depth is reduced by the drum's increased diameter preventing positive anti-reverse locking under load tension conditions

C. The securement strap has stretched beyond its elastic limit and the reduced tension spring-back force is insufficient to maintain the ratchet in the engaged position against the strap's reduced tensioning load

D. The ratchet pawl, its spring, or the engagement teeth on the winch drum are worn, damaged, or contaminated with debris preventing the pawl from fully seating into the anti-reverse teeth to hold the tension

115. A trailer's electrical system has a 15-amp fuse for the interior cargo light circuit. The cargo lights draw 12 amps total. A technician installs additional LED work lights inside the trailer that draw 5 amps. The total circuit load is now 17 amps. What must be done?

A. Upgrade the circuit fuse to 20 amps and verify the existing wiring gauge is rated for the increased 17-amp load — if the wiring is undersized it must be upgraded to prevent overheating under the higher current

B. The additional LED lights must be wired on a separate dedicated circuit with its own fuse rated for the LED load to avoid overloading the existing cargo light circuit beyond its 15-amp fuse protection capacity

C. Install a 25-amp fuse to provide adequate overhead for the combined 17-amp load plus a safety margin for the inrush current of the LED drivers during initial power-on of the additional LED work light fixtures

D. The LED lights can be connected to the existing circuit without changes because LED lights draw constant current without inrush and the 15-amp fuse will handle the 17-amp load within its built-in overload tolerance

116. A trailer equipped with a hydraulic liftgate has the liftgate platform rise unevenly — the left side rises approximately 100 mm higher than the right side when the raise function is activated. Both cylinders appear to extend. What systematic approach should the technician use to diagnose this complaint?

A. Compare the extension rate of each cylinder by disconnecting them individually and observing their speed under no load to determine if one cylinder is receiving less flow than the other from the directional valve

B. Measure the hydraulic pressure at each cylinder's supply port during the raise operation to determine if the pressure is equal at both cylinders or if one is receiving less pressure due to a line restriction or valve fault

C. Check both cylinders for internal leakage, verify that both supply lines are unrestricted and equal in diameter, and inspect the directional valve for an internal bias that delivers unequal flow to the two cylinder circuits

D. Replace both liftgate cylinders with new matched units because the uneven rise indicates the existing cylinders have different internal conditions from wear that cannot be equalized through any external adjustment

117. A truck's A/C system has adequate cooling at all times except during long idle periods in hot weather. After 15 minutes of idling in 35°C ambient heat, the outlet air temperature rises from 5°C to 15°C. What is the most likely cause?

A. The engine cooling fan is not engaging at idle which reduces the airflow across the A/C condenser that is mounted directly in front of the radiator — without fan airflow the condenser cannot reject heat efficiently at idle

B. The A/C compressor clutch is slipping at the lower idle RPM because the belt tension is insufficient for the compressor load at idle speed reducing the compressor's effective displacement and cooling output

C. The evaporator core has developed a partial ice blockage from the extended operation at maximum cooling and the accumulated ice restricts airflow across the coil reducing the heat transfer and raising outlet temperature

D. The refrigerant charge is marginally low and the reduced flow rate at the compressor's lower idle RPM speed drops the suction pressure below the evaporator's optimal operating range reducing cooling performance

118. A truck's HVAC system has a complaint of a clicking or tapping noise behind the dashboard that occurs approximately every 30 seconds. The noise is present regardless of the HVAC mode or temperature setting. The A/C and heater function normally. What is the most likely source?

A. The blower motor has a loose fan blade that contacts the housing during each revolution creating a tapping noise at a frequency corresponding to the blower speed and the blade's eccentric orbit path around the housing

B. The HVAC mode door or blend door actuator motor is continuously hunting for its commanded position — the motor advances, overshoots, reverses, and repeats creating the clicking noise at regular intervals

C. The evaporator has developed a refrigerant flow restriction that causes the expansion valve to cycle open and closed at 30-second intervals producing a clicking sound as the valve snaps between positions

D. The cabin air filter housing has a loose retaining clip that vibrates against the housing with each engine firing pulse creating a tapping noise that is transmitted through the ductwork to the dashboard vents

119. A truck's A/C system has been diagnosed with a compressor that has failed from lack of lubrication. The system is contaminated with metallic debris from the disintegrated compressor bearings. What components must be replaced or cleaned in addition to the compressor?

A. The receiver/dryer, the condenser, the expansion valve, and the evaporator must be flushed or replaced — the metallic contamination circulates through the entire system and will destroy the new compressor if not removed

B. Only the receiver/dryer needs to be replaced because its internal filter screen will capture the metallic debris and prevent it from reaching the new compressor after the system is recharged and operated normally

C. The expansion valve and the receiver/dryer must be replaced but the condenser and evaporator can be flushed with approved refrigerant system flushing solvent to remove the metallic debris without replacement

D. The entire refrigerant circuit must be replaced including all hoses and hard lines because metallic particles embed in the rubber inner liner of the hoses and cannot be flushed out effectively for long-term contamination prevention

120. A truck's cab heater produces adequate heat but a strong coolant odour is present inside the cab when the heater is operating. There is no visible coolant leak inside the cab, no wet spots on the floor, and no film on the inside of the windshield. What could cause the odour without visible leak evidence?

A. The coolant overflow bottle is near the cab's fresh air intake and the coolant fumes from the hot overflow bottle are being drawn into the HVAC system through the fresh air inlet during normal driving operation

B. The heater hose connections at the firewall are seeping coolant that vaporizes immediately on the hot engine surface and the vapour enters the cab through the firewall grommets or HVAC fresh air intake opening

C. The heater core has a very small seep that vaporizes on the hot core surface before it can form droplets — the coolant vapour enters the cab air stream through the HVAC system without leaving visible liquid residue

D. The engine's coolant overflow bottle has been overfilled and the expanding coolant pushes past the cap during operation creating vapour that enters the cab through the HVAC system's fresh air intake opening

121. An A/C system has been evacuated and the technician notices the vacuum pump oil has turned milky white after pumping the system down. What does this indicate?

A. The vacuum pump has failed internally and is mixing its own lubricating oil with the refrigerant vapour being evacuated from the A/C system creating the milky appearance from the incompatible fluid mixture

B. The A/C system contained a significant amount of moisture that was extracted during the evacuation and the water condensed in the vacuum pump oil as it was drawn through the pump during the vacuum process

C. The refrigerant recovered from the system was contaminated with a different refrigerant type and the chemical reaction between the two refrigerants and the pump oil produced the milky discoloration in the pump

D. The vacuum pump oil needs to be changed at its regular maintenance interval and the milky appearance is a normal characteristic of aged vacuum pump oil that has reached the end of its service life from use

122. A truck's auxiliary coolant heater (Webasto-type) starts and runs for 10 minutes then shuts down with a fault code for "high temperature limit exceeded." The heater restarts after a 5-minute cool-down. The combustion appears normal and the exhaust is clear. What is the most probable cause?

A. The heater's internal temperature sensor has drifted from its calibration and is reading higher-than-actual temperatures which triggers the high-temperature shutdown prematurely during normal operation

B. The auxiliary coolant circulation pump has failed or is running at reduced speed and the heated coolant is not being circulated away from the heater fast enough causing the heater's outlet temperature to spike

C. The heater's combustion air fan is running at excessive speed creating a richer-than-designed combustion mixture that produces higher flame temperatures exceeding the heat exchanger's design temperature limit

D. The coolant circuit has an airlock that prevents coolant from flowing through the heater's heat exchanger — the heater combustion operates normally but the heat cannot be carried away by the stagnant coolant

123. A truck's A/C system has been recharged to the correct specification. The cooling performance is adequate but the compressor is noticeably louder than before the service. The noise is a continuous rhythmic thumping synchronized with the compressor shaft rotation. What is the most probable cause?

A. The compressor was over-oiled during the recharge and the excess oil is being compressed in the cylinder head during each compression stroke creating a liquid-hammer thumping noise with each revolution

B. The compressor clutch air gap has widened from wear and the clutch engagement is marginal creating a slap or thump with each revolution as the clutch alternately grips and releases on the pulley surface

C. The new refrigerant charge has a slightly different molecular weight than the old charge from a different manufacturer which changes the compression characteristics and produces a different acoustic signature

D. A refrigerant overcharge has flooded the evaporator and liquid refrigerant is being drawn into the compressor suction creating a liquid slugging condition that thumps with each piston stroke as it compresses liquid

124. A hydraulic system on a truck-mounted crane has developed erratic boom movement — the boom jerks and hesitates during extension rather than moving smoothly. The pump flow is adequate and the system pressure is normal. The hydraulic fluid level is correct. What should be investigated?

A. The boom cylinder piston seals for intermittent leakage that alternately holds and releases pressure causing the boom to move in jerky increments rather than smoothly during the extension operation

B. The load-sensing circuit for a contaminated or sticking compensator valve that intermittently adjusts the pump displacement creating flow variations that manifest as jerky boom movement during extension

C. The directional control valve spool for contamination in the bore that causes the spool to stick and release intermittently as it moves through its stroke creating inconsistent flow delivery to the boom cylinder

D. The counterbalance valve on the boom circuit for an incorrect pilot ratio setting that causes the valve to hunt (open-close-open) as the boom load varies during extension creating the jerky movement pattern

125. A dump truck's hydraulic pump has been rebuilt. After installation, the system operates normally for the first hour and then the pump begins making a loud knocking noise. The oil level is correct and the oil is clean. The technician checks the pump inlet and finds the suction strainer is clean. What else could cause the knocking after one hour of operation?

- A. The pump's internal relief valve has a foreign object lodged under the seat that intermittently blocks and unblocks with each pump revolution creating a rhythmic pressure spike that sounds like knocking
- B. The rebuilt pump's internal bearings are failing prematurely from an assembly defect and the knocking is from the damaged bearing surfaces impacting as the pump shaft rotates under the system load conditions
- C. The hydraulic fluid temperature has risen after one hour of operation to a point where the reduced viscosity allows the pump to cavitate at the inlet creating the knocking noise from collapsing vapour bubbles
- D. The pump's inlet check valve is not seating properly after the rebuild and at operating temperature the reduced oil viscosity allows air to enter the pump through the check valve seat during each suction stroke

126. A hydraulic system has a cylinder that extends at the correct speed and force but retracts at approximately 60% of the expected speed even though the system pressure reads the same in both directions. What is the most likely cause?

- A. The rod-end port fitting or hose has a smaller internal diameter than the cap-end port which restricts the flow rate entering the rod-end chamber during retraction while the cap-end receives unrestricted flow
- B. The directional control valve's spool is not shifting fully to the retract position and the partially opened work port creates a restriction that limits the flow rate to the rod-end during retraction operation
- C. The cylinder rod seal has increased friction from ageing and the additional resistance slows the retraction stroke compared to the extension stroke where the larger piston area overcomes the seal friction
- D. This is normal operation — the rod-end effective area is smaller than the cap-end area so the same flow rate fills the smaller rod-end volume faster but the piston moves at a slower speed during retraction

127. A PTO-driven hydraulic system has been operating at elevated temperatures for several weeks. Oil analysis shows the acid number has increased significantly above the baseline for new oil. What does the elevated acid number indicate?

A. The hydraulic fluid has oxidized from the prolonged elevated temperature and the oxidation byproducts have formed acids that attack metal surfaces, degrade seals, and produce varnish and sludge in the system

B. The hydraulic fluid was inadvertently mixed with engine coolant that leaked through a shared heat exchanger and the ethylene glycol in the coolant has reacted with the hydraulic fluid to produce acidic compounds

C. The hydraulic fluid additive package has been depleted from the extended high-temperature operation and the base oil is reverting to its natural acidic state as the alkaline additives are consumed by neutralization

D. Water contamination in the hydraulic fluid has promoted bacterial growth and the bacteria are producing organic acids as metabolic byproducts that elevate the oil's acid number above the normal baseline value

128. A hydraulic system uses a proportional directional control valve that provides variable flow to a boom cylinder based on the operator's joystick input. The operator reports that the boom speed does not respond proportionally — it either moves at full speed or not at all with no intermediate speed control. What has failed?

A. The proportional solenoid on the directional valve or its driver circuit has a fault and the solenoid can only achieve full stroke or zero stroke rather than the proportional intermediate positions needed for speed control

B. The joystick potentiometer has failed and is sending only minimum or maximum voltage signals to the valve controller rather than the proportional voltage sweep needed for smooth speed variation control

C. The valve spool's proportional orifice has been contaminated with debris that prevents the spool from positioning at intermediate openings — it either bypasses the contamination at full stroke or blocks entirely at rest

D. The hydraulic pump's load-sensing compensator has failed and is delivering either full displacement or zero displacement instead of the proportional displacement needed to match the valve's commanded flow rate

129. A hydraulic liftgate system has adequate lifting force but the platform descends too slowly when the lower function is activated. The lowering speed valve (needle valve) is fully open. What else could restrict the lowering speed?

A. The check valve in the raise circuit is not opening to allow oil to flow from the cylinder back to the reservoir during the lowering operation and the restricted path forces the oil through an alternative bypass route

B. The return line filter element is severely restricted from contamination and the increased backpressure on the return circuit slows the flow rate from the lowering cylinder to the reservoir during descent

C. The cylinder rod seals have excessive friction from age and hardening that resists the piston movement during retraction requiring more force than the platform's gravity provides to overcome the seal drag

D. The hydraulic pump motor is running in reverse during the lower function which creates a small resistance to oil flow through the pump's internal passages instead of providing a free-flow return path to the tank

130. A hydraulic system's accumulator is being pre-charged with nitrogen. The technician charges the bladder to 12,000 kPa per the specification. After connecting the hydraulic system and cycling the circuit several times, the technician rechecks the nitrogen pre-charge with the hydraulic pressure at zero. The reading now shows 11,200 kPa. What explains the 800 kPa decrease?

A. The accumulator bladder has a slow leak and the nitrogen is escaping through a pinhole in the bladder material at a rate that produces the 800 kPa drop during the short period of hydraulic cycling and rechecking

B. The nitrogen gas has compressed permanently from the hydraulic pressure and the pre-charge will not recover to the original 12,000 kPa setting without adding additional nitrogen to restore the original volume

C. The accumulator's gas valve (charging valve) has a slow leak at the valve stem seal that allows nitrogen to escape during the hydraulic cycling period and the lost nitrogen reduces the pre-charge pressure reading

D. The nitrogen gas temperature has dropped from the expansion cooling effect during the hydraulic cycling and the cooler gas occupies less volume at the lower temperature producing a lower pressure reading

131. A truck-mounted hydraulic system has a manual directional control valve with two spool sections — one for the boom and one for the winch. When the operator activates the boom section, the winch also moves slightly. The valve is an open-centre tandem design. What is the most likely cause?

A. The tandem-centre valve's internal passages allow a small amount of pressurized oil to cross from the active boom section to the inactive winch section through the interconnected centre gallery passages during operation

B. The winch cylinder has an external hose leak at the cylinder port fitting that allows a small amount of atmospheric air to enter the cylinder during boom operation and the air displacement moves the winch piston slightly

C. The valve body has an internal casting defect (porosity) between the boom section and the winch section that allows a small amount of pressurized oil to cross from one section to the other during boom activation

D. The boom and winch circuits share a common return line and the flow restriction in the return creates enough backpressure during boom operation to push a small amount of oil into the winch cylinder through its return port

132. A battery-electric truck has a complaint that the vehicle's range varies significantly between summer and winter operation — the winter range is approximately 30% less than summer. The battery SOH is verified at 95%. What is the primary cause of this seasonal range variation?

A. The tire rolling resistance increases in cold weather from the harder rubber compound becoming less flexible which requires more energy from the battery to maintain the same vehicle speed during winter driving

B. The vehicle's aerodynamic drag increases in cold winter air because cold air is denser than warm summer air and the higher density increases the aerodynamic force the motor must overcome during highway driving

C. The battery cells operate less efficiently at cold temperatures due to increased internal resistance, and the cabin heating system draws significant electrical energy from the battery that reduces the available driving range

D. The regenerative braking system recovers less energy in winter because the cold brake rotors and pads generate more friction than warm components and the ABS activates more frequently on winter road surfaces

133. A hybrid truck's high-voltage battery pack is being removed for service. The technician has de-energized the system, verified zero voltage, and is preparing to disconnect the high-voltage cables from the battery pack. What additional precaution must be taken when physically lifting the battery pack out of the vehicle?

A. The battery pack must be kept level during removal because tilting it beyond 15 degrees from horizontal can cause electrolyte to leak from the cell vent caps and contaminate the vehicle's frame and undercarriage

B. The battery pack must be lifted using insulated rigging (nylon slings, not metal chains) and the lifting equipment must be rated for the pack's significant weight which can range from 200 to over 1,000 kg for commercial vehicles

C. The battery pack must be immediately placed in a fireproof containment vessel after removal because the mechanical shock of removal may trigger delayed thermal runaway even after the system has been verified at zero voltage

D. The battery pack must be wrapped in anti-static material before lifting because the mechanical vibration of the removal process can generate static electricity on the pack's surface that could discharge into the cells

134. A battery-electric truck's onboard charger displays a "ground fault detected" warning and will not begin a charging session when plugged into a Level 2 AC charging station. The charging station functions normally with other vehicles. What vehicle-side condition could trigger this fault?

A. The vehicle's 12-volt auxiliary battery is deeply discharged preventing the onboard charger from powering its internal control circuit which responds by displaying the ground fault message as a default error state

B. The high-voltage battery pack's insulation resistance has dropped below the minimum threshold — moisture intrusion, damaged cable insulation, or a compromised connector has reduced the HV-to-chassis isolation

C. The onboard charger's internal cooling fan has failed and the charger's thermal protection circuit prevents the charging session from starting to avoid overheating and displays the ground fault message incorrectly

D. The vehicle's CCS charging connector has a damaged pin that creates a high-resistance connection which the charger's ground fault detection circuit interprets as an insulation fault preventing the charging session

135. A parallel hybrid truck's electric motor provides regenerative braking force during deceleration. The driver reports that the regenerative braking force has suddenly decreased to near zero. The battery SOC is at 50%, cell temperatures are normal, and no fault codes are stored. What should the technician investigate?

- A. The inverter's power stage for a partial failure that limits the current flow from the motor (acting as generator) to the battery — a failed phase reduces the regenerative capacity by one-third without setting a fault code immediately
- B. The friction brake system for a fault that is overriding the regenerative system — if the ABS detects a wheel speed anomaly it may reduce regen to prevent drive axle lockup during deceleration events
- C. The traction motor's temperature sensor for a false high reading that causes the PCS to limit regen to protect the motor from perceived overheating even though the actual motor temperature is within normal range
- D. The motor bearings for increased friction that creates a drag force opposing the regenerative generation and absorbing the braking energy as heat rather than converting it to electrical energy for battery charging

Practice Exam 8: Answer Key and Explanations

1. C — A collision-damaged fuel tank may have micro-cracks or weakened seams that release flammable vapours when the tank is disturbed during removal. Disconnecting the battery cables eliminates potential ignition sources from electrical arcing, and ensuring no other ignition sources are present (grinders, torches, running engines nearby) protects against fire or explosion.
2. A — The primary safety purpose of tool control is preventing tools from being left inside, on, or under a vehicle after service. A forgotten wrench on an engine can fall into the fan or belt, a socket left on a frame rail can short a battery cable, and tools left on a cab roof can fall onto following traffic — all creating serious safety hazards.
3. B — A steering column universal joint with noticeable play is a safety defect that affects the vehicle's steering response and control. The technician must document the finding on the work order, notify the fleet manager, and recommend the vehicle not be dispatched until the defect is corrected. Steering defects should never be deferred.
4. D — A hot work permit ensures a formal risk assessment is completed before any flame-producing activity begins. The permit verifies that flammable materials have been removed from the area, fire suppression equipment is immediately available, and a trained fire watch person is assigned to monitor for ignition during and after the hot work.

5. C — A 250 kg transmission must be lifted mechanically — never manually. The floor crane (engine hoist) with a rated sling or chain provides controlled, safe lifting within the crane's capacity. Manual lifting of 250 kg risks severe back injury, and improvised sliding methods risk uncontrolled movement that can crush hands or feet.

6. A — PTO shafts rotate at high speed (typically 500 to 1,000 RPM) with enormous torque. Any contact with clothing, hair, jewelry, or body parts results in instantaneous entanglement. The shaft wraps the material so fast that the human reaction time is inadequate to pull away. PTO entanglement injuries are almost always severe, frequently fatal.

7. D — Exposed conductors on an extension cord create two immediate hazards: electrocution (the technician can contact the live conductor, especially in the confined metal environment of a truck cab) and fire (the exposed conductor can arc against the truck's metal surfaces, igniting insulation, upholstery, or accumulated grease and debris).

8. B — The top of the ring travel area experiences the most wear because the piston rings reverse direction at TDC under the highest combustion loads. The bottom of ring travel experiences the least wear. Measuring at both locations captures the maximum diameter (top, most worn) and minimum diameter (bottom, least worn) to calculate liner taper.

9. A — Repeated bolt failure at the same location despite correct grade and torque indicates the sealing surface is not flat. A warped exhaust manifold creates uneven clamping — some bolts carry excessive load while others are unloaded. The overloaded bolts cycle between thermal expansion (tension) and contraction (relaxation) until they fatigue and break.

10. C — If the VGT vanes open too far at full load, they reduce the exhaust gas velocity across the turbine. While boost may still reach specification through increased mass flow at full load, the reduced exhaust restriction allows combustion gases to exit the cylinders more rapidly, carrying more thermal energy into the exhaust stream and raising the EGT.

11. D — Before diagnosing internal engine wear from elevated crankcase pressure, the crankcase ventilation system must be verified as unrestricted. A plugged CCV filter, frozen breather tube (common in Canadian winters), or blocked vent line prevents normal crankcase gas escape. The trapped gases build pressure that mimics ring wear symptoms.

12. B — The replacement radiator may have fewer tubes, smaller tube diameter, thinner fins, or a smaller overall frontal area than the original. These differences reduce the radiator's heat rejection capacity below what is needed for sustained heavy-load operation (grade climbing), even though the reduced capacity is adequate for normal highway cruise conditions.

13. A — Excessive crankshaft end play allows the crankshaft to shuttle axially under the forces of clutch engagement, converter loading, and accessory drive belt tension. This repetitive axial movement concentrates wear on the thrust bearing flanges. A properly sized thrust bearing controls end play within specification and distributes the axial load evenly.

14. D — The DEF pump pressure is adequate and the scan tool commands the valve open, but no flow increase occurs. The dosing valve nozzle is clogged with crystallized urea deposits that have blocked the orifice. DEF crystallizes when exposed to heat (from the exhaust) after the engine is shut down, and repeated cycles build up deposits that eventually block the nozzle completely.

15. C — A single loud knock during cold start that disappears within 30 seconds and does not set fault codes is consistent with an incorrect injector calibration code. The ECM applies the wrong cold-start fuel correction for that cylinder based on the stored code, momentarily over-fuelling it and producing a detonation event until the cold-start enrichment period ends.

16. B — Opening the water separator drain valve introduces air into the fuel supply circuit. The air bubble travels through the fuel lines and disrupts fuel delivery to the injection system, causing the hesitation under load. Bleeding the air from the fuel system by operating the priming pump and cracking the injector fittings restores normal fuel delivery.

17. A — After replacing the turbocharger, pressure-testing the charge air cooler, and verifying all piping clamps, the air filter is the remaining component in the intake path that could restrict airflow. A partially restricted air filter limits the air volume available at the turbocharger compressor inlet, preventing the compressor from achieving its full rated boost output.

18. D — The DPF was recently cleaned (so it should be clear) but the fault code says it is loaded. If the DPF is actually clear, the differential pressure reading is wrong. The DP sensor or its connecting tubes are the most likely cause — soot-plugged tubes, moisture in the lines, or a failed sensor produce false high readings that trigger the fault code.

19. C — After resurfacing the head and reinstalling it, an exhaust-side leak between cylinders suggests the sealing surface is not uniform. The most probable cause is the block deck surface — if it was not checked for flatness before the head was reinstalled, a localized high spot or warpage on the block creates a gap that the gasket cannot bridge at the leak location.

20. B — With the charge air cooler outlet boot disconnected, all compressed air from the turbocharger escapes to atmosphere before reaching the intake manifold. The engine operates on atmospheric air pressure only — losing the 150 to 250 kPa of boost that normally forces additional air into the cylinders. The reduced air charge cannot support full fuelling, producing black smoke from the rich mixture.

21. A — One truck consistently producing 40% higher iron than identical fleet trucks in identical conditions points to a truck-specific contamination source. A subtle air filtration leak — a cracked boot, loose clamp, or damaged air cleaner housing — allows a small amount of unfiltered abrasive dust to enter the engine, consistently accelerating wear across all iron-containing internal components.

22. C — A deteriorating crankshaft vibration damper allows the crankshaft to oscillate at its natural torsional frequency during idle. This oscillation transmits through the engine block to the cab as a perceived roughness. The combustion events themselves are balanced (confirmed by injector contribution data), but the crankshaft's torsional movement creates the vibration the driver feels.

23. C — DEF (32.5% urea solution) has a eutectic freezing point of approximately -11°C (12°F). This is an important specification because DEF systems operating in Canadian winters must include a tank heater and heated supply lines to prevent freezing. The -11°C freeze point is significantly higher than engine coolant, making freeze protection critical.

24. B — Injector 2 returns 85 ml/min while all others return 30-35 ml/min. The excessive return represents fuel that is bypassing the injector's internal components and flowing to the return circuit instead of being injected. This fuel loss reduces the fuel rail pressure for all six cylinders because the high-pressure pump must replace the leaked volume, causing system-wide low power.

25. D — The injector calibration codes correct for individual manufacturing variations in each injector's fuel delivery quantity. Running with the old codes means the ECM applies correction factors that do not match the new injectors' actual characteristics. The result is unbalanced fuelling across cylinders, potentially rough idle, elevated emissions, and fault codes.

26. B — Injector calibration codes compensate for manufacturing variations so the ECM equalizes fuel delivery across all cylinders. Running without updating the codes for new injectors causes the ECM to apply incorrect corrections, potentially causing rough running and elevated emissions.

27. C — A resonance condition exists when a component's natural vibration frequency matches an excitation frequency. At 1,400 RPM, the engine's firing frequency (which depends on the number of cylinders and the RPM) coincides with a component's natural frequency — a deteriorating vibration damper, loose bracket, worn mount, or structural resonance — amplifying the vibration at that specific speed only.

28. D — In a relative compression (cranking RPM variation) test, each cylinder's compression resistance slows the crankshaft during its compression stroke. Lower compression on cylinder 6 offers less resistance, so the starter accelerates the crankshaft faster at that position. The higher momentary RPM on cylinder 6 indicates it has less compression than the other five cylinders.

29. A — The oil-soot mixture from crankcase ventilation gases coats the intake ports and valve stems, reducing the effective cross-sectional area of the intake passages. This restriction limits airflow to the cylinders, reducing volumetric efficiency (the percentage of theoretical air charge the cylinder actually receives), which decreases engine power and increases emissions.

30. C — A remanufactured compressor may have worn cylinder bore tolerances that allow more engine oil to pass the piston rings into the compressed air discharge. This excess oil carry-over saturates the air dryer desiccant faster than the purge cycle can regenerate it, requiring more frequent purge cycles to maintain the desiccant's moisture absorption capacity.

31. A — The service signal must travel a significantly longer path from the foot valve to the trailer brakes than from the foot valve to the tractor brakes. The signal travels through tractor plumbing, through the gladhand connection, through trailer plumbing to the relay valve, and then from the relay to the chambers. This cumulative pneumatic distance creates an inherent signal propagation delay.

32. B — After overnight parking, the exposed drum surface develops a thin layer of surface rust from moisture in the air. On the first brake application, the brake linings break through this rust layer with a characteristic snapping or popping sound as the rust bonds between the lining and drum surface are broken. Once cleared, subsequent applications are smooth.

33. C — During normal braking, the vehicle's weight transfers forward from deceleration (Newton's first law — the body in motion resists the deceleration force). This dynamic weight transfer loads the front axle more heavily, causing the front brakes to absorb more kinetic energy and generate more heat. This is normal physics, not a proportioning problem.

34. C — The check valve between the compressor and the supply tank is in the closed position, blocking all compressed air from reaching the downstream system. The compressor builds pressure between itself and the closed valve, but no air passes through to the supply tank. The vehicle's air gauges remain at zero because no air reaches the reservoirs.

35. B — Incorrect brake pad retention allows the pads to shift or cock in the caliper bracket during braking. If the pads move out of their designed position, the contact area between the pad and rotor changes — reducing the effective braking force on the right side. The left side, with correct retention, provides full force, creating the pull during braking.

36. A — Petroleum-based oil attacks and degrades rubber components throughout the air system. Brake chamber diaphragms, valve seals and O-rings, air bag rubber bellows, and air dryer desiccant beds are all damaged by oil contact. The rubber swells, softens, and eventually fails — causing leaks, valve malfunctions, and component failures throughout the brake and suspension systems.

37. B — The ABS module must be reconfigured or reprogrammed to match the trailer's actual axle count and sensor/modulator configuration. Operating with an incorrect axle count configuration means the ABS cannot correctly modulate all wheel positions and may provide incomplete anti-lock protection on the unconfigured axle positions.

38. A — ATC controls wheel spin through two primary actions: it applies the brake on the spinning wheel (which transfers torque to the wheel with traction through the differential's torque-biasing effect) and may simultaneously reduce engine torque (by communicating with the engine ECM over the CAN bus to limit fuel delivery and reduce the drive force at the wheels).

39. C — Disc brakes on the steer axle provide more consistent braking force across a wider temperature range, better fade resistance during repeated or sustained braking, and more predictable brake response characteristics. These qualities are critical for the steer axle because predictable front brake performance is essential for maintaining directional control during emergency braking.

40. A — The air dryer purge valve has a worn piston seal that cannot fully close the valve seat after each moisture ejection cycle. The valve remains partially open, allowing a continuous small air leak from the supply tank. While the leak may be small enough that the compressor compensates during normal operation, it constitutes continuous air loss.

41. B — Most trailer ABS systems communicate fault codes through a flashing lamp pattern. The technician counts the number of flashes in each sequence to identify the specific fault code being reported. A steady lamp typically indicates a general ABS fault, while a flashing pattern conveys a specific diagnostic code for the particular fault condition detected.

42. D — The spring brake chamber on that specific wheel has an internal restriction, a damaged diaphragm, or a weakened spring that prevents it from fully compressing when supply air is delivered. Air reaches the chamber (the system is pressurized) but the chamber cannot convert the air pressure into the mechanical force needed to fully compress the spring.

43. A — The air-over-hydraulic booster uses a hydraulic circuit with its own fluid reservoir. Low fluid can indicate external leaks at the caliper, lines, or booster, internal booster seal leakage, or simply normal pad wear that has caused the caliper pistons to extend further and displace more fluid from the reservoir.

44. B — The maximum allowable pressure drop for a straight truck (no trailer) with brakes applied is 28 kPa (4 psi) per minute. The measured drop of 24 kPa (3.5 psi) per minute is below this threshold. The vehicle passes the applied-brake leak rate portion of the pre-trip air brake test.

45. B — The quick-release valve's purpose is to exhaust application air locally at the brake chambers for rapid brake release. A contaminated or damaged valve seat or diaphragm cannot open properly to vent the air. The brake chamber air must travel the long return path through the supply lines, significantly slowing the release compared to the designed rapid local exhaust.

46. D — The trailer spring brake relay valve or the spring brake circuit has a fault that prevents supply air from reaching the spring brake chambers. Even though the supply pressure shows correct on the gauge (the supply reservoir is full), a stuck valve, blocked line, or frozen fitting between the relay and the spring chambers prevents the air from reaching and releasing the springs.

47. C — The scan tool confirms the ECM is reading and broadcasting the correct oil pressure (310 kPa) on the CAN bus. Since the data is correct at the source (ECM), the fault must be at the display end — the instrument cluster's oil pressure gauge stepper motor or its internal driver circuitry has failed specifically for the oil pressure gauge while all other gauge drivers work normally.

48. B — The turn signals flash correctly (using the turn signal flasher circuit) but the hazard flashers do not function. On many commercial vehicles, the hazard and turn signal circuits use separate flasher modules. The LED conversion's reduced current draw has affected the hazard flasher's thermal element or electronic detection while the turn signal flasher operates on a different circuit path.

49. A — An alternator's output is demand-driven — the voltage regulator adjusts the field current to produce only the current needed by the loads and battery charging at any moment. At 130 amps, the alternator is meeting the current demand. Testing at full output requires applying a carbon pile load or maximum accessory load to verify the alternator can reach its 160-amp rating.

50. D — FMI 14 (special instructions) means the fault code requires manufacturer-specific service information for proper interpretation. The SPN and FMI combination has a meaning defined by the specific module manufacturer that cannot be determined from the generic J1939 FMI definitions. The technician must consult the manufacturer's service literature.

51. D — The tractor is not connected to a trailer, so no trailer wiring should be completing a circuit. However, moisture intrusion in the seven-pin socket creates conductive paths between the powered pins (marker, tail, ABS power) and the ground pin. The wet contamination acts as a resistor allowing continuous current to flow and drain the battery through the corroded, moist socket.

52. A — In a parallel battery configuration, a battery with lower internal resistance accepts more current during charging and delivers more current during discharge. The hotter battery has lower resistance and is doing a disproportionate share of the electrical work — accepting more charging current and delivering more load current — which generates more internal heat from the higher current flow.

53. B — FMI 8 (abnormal frequency, period, or pulse width) means the sensor is producing pulses but their characteristics don't match the expected pattern. The CKP sensor may detect the correct number of teeth but the pulse width, amplitude, or spacing is inconsistent — from a damaged reluctor tooth, an intermittent air gap variation, or a cracked tone ring.

54. D — Automatic headlamp leveling systems use suspension height sensors on the front and rear axles to measure the vehicle's pitch angle. When the rear suspension compresses from loading, the sensors detect the change and the leveling controller tilts the headlamp assemblies downward to compensate and maintain the correct beam pattern on the road surface.

55. A — The intermittent wiper timing circuit often routes its ground connection through the park switch assembly. If the ground was not reconnected during the park switch replacement, the intermittent timer circuit loses its ground return path and cannot complete the timing cycle that triggers each intermittent sweep — the wipers sweep once and stop.

56. C — The keep-alive memory wire maintains power to the ECM's volatile memory storage during key-off periods. An open circuit in this wire causes the ECM to lose adaptive fuel trim values, learned idle parameters, trip data, and maintenance counters. The calibration file and injector codes are stored in non-volatile memory and are retained.

57. B — Two halogen lamps: $2 \times 55\text{W} = 110\text{W} \div 12\text{V} = 9.17\text{A}$. Two LED lamps: $2 \times 35\text{W} = 70\text{W} \div 12\text{V} = 5.83\text{A}$. Difference: $9.17 - 5.83 = 3.34\text{A} \approx 3.3$ amps reduction. The LED conversion saves approximately 3.3 amps on the low-beam circuit, reducing the electrical load on the alternator and wiring.

58. B — The brake light switch opens correctly (confirming the input signal is correct) but the body controller's output driver remains energized. The internal output driver circuit — typically a MOSFET or relay driver — has failed in the on state and continues to power the brake lamp output regardless of the switch input signal state.

59. A — The starter drive gear or the flywheel ring gear has damaged, worn, or chipped teeth at the engagement point. When the solenoid pushes the drive gear into the ring gear, the damaged teeth cannot mesh smoothly and produce a grinding noise during the initial engagement before the motor begins rotating and the teeth find their mesh.

60. C — Both belts are tight and Alternator 1 produces the correct voltage. Alternator 2's low output (12.8V) points to its voltage regulation system. The voltage regulator or the field circuit (connector, wiring, or brushes) is limiting the field current below the level needed for the alternator to produce its rated output voltage.

61. B — The gateway module translates data between the J1939 powertrain CAN bus and the body CAN bus. Without the gateway, engine data (temperature, oil pressure, RPM, vehicle speed) from the J1939 bus cannot reach the instrument cluster on the body CAN bus. The engine operates normally because the ECM and TCM communicate directly on J1939.

62. D — FMI 14 requires manufacturer-specific diagnostic procedures. The sensor appears to function correctly by external measurement (smooth sweep, correct voltage range), so the fault is not detectable through standard electrical testing. The manufacturer's service information will define the specific condition and procedure for this code.

63. A — The pump outlet tests at 455 kPa and the rail shows 420 kPa — a 35 kPa drop. This pressure loss occurs in the fuel delivery path between the pump and the rail. Every fitting, hose connection, filter, and coupling in this path contributes some flow resistance. The cumulative pressure drop of 30-35 kPa through these components under normal flow conditions is typical.

64. B — The batteries pass the conductance test (which measures the battery's plate condition and remaining capacity) but the actual CCA capacity has decreased from aging. Conductance testing can indicate a "good" battery that still has reduced cranking capability compared to when it was new. The aging batteries require slightly longer cranking time during cold first starts.

65. C — The CAN bus should read approximately 60 ohms (two 120-ohm resistors in parallel: $120 \times 120 \div (120 + 120) = 60$ ohms). A reading of 40 ohms means an additional parallel resistance path exists — either a partial short between CAN-H and CAN-L from damaged insulation, or a third resistance source is connected to the bus through a faulty module or aftermarket device.

66. B — The fuse must protect the weakest component in the circuit. With a 15-amp socket and a 20-amp fuse, a load drawing 15-20 amps would overheat the socket but would not blow the fuse. The fuse must be replaced with a 15-amp unit to ensure the socket is protected from loads exceeding its rated capacity.

67. A — The coolant level is verified full but the sensor reads low. The sensor probe detects coolant through direct contact — if the probe surface is coated with scale, additive deposits, or debris, it is insulated from the coolant and cannot detect its presence. Cleaning the sensor probe restores the electrical contact with the coolant.

68. B — The marker lamp dimming feature is a designed function of the body controller. The technician should explain the feature's purpose to the driver and verify the actual dimming percentage matches the manufacturer's specification. If the dimming percentage is correct, the system is operating as designed. If it exceeds the specification, the output circuit should be investigated.

69. B — The clutch slave cylinder pushrod seal leaks fluid into the bell housing where it is not visible externally. The leaked fluid contacts the clutch disc friction surfaces, contaminating them. This explains both the fluid loss (dropping reservoir level) and any developing clutch slip. The bell housing inspection cover should be checked for fluid traces.

70. D — A transmission that jumps out of one specific gear during coast with correct clutch adjustment points to a worn detent mechanism for that gear's shift rail. The detent spring has weakened or the detent notch has worn, so the shift fork cannot resist the reverse-torque loading during deceleration and allows the rail to slide out of the engaged position.

71. A — A shorter-than-normal shift time for one specific gear change indicates the clutch pack is applying too quickly. A failed accumulator piston (which should cushion the apply rate), a worn cushion spring, or excessive apply pressure all cause the clutch to engage abruptly. The other shifts have functioning accumulators that provide the designed 0.6-0.8 second apply time.

72. C — The two-speed shift mechanism (sliding clutch, engagement dogs, and the reduction gear set) is only loaded during low-range operation. In high range, the power path bypasses these components. Noise only in low range isolates the source to the components unique to the low-range power path — the shifting mechanism and its associated gears.

73. A — The pinion bearing preload reading of 3.4 Nm is exactly at the upper limit of the 1.7-3.4 Nm specification for new bearings. While technically within specification, the reading should be verified after 500 km of operation. Bearing preload may increase as the bearings seat during initial service, and a reading at the upper limit may exceed the specification after break-in.

74. B — Compression fittings can fatigue and crack from the repeated pressure cycling and vibration of transmission cooler line operation. A proper flare or braze joint provides a mechanically superior connection that withstands the long-term vibration, pressure cycling, and temperature range of transmission cooler line service. Compression fittings are not recommended for this application.

75. A — A release bearing noise that is continuous at idle and disappears when the pedal is depressed indicates the bearing is in constant contact with the rotating pressure plate fingers. The noise is from the dry bearing running against the fingers. When the pedal is depressed, the bearing is loaded against the fingers which stabilizes the contact and quiets it.

76. D — A one-second delay between pedal release and vehicle movement suggests the flywheel friction surface is not making immediate contact with the clutch disc across its full area. A warped flywheel contacts the disc at only a few high points initially, and approximately one second of slipping is required before enough friction force accumulates across the limited contact area to begin accelerating the vehicle.

77. B — On NTC temperature sensor circuits, an open circuit leaves the signal wire at the full reference voltage (typically 5V). The TCM interprets maximum voltage as minimum temperature on an NTC circuit (because NTC resistance decreases with heat — high resistance/high voltage = cold). An open circuit reads as the coldest possible temperature: -40°C .

78. A — The engine brake changes the crankshaft's torsional vibration characteristics by adding compression release events at each cylinder's TDC. These additional decompression pulses alter the engine's torsional excitation pattern, which may excite a driveline resonance frequency that is not present during normal powered operation when the combustion events provide a different torsional input.

79. A — The indicator lamp confirms air pressure reached the actuator circuit. However, the lamp switch is typically activated by the air pressure arriving at the actuator — it does not confirm the actuator physically moved the locking mechanism. The actuator may receive air but be unable to move the lock collar due to corrosion, mechanical binding, or debris in the engagement mechanism.

80. C — Both U-joints are smooth, eliminating them as the cause. The centre bearing rubber isolator has seized to the bearing housing from age, heat, and oil contamination. The seized isolator creates friction that resists rotation of the rear section independently from the front section, which turns freely because it is not affected by the centre bearing condition.

81. D — The clutch disc damper springs have a natural resonance frequency. When this frequency matches the engine's firing impulse frequency at idle, the springs amplify the torsional pulses rather than dampening them. The amplified pulses cause the transmission gear teeth to rattle in their backlash clearance. Slight pedal depression shifts the clutch disc position, changing the resonance point.

82. B — With the inter-axle differential locked, both drive axles are forced to rotate at the same speed. During a parking lot turn, the outer wheels must travel further than the inner wheels. The locked differential prevents this speed difference, creating driveline windup. The stored torsional energy releases suddenly as the tires alternately break traction and regain grip, producing the popping noise.

83. A — The transmission oil pump is driven by the torque converter housing, which rotates at engine speed whenever the engine is running — in all gear ranges including Park and Neutral. A worn pump with enlarged internal clearances produces a speed-dependent whining noise proportional to the pump shaft speed, which equals engine RPM in all operating modes.

84. A — Ring and pinion gears are manufactured and lapped (ground together) as matched sets. Each gear's tooth profile is ground to mate precisely with its partner. Installing a new ring gear against an old pinion creates a contact pattern mismatch — the new ring gear's profile does not match the worn pinion's surface, causing concentrated loading that accelerates wear on the new gear.

85. C — The compression brake operates by opening the exhaust valves at TDC of the compression stroke to release the compressed air. The exhaust valve lash directly determines when and how far the exhaust valve opens during the brake event. Uneven lash across the six cylinders produces different valve opening events per cylinder, creating the surging or hunting sensation during operation.

86. B — A restricted power steering return hose prevents adequate fluid from flowing back to the reservoir. This starves the pump inlet — the pump draws more fluid than the restricted return can supply, dropping the reservoir level at the pump suction. The pump cavitates from insufficient inlet flow, producing the whining noise and increased steering effort.

87. D — The sector shaft over-centre adjustment has a limited range that can compensate for a specific amount of internal wear. When the recirculating ball mechanism (worn balls, enlarged worm grooves, worn ball nut teeth) has worn beyond this adjustment range, the external adjustment screw cannot eliminate the remaining play regardless of how far it is advanced.

88. A — Failed cab mount rubber isolators create rigid metal-to-metal contact between the cab and frame. Every road impact force is transmitted directly into the frame at the cab mounting bolt holes without the rubber's designed energy absorption. The concentrated cyclic loading at these bolt holes exceeds the frame's fatigue endurance, initiating cracks that propagate with continued service.

89. C — A steer tire that sustained a high-speed pothole impact should be removed from the rim and internally inspected. Internal sidewall bruising, the beginning of belt separation, and cord damage from impact can all exist without any external visual evidence. These internal injuries weaken the tire structure and can lead to delayed failure at highway speed.

90. A — Rubber helper springs are designed to provide a progressive spring rate — they engage gently as the suspension compresses and provide increasingly stiffer resistance as the compression deepens. At full load capacity, the rubber is compressed significantly and the spring rate is at its maximum — producing the firm ride that is the designed characteristic, not a fault.

91. B — New fifth wheel mounting bolts that are not fully torqued allow the plate to shift on its bracket during the torque reversals of acceleration and braking. Each shift produces a clunk as the plate moves to the limit of the loose bolt clearance, reverses direction, and moves to the opposite limit. Verifying and correcting the mounting bolt torque eliminates the movement.

92. D — An end play increase from 0.003" to 0.008" within 1,000 km indicates rapid bearing deterioration. The most common cause is contamination — debris introduced during the adjustment process embeds in the bearing roller surfaces and races, causing accelerated abrasive wear. The contaminated bearing surfaces wear rapidly under load, increasing the clearance far beyond the initial setting.

93. B — A severely deteriorated trailing arm bushing allows the axle to shift position during driving — forward under braking, rearward under acceleration, and laterally during turns. This movement changes the drive axle's alignment relative to the frame centreline, creating a thrust angle error that alters the vehicle's tracking characteristics and causes accelerated tire wear.

94. C — A retreaded tire with a separating cap is a progressive failure that will worsen during continued driving. The separated tread cap will eventually detach completely from the casing, creating a large road debris hazard for following vehicles and leaving the tire's casing running on the road surface without tread. The tire must be removed from service immediately.

95. A — Hub-piloted wheels require flat flange-seat nuts that clamp against the wheel's flat mounting surface. A cone-seat nut contacts the flat surface at a single ring rather than a full flat face, creating an unstable rocking point. The nut cannot properly clamp the wheel, allows the wheel to shift and elongate stud holes under dynamic loads, and risks wheel separation.

96. A — A new replacement spring has its full designed camber (arc), while the opposite side's original spring has taken a permanent set (lost some camber) from years of service. The new spring sits 15 mm higher because it has not yet settled. Normal driving loads will cause the new spring to settle and the height difference will equalize within 5,000 to 10,000 km.

97. C — The power steering pump ran without fluid for 5 km. The pump relies on the hydraulic fluid for both lubrication and cooling of its internal components. Running dry causes the pump's internal vanes, rotor, cam ring, and bearings to operate metal-to-metal, generating extreme heat and friction. The pump should be inspected for scoring, wear, or seizure damage before returning to service.

98. D — The tandem alignment is correct but the trailer dog-tracks. A steerable axle that does not return to the straight-ahead position after turns will cause the trailer to track at an angle. A failed centering spring, worn bushing, or contaminated pivot in the self-centering mechanism prevents the axle from returning to neutral, creating the persistent dog-tracking condition.

99. D — A steering vibration at a specific speed range ($100 \text{ km/h} \pm 10 \text{ km/h}$) with correct balance, alignment, and component condition indicates a resonance condition. A failed steering damper allows the steer axle to oscillate at its natural frequency when road surface irregularities excite that frequency at the specific speed corresponding to the resonance.

100. D — During pad replacement, the caliper pistons were pushed fully back into their bores to accommodate the thicker new pads. On the first applications, the pistons must travel the full distance across the bore to reach the new pad surfaces. This additional piston travel consumes more brake fluid volume, which the pedal must displace — creating the longer pedal travel until the pistons seat against the pads.

101. C — The heavier gear oil generates significantly more internal friction than the specified lighter hub oil. The increased viscosity creates more resistance as the bearings rotate through the heavier fluid, generating additional heat. This elevated temperature accelerates seal deterioration, breaks down the oil's lubricating properties, and can lead to premature bearing failure.

102. D — Setting the ride height 25 mm lower than specification reduces the available suspension travel before bump stop contact. During hard braking, the dynamic weight transfer compresses the front suspension. The reduced travel means the suspension bottoms out on the rigid bump stops, creating a harsh jarring impact that can damage components and affect braking stability.

103. A — A sensor air gap of 0.3 mm (below the 0.5 mm minimum specification) creates a risk of physical contact between the sensor tip and the tone ring. Thermal expansion of the axle components, wheel bearing play, and suspension deflection can close the remaining 0.3 mm gap. Contact damages the sensor tip and can break teeth from the tone ring.

104. D — A cab tilt safety latch that releases with almost no resistance indicates the latch engagement mechanism has deteriorated. The spring, detent, or striker alignment has weakened to the point where the latch may not hold during driving forces — a hard braking event or collision could cause the cab to unlatch. The latch should require significant effort to confirm positive engagement.

105. C — During sleep, the driver's body releases moisture through respiration and perspiration. In the enclosed, poorly ventilated sleeper compartment during cold weather, this moisture condenses on the cold interior surfaces (walls, ceiling, windows) and drips onto the mattress. Proper ventilation or a small dehumidifier addresses the moisture accumulation.

106. B — Gradually increasing road noise over a year with good tires and intact seals points to the cab's sound-deadening materials. Floor insulation, headliner material, and door panel damping layers deteriorate from moisture exposure, vibration fatigue, and age. As these materials break down, they lose their noise-attenuation properties, allowing progressively more road noise into the cab.

107. A — A new wind noise after windshield replacement most commonly results from the adhesive not being allowed to cure fully before the vehicle was driven. Highway wind pressure acting on the partially cured adhesive can shift the glass or create a gap between the glass edge and the frame. The gap allows wind noise to penetrate at highway speed.

108. D — The cab tilt warning lamp indicates the cab is not confirmed in the fully locked position. The latch switch, the latch mechanism itself, and the cab's seating position should all be checked. A misadjusted switch, partially engaged latch, or cab that is not fully seated on its mounting points can all prevent the full-lock confirmation that extinguishes the lamp.

109. B — During highway driving, ram airflow through the condenser supplements the condenser fan's heat rejection. During static overnight parking, only the condenser fan provides airflow. If the condenser fan's capacity alone cannot reject enough heat at the overnight ambient temperature, the system's cooling capacity decreases and the cargo temperature gradually rises.

110. D — Progressively harder cranking over months indicates increasing friction in the landing gear mechanism. The internal gear reduction, the extension sleeve bearing surfaces, and the cross-shaft bearings all require periodic lubrication. Without it, the metal-to-metal friction increases progressively, requiring more and more effort to operate the crank handle.

111. A — New brake shoes installed with the wrong shoe in each position reverses the self-energizing and de-energizing characteristics. The trailing shoe, designed to carry less braking force, is now in the leading (self-energizing) position where it produces excessive force. The result is aggressive braking that feels like lockup during even light applications.

112. C — A standard dry van trailer's nose (front wall) is exposed to highway-speed wind chill. The cold nose wall becomes a condensation surface. Moisture from the cargo, from wet packaging, or from humid air that entered during loading migrates to the coldest surface — the nose — where it condenses and freezes during winter driving conditions.

113. B — The 4S/2M configuration has a sensor at each wheel position and a modulator controlling each side independently. The ABS module can detect individual wheel speed variations on each axle and modulate each side's brake pressure independently. The 2S/1M system modulates both wheels on an axle together, unable to address individual wheel lockup on one side.

114. D — The ratchet mechanism (pawl, spring, and engagement teeth on the drum) is the anti-reverse mechanism that holds tension. If the pawl is worn, the spring is broken, or the engagement teeth are damaged or contaminated with debris, the pawl cannot fully seat to prevent reverse rotation. The strap gradually loosens as the drum slowly releases under the load tension.

115. A — The total circuit load (17 amps) now exceeds the 15-amp fuse rating. The fuse must be upgraded to at least 20 amps, but the existing wiring must also be verified as adequate for the increased current. If the wiring is rated for only 15 amps, it must also be upgraded to prevent overheating under the higher 17-amp continuous load.

116. C — Diagnosing uneven liftgate rise requires checking both cylinders for internal leakage, verifying both supply lines are unrestricted and equal, and inspecting the directional valve for internal bias. A single cylinder with seal leakage, a restricted hose on one side, or a valve spool that favors one port over the other could all cause the uneven rise.

117. B — At idle, the engine RPM is at its lowest and the A/C compressor runs at its slowest speed, producing reduced refrigerant flow. Additionally, idle conditions minimize ram airflow through the condenser. The compressor belt may slip at the lower idle tension under the compressor's full load. All of these factors reduce cooling capacity during extended idle in hot weather.

118. D — The blend door or mode door actuator motor is continuously hunting — advancing toward its target position, overshooting, reversing, and repeating. This hunting cycle produces a clicking or tapping noise at regular intervals. The actuator motor, its position feedback sensor, or the control module's drive circuit may be causing the continuous hunting behavior.

119. A — A compressor failure from lack of lubrication circulates metallic debris throughout the entire sealed refrigerant system. The contamination lodges in the receiver/dryer, condenser passages, expansion valve orifice, and evaporator tubes. All of these components must be flushed or replaced, and the new compressor charged with the correct oil, to prevent the debris from destroying the new compressor.

120. C — A very small heater core seep that vaporizes on the hot core surface before forming visible droplets produces a coolant odour without the typical evidence (wet floor, windshield film). The coolant vapour enters the HVAC airstream directly from the core surface and is distributed through the cab ventilation. The quantity is too small for visible condensation but sufficient for the driver to smell.

121. B — Milky white vacuum pump oil after evacuating an A/C system indicates the pump extracted a significant amount of moisture from the system. The water vapor was drawn through the pump and condensed in the oil. This confirms the A/C system had substantial moisture contamination that the evacuation successfully removed. The pump oil should be changed before the next use.

122. D — The combustion is normal and the exhaust is clear, but the heater reaches the high-temperature limit after 10 minutes. The coolant is not circulating through the heat exchanger — an airlock in the coolant circuit prevents flow. The combustion heat cannot be carried away by the stagnant coolant, and the heat exchanger temperature rises until the safety limit shuts the heater down.

123. A — A rhythmic thumping synchronized with the compressor shaft rotation after a recharge with correct refrigerant weight is most commonly caused by excess oil. If the compressor was over-oiled during the service, the liquid oil is drawn into the cylinders and compressed with each piston stroke. Since liquid is incompressible, the piston impacts the oil slug creating the characteristic liquid hammer thump.

124. C — The pump delivers adequate flow and the pressure is normal, but the boom moves jerkily. The directional control valve spool is the flow control point between the pump and the cylinder. Contamination in the valve bore causes the spool to stick and release intermittently as it moves, creating inconsistent flow delivery to the boom cylinder and the jerky movement.

125. B — The pump operated normally for one hour then developed knocking. After one hour, the pump is at operating temperature and the rebuilt internals have been running under load. Premature bearing failure from an assembly defect (incorrect bearing fit, contamination during assembly, insufficient lubrication during the rebuild) manifests after the initial break-in period.

126. D — This is normal operation for a double-acting cylinder. The rod-end effective area (piston area minus rod cross-section) is smaller than the cap-end area (full piston area). With the same flow rate, the larger cap-end volume fills and extends faster, while the smaller rod-end volume fills at the same rate but the piston moves slower because it has further to push the fluid from the cap end.

127. A — The acid number measures the level of acidic compounds in the oil. Elevated acid number from prolonged high-temperature operation indicates the oil has oxidized. Oxidation byproducts include organic acids that attack metal bearing surfaces, degrade seal materials, and produce varnish and sludge that clog filters, orifices, and valve passages throughout the system.

128. B — The proportional valve requires a proportional input signal from the joystick to position the spool at intermediate openings. If the joystick potentiometer has failed and sends only minimum (zero) or maximum (full) voltage, the valve controller receives only off or full-on commands. The spool cannot achieve intermediate positions, eliminating speed control.

129. B — The lowering speed valve (needle valve) is fully open, eliminating it as the restriction. The return line filter is the next flow restriction in the lowering path. A severely contaminated filter element creates significant backpressure that resists the oil flow from the lowering cylinder to the reservoir, slowing the platform's descent speed.

130. D — The nitrogen gas was at ambient temperature when pre-charged. During hydraulic cycling, the gas compresses and expands rapidly. The expansion cooling effect (adiabatic cooling) lowers the gas temperature. Cooler gas occupies less volume at the same container size, producing a lower pressure reading. When the gas returns to ambient temperature, the reading will recover.

131. A — In a tandem-centre valve design, the sections are connected through internal gallery passages. When the boom section activates, the pressurized oil in its circuit can transfer a small amount of pressure through the tandem centre passages to the winch section's work ports. This small pressure causes slight winch movement even though the winch spool is in neutral.

132. C — Cold battery cells have significantly higher internal resistance, which limits both the current they can deliver (reducing power and range) and accept (limiting regenerative braking). Additionally, the cabin heating system on a BEV draws substantial electrical energy directly from the battery — unlike a diesel truck where waste engine heat provides free cab heating.

133. B — High-voltage battery packs for commercial vehicles can weigh 200 to over 1,000 kg. The pack must be lifted using insulated rigging (nylon slings, not metal chains that could create a conductive path) and the lifting equipment must be rated for the pack's substantial weight. Proper rigging and rated equipment prevent both electrical hazards and dropping the heavy pack.

134. D — The onboard charger performs a ground fault (insulation resistance) test before initiating each charging session. A high-voltage insulation fault — from moisture intrusion, damaged cable insulation, or a compromised connector — reduces the HV-to-chassis isolation below the minimum threshold. The charger detects this condition and refuses to energize the high-voltage charging circuit.

135. A — With 50% SOC, normal temperatures, and no fault codes, the system should provide full regenerative braking. A sudden reduction to near-zero regen without codes suggests a partial hardware failure that has not yet triggered the fault detection threshold. A failed phase in the inverter reduces the motor/generator's capacity by one-third without immediately setting a code.