PRACTICE EXAM 12: RED SEAL TRUCK AND TRANSPORT MECHANIC SIMULATION (135 QUESTIONS)

1. A technician is using an oxy-acetylene torch to heat a seized exhaust manifold bolt for removal. The bolt is located directly above a braided stainless steel fuel line that runs along the engine block. What specific fire prevention measure must be taken before heating the bolt?

A. Apply water to the fuel line continuously during the heating process to keep the fuel line temperature below the diesel fuel flash point while the torch is directed at the bolt

B. Wrap the fuel line with aluminum foil to reflect the radiant heat away from the fuel line surface and prevent the diesel fuel inside from reaching its ignition temperature during heating

C. Disconnect the fuel line and cap both ends before heating because the stainless steel braiding can conduct enough heat to ignite the fuel inside the line from the torch's radiant energy

D. Position a fire-resistant heat shield between the torch flame and the fuel line to prevent direct radiant heat from reaching the fuel line surface during the bolt heating operation

2. A shop recently purchased a new hydraulic shop press rated at 50 tonnes. Before technicians begin using it, what documentation should be reviewed and what training should be completed?

A. The press manufacturer's warranty registration must be completed online before the first use to ensure any manufacturing defects discovered during initial operation are covered

B. The operator's manual must be reviewed for the press's rated capacity at each bed position, the safety features and their operation, and technicians must be trained on the specific press procedures

C. The press must be tested at 75 tonnes (150% of rated capacity) by a certified pressure vessel inspector before first use to verify the hydraulic cylinder and frame meet the safety standard

D. The press manufacturer must provide a factory technician to supervise the first 10 pressing operations to verify the installation is correct and the technicians operate the equipment safely

3. A technician is replacing a leaf spring on a truck. During disassembly, the technician removes the spring's centre bolt and begins separating the spring leaves. As the leaves separate, one leaf springs upward forcefully. What safety precaution was not taken?

A. The spring leaves should have been clamped together with spring clamps before the centre bolt was removed to prevent the leaves from separating under their stored tension during disassembly

B. The spring should have been heated with a torch before disassembly to relieve the internal stress in the leaves that causes them to spring apart when the centre bolt constraint is removed

C. The technician should have worn a face shield only — the spring leaf's upward movement is a normal characteristic that poses no injury risk beyond eye protection from rust particles

D. The vehicle should have been raised higher before the spring disassembly to provide more clearance between the spring leaves and the technician's body when the leaves separate during removal

4. A technician is assigned to repair a truck's exhaust system. The repair requires cutting a section of exhaust pipe with a reciprocating saw. The truck is parked inside the shop with the engine off. What hazard is associated with cutting into a cold exhaust system?

A. The cold exhaust pipe metal is more brittle than when warm and the saw blade may shatter from the vibration against the hardened cold metal sending blade fragments toward the technician

B. The exhaust pipe may contain residual liquid fuel from the aftertreatment system's regeneration cycle that could ignite when the reciprocating saw blade creates sparks during the cutting operation

C. The exhaust pipe interior may contain residual carbon monoxide gas that is released when the pipe is cut open — the gas can accumulate in the shop at floor level creating an inhalation hazard

D. The catalytic converter or DPF substrate contains toxic compounds (platinum, palladium, rhodium) that become airborne dust when the pipe is cut near these components creating an inhalation hazard

5. A fleet maintenance facility has an oil/water separator connected to the shop floor drains. The separator removes petroleum hydrocarbons from the drain water before it enters the municipal sewer system. During an inspection, the technician finds the separator is overdue for service — the oil accumulation has reached the maximum level. What is the consequence of operating with the separator at capacity?

A. The separator will still function at reduced efficiency because the oil accumulation compresses under the weight of new incoming wastewater allowing some additional capacity for continued operation

B. The separator can no longer effectively remove petroleum from the drain water and untreated contaminated water will pass through to the municipal sewer system creating an environmental violation

C. The separator's internal structure will be permanently damaged by the excessive oil accumulation and the entire unit must be replaced rather than simply serviced when it reaches the maximum level

D. The separator will automatically close the drain inlet when the maximum oil level is reached preventing any additional wastewater from entering the drains until the separator is serviced and drained

6. A technician is performing a cooling system service and needs to dispose of 40 litres of used ethylene glycol coolant. The coolant is not contaminated with oil. What is the correct disposal method?

A. Pour the used coolant into the shop's used oil collection tank because ethylene glycol is compatible with used oil and both fluids are recycled through the same re-refining process

B. Dilute the used coolant with water at a 10:1 ratio and pour it down the shop floor drain because the diluted glycol concentration is below the regulatory threshold for direct sewer disposal

C. Flush the coolant down the sanitary sewer with adequate water volume because ethylene glycol is biodegradable and municipal wastewater treatment plants can process glycol compounds effectively

D. Collect the used coolant in a dedicated coolant recycling container and arrange disposal through the shop's waste coolant recycling program or licensed waste hauler for proper recycling or treatment

7. A technician is diagnosed with occupational hearing loss after 15 years of working in a fleet maintenance shop. The shop has impact wrenches, air chisels, and engine dynamometers operating regularly. What hearing protection program failure contributed to this condition?

A. The shop should have implemented a hearing conservation program including noise level monitoring, hearing protection equipment, annual audiometric testing, and technician training on noise hazard awareness

B. The technician should have been provided with noise-cancelling headphones that actively reduce the sound level rather than passive ear plugs or muffs that only attenuate the noise by a limited number of decibels

C. The shop should have replaced all pneumatic impact wrenches with electric impact wrenches that produce noise levels below the regulatory threshold eliminating the need for any hearing protection equipment

D. The technician's hearing loss was caused by age-related deterioration rather than occupational exposure and no shop hearing protection program would have prevented the natural progression of hearing decline

8. A technician is lifting a 30 kg brake drum from the floor to a workbench. The drum is awkward to grip due to its shape. What is the safest method to perform this lift?

A. Grip the drum by its friction surface edge and lift with arms extended to keep the heavy drum away from the body and prevent the drum's rust from contacting the technician's clothing

B. Roll the drum across the floor to the workbench and then use a floor jack positioned under the drum to raise it to the bench height avoiding the need for any manual lifting of the heavy drum

C. Use proper lifting technique — squat with the knees bent, grip the drum securely at two points, keep the drum close to the body, and lift with the legs while keeping the back straight throughout the lift

D. Ask a coworker to assist with the lift because 30 kg exceeds the single-person lifting limit for awkward-shaped objects under the shop's manual material handling policy regardless of technique used

9. A heavy-duty diesel engine produces a loud metallic knocking noise that is present at idle and increases in intensity and frequency with RPM. The noise is most noticeable from the bottom of the engine near the oil pan. Disabling individual injectors does not change the noise. What is the most probable source?

A. A loose flywheel bolt that allows the flywheel to shift and impact the engine block during each revolution creating a knock proportional to engine speed from the crankshaft end of the engine

B. A failed main bearing with excessive clearance that allows the crankshaft to impact the bearing cap during each revolution — the sound radiates from the bottom of the engine at crankshaft frequency

C. A damaged connecting rod bearing that impacts the crankshaft journal during each power stroke on the affected cylinder creating a knock that is loudest from the lower engine near the oil pan area

D. A cracked crankshaft counterweight that has loosened and impacts the engine block at a contact point during each revolution creating a metallic knock from the bottom of the engine at crankshaft rotational frequency

10. A diesel engine equipped with a common rail fuel system has a rail pressure of 200 bar at idle. The specification calls for 400 bar at idle. The engine runs rough at idle but smooths out above 1,200 RPM where the rail pressure reaches the correct specification. What component is the most likely cause of the low idle rail pressure?

A. The fuel rail pressure sensor has drifted from calibration and is reading 200 bar lower than the actual rail pressure at idle which makes the scan tool display appear incorrect while the actual pressure is adequate

B. The high-pressure pump's intake metering valve is stuck at a reduced opening that limits fuel delivery at the low pump speed of idle but allows adequate fuel at the higher pump speed above 1,200 RPM

C. The fuel transfer pump output is at the lower limit of its specification and can supply adequate volume only at higher pump speed — at idle the reduced supply cannot fill the high-pressure pump chambers completely

D. The fuel rail pressure relief valve is leaking at idle pressure and the small leak rate is enough to prevent the pump from building to 400 bar at idle but the higher pump output above 1,200 RPM overcomes the leak

11. A diesel engine has been running on ultra-low sulphur diesel (ULSD) for its entire service life. A fleet decision changes the fuel supply to a renewable diesel (R100 — 100% renewable, no petroleum content). Before switching fuels, what compatibility concern should the technician investigate?

A. Renewable diesel's compatibility with the engine's fuel system seals, gaskets, and hoses — R100 may soften or swell certain rubber compounds that were designed for petroleum-based ULSD fuel chemistry

B. Renewable diesel has a significantly higher cetane number than ULSD which may cause the ECM to retard injection timing beyond its designed range producing combustion knock from the excessively early ignition

C. Renewable diesel's cold-weather performance because R100 has a higher cloud point than ULSD in most formulations and the fuel may gel at temperatures where ULSD remains liquid in the supply system

D. Renewable diesel produces higher exhaust temperatures than ULSD which may exceed the turbocharger's thermal limits and require a turbocharger upgrade before the fuel switch can be implemented safely

12. A heavy-duty diesel engine's intercooler (charge air cooler) effectiveness has been tested by measuring the intake manifold temperature at full load. The ambient air is 25°C, the turbocharger compressor outlet temperature is 200°C, and the intake manifold temperature (after the intercooler) is 75°C. What is the intercooler's effectiveness percentage?

A. The intercooler effectiveness is approximately 50% because the cooler reduces the intake air temperature from 200°C to 75°C which is a 125°C reduction against the 200°C compressor outlet temperature

B. The intercooler effectiveness is approximately 62.5% because it reduces the temperature by 125°C against the total possible reduction of 200°C from the compressor outlet to absolute zero

C. The intercooler effectiveness is approximately 71% because it reduces the temperature by 125°C against the maximum possible reduction of 175°C (the difference between the 200°C compressor outlet and the 25°C ambient)

D. The intercooler effectiveness is approximately 37.5% because the remaining 50°C above ambient represents the cooler's inability to reach the ambient baseline and 50°C of the 200°C input remains uncooled

13. A diesel engine's exhaust manifold pyrometer probe on cylinder 4 reads 100°C higher than all other cylinders at full load. The injection timing is confirmed equal on all cylinders. The compression test shows all cylinders within specification. What should be investigated on cylinder 4?

A. The exhaust valve on cylinder 4 for a restriction that traps more combustion heat in the cylinder longer than the other cylinders before the exhaust valve opens and releases the heated gas past the pyrometer

B. The fuel injector on cylinder 4 for a delivery quantity that exceeds the specification — overfuelling that specific cylinder produces more combustion heat and higher exhaust temperature at the pyrometer location

C. The intake valve on cylinder 4 for a restriction that reduces the air charge on that cylinder creating a richer-than-designed fuel-to-air ratio that burns at a higher temperature producing the elevated pyrometer reading

D. The pyrometer probe itself for a grounding fault that creates a voltage offset on the thermocouple circuit producing a false reading that is consistently higher than the actual exhaust temperature at that cylinder location

14. A diesel engine has been rebuilt with new piston rings but the original cylinder liners were reused because they measured within the OEM specification. After 10,000 km of operation, the engine oil consumption is 0.8 litres per 1,000 km — above the maximum specification of 0.5 litres. What is the most likely cause?

A. The original liners should have been honed (deglazed) before installing the new rings — the polished bore surface from years of ring contact cannot allow new rings to seat properly against the existing glaze

B. The new piston rings have a manufacturing defect in the face coating that prevents them from conforming to the cylinder bore surface even though the bore dimensions are within the OEM specification

C. The original liners have a wear ridge at the top of ring travel that the new rings contact at TDC causing them to flex and lose their seal against the liner during each stroke allowing oil to pass into the chamber

D. The original cylinder liners have developed a bore geometry error (egg-shaped or barrelled) that is within the OEM dimensional specification but is not round enough for the new precision rings to seal completely

15. A truck's engine ECM has set a fault code for the fuel temperature sensor — SPN 174, FMI 10 (abnormal rate of change). The code sets intermittently during the first 10 minutes of operation after a cold start. What condition could cause a rapid temperature change that triggers this code?

A. A fuel return line from the high-pressure pump discharges hot fuel near the fuel temperature sensor location and the sudden introduction of hot return fuel creates a rapid temperature spike at the sensor during warmup

B. The fuel heater activates aggressively during cold starts creating a rapid temperature rise in the fuel that exceeds the ECM's expected rate-of-change threshold for normal fuel system warmup progression

C. The fuel temperature sensor has a cracked seal that allows coolant from an adjacent passage to contact the sensor intermittently during warmup creating rapid temperature fluctuations between fuel and coolant temperature

D. The fuel tank return line is routed near the exhaust system and the returning fuel absorbs exhaust heat rapidly during the first minutes of operation before the fuel volume in the tank dilutes the heated return fuel

16. A diesel engine's aftertreatment system has a fault code indicating the SCR catalyst inlet temperature is below the minimum required for DEF injection. The engine has been running at idle for 45 minutes. Is this condition normal?

A. No — the ECM should command a thermal management strategy (intake throttle closing, late-post injection, VGT position change) to raise the exhaust temperature above the DEF dosing threshold during extended idle

B. No — the exhaust temperature should reach the DEF dosing threshold within 5 minutes of idle regardless of the ambient temperature because the combustion process produces adequate heat at any operating condition

C. Yes — extended idle produces low exhaust temperatures because the minimal fuel combustion at idle generates insufficient exhaust heat to reach the 200-250°C minimum required for DEF injection and SCR catalyst activation

D. Yes — the ECM intentionally delays DEF injection during the first 60 minutes of operation to allow the SCR catalyst substrate to stabilize thermally before introducing the urea solution to prevent thermal shock damage

17. A heavy-duty diesel engine has a complaint of blue smoke during deceleration. The smoke appears briefly when the driver lifts off the throttle at highway speed. The engine does not smoke at idle, during acceleration, or at steady cruise. What is the most common cause?

A. The turbocharger compressor seal has a slight leak that allows oil into the intake during the high vacuum condition that occurs in the intake manifold during the closed-throttle deceleration transition at highway speed

B. The valve stem seals on the intake valves have hardened and cannot prevent oil from being drawn past the guides into the combustion chambers during the high intake manifold vacuum of the deceleration transition

C. The piston rings are worn on one or more cylinders and the reduced ring tension combined with the negative cylinder pressure during deceleration allows oil to enter the combustion chamber from the crankcase

D. The crankcase ventilation system is routing excessive oil vapour into the intake manifold during deceleration because the reduced engine load creates higher crankcase pressure that forces more vapour through the vent

18. A diesel engine equipped with a DPF has completed a forced regeneration. The post-regeneration DPF differential pressure reads 1.5 kPa. The pre-regeneration pressure was 12 kPa. Is the 1.5 kPa post-regeneration reading acceptable?

A. Yes — 1.5 kPa represents the flow resistance of the clean DPF substrate itself and is within the normal range for a properly regenerated filter that has had its accumulated soot burned off during the forced regeneration

B. No — a properly regenerated DPF should read 0.0 kPa because the regeneration process burns all the particulate material from the filter substrate restoring the filter to its original factory flow resistance of zero

C. Yes — but only for the first 100 km after regeneration because the differential pressure will rise rapidly as the filter captures new soot and the 1.5 kPa baseline will double within the first 200 km of normal operation

D. No — the 1.5 kPa reading indicates the DPF has accumulated non-combustible ash that was not removed during the soot regeneration and the filter should be professionally cleaned to remove the ash residue

19. A diesel engine's coolant test strip shows the coolant pH at 7.0 (neutral). The specification calls for pH between 8.0 and 10.5. What does the low pH indicate?

A. The coolant pH is too acidic which indicates the coolant concentration is too high and the excessive glycol content has overwhelmed the inhibitor package's ability to maintain the designed alkaline pH range

B. The coolant's corrosion inhibitor package has deteriorated from age or contamination and cannot maintain the alkaline pH needed to protect the metallic components in the cooling system from corrosion attack

C. The coolant was recently changed and new coolant requires 500 km of circulation to activate the inhibitor package and raise the pH from its neutral shipping value to the designed operating alkaline range

D. The coolant inhibitor package has depleted — the pH has dropped from the designed alkaline range (8.0-10.5) to neutral (7.0) indicating the coolant can no longer protect the engine's metal surfaces from corrosion

20. A diesel engine has been diagnosed with a failed head gasket between cylinder 2 and the water jacket. The technician plans to replace the gasket. Before reassembly, what critical inspection must be performed on both the head and block deck surfaces?

A. The deck surfaces must be inspected for corrosion or pitting damage from the coolant exposure that occurred during the gasket failure to determine if the surfaces need machining before the new gasket will seal

B. The deck surfaces must be measured for cracks using magnetic particle inspection because the thermal and pressure stresses from the gasket failure may have initiated stress cracks in the casting around the combustion chamber

C. The deck surfaces must be checked for flatness with a precision straightedge and feeler gauges because the thermal distortion from the gasket failure may have warped the head or block beyond the new gasket's sealing ability

D. The deck surfaces must be cleaned and inspected for pitting, corrosion, and cracks, and measured for flatness — all conditions must be within the specification before the new gasket can be expected to seal properly

21. A diesel engine's turbocharger has a fault code for VGT actuator over-travel. The scan tool shows the actuator is commanding the vanes to 105% of their maximum position. The engine is derated. What has caused the actuator to attempt to move beyond its physical range?

A. The VGT vanes are partially seized from carbon deposits and the actuator is increasing its commanded position beyond 100% trying to force the stuck vanes to move to the target position against the carbon resistance

B. The actuator calibration has drifted and the ECM's commanded positions no longer correspond to the actuator's actual physical positions — the actuator reaches its mechanical stop before the ECM reaches its commanded target

C. The turbocharger bearing has worn and the increased shaft play has shifted the vane ring position relative to the actuator lever creating a geometric mismatch between the commanded and actual vane positions

D. The exhaust gas temperature has expanded the turbine housing beyond its designed dimensions and the thermal expansion has moved the vane ring further from the actuator's reach requiring more travel to achieve the same vane angle

22. A heavy-duty diesel engine has a complaint that the engine oil turns acidic faster than expected — oil analysis shows the Total Base Number (TBN) drops from 10 to 3 within 15,000 km instead of the expected 30,000 km. The oil is the correct specification and the drain interval has not been exceeded. What engine condition accelerates TBN depletion?

A. The engine's combustion is producing excessive sulphuric acid from either a fuel sulphur content above the specification or incomplete combustion that produces more acidic byproducts than the oil's alkaline reserve can neutralize at the normal rate

B. The EGR system is introducing excessive exhaust gas into the crankcase through a failed EGR cooler that leaks exhaust directly into the oil circuit rather than through the intake manifold for combustion

C. The engine's coolant has contaminated the oil through a failed oil cooler and the glycol-based coolant reacts with the oil's additive package consuming the alkaline reserve faster than combustion acids alone would deplete it

D. The crankcase ventilation system is not removing the acidic blow-by gases adequately and the trapped gases accumulate in the crankcase reacting with the oil's alkaline reserve at an accelerated rate compared to a properly vented system

23. A diesel engine's fuel injector has been removed for inspection. The injector nozzle tip shows a circular erosion pattern around the spray holes — the edges of the holes have enlarged and rounded from the erosion. What caused this nozzle tip erosion?

A. The injector was operating at a fuel pressure below the specification for an extended period and the low-pressure fuel stream created a cavitation effect at the nozzle holes that eroded the metal edges over time

B. The fuel has been contaminated with water that creates a steam-erosion effect at the nozzle holes during injection — the water flashes to steam at the high injection temperature and the expanding steam erodes the nozzle edges

C. The diesel fuel's natural acidity has chemically attacked the injector nozzle material over the extended service life of the injector creating the chemical erosion pattern around the spray hole openings from the corrosive fuel

D. The extremely high fuel injection pressure (1,600-2,500 bar) creates cavitation and erosion at the spray hole edges over the injector's service life — the fuel's velocity through the small orifices erodes the hole boundaries progressively

24. A diesel engine equipped with an EGR system has a complaint of excessive turbo lag during tip-in acceleration from idle. The turbocharger has been tested and produces adequate boost at steady state. What EGR-related condition could worsen turbo lag during the acceleration transition?

A. The EGR valve is slow to close during the acceleration transition and the residual exhaust gas in the intake manifold displaces fresh air reducing the combustion energy available to drive the turbine during the spool-up phase

B. The EGR cooler has an internal restriction that creates backpressure on the exhaust side slowing the turbocharger spool-up by diverting exhaust energy through the restricted cooler rather than through the turbine inlet

C. The EGR valve's slow closing during acceleration allows exhaust gas to remain in the intake manifold displacing fresh air which reduces combustion energy and the resulting exhaust energy needed to spool the turbocharger

D. The EGR valve is stuck partially open at all times and the constant exhaust gas recirculation reduces the oxygen concentration during the acceleration transition preventing the increased fuel from burning efficiently

25. A diesel engine has a complaint that the exhaust smells like raw fuel during cold idle operation below -15°C. The engine starts and runs normally but the fuel odour persists for approximately 20 minutes. No fault codes are present. What is the most probable cause?

A. The fuel injectors are dribbling small amounts of unburned fuel into the exhaust during cold idle because the injector nozzle seats contract in the extreme cold and cannot seal completely against the fuel pressure

B. The cold exhaust system temperature prevents the DOC from reaching its light-off temperature during cold idle — the catalyst cannot oxidize the unburned hydrocarbons in the exhaust creating the raw fuel smell

C. The engine's cold-start fuel enrichment strategy is adding excessive fuel during the first 20 minutes of cold operation and the over-fuelled cylinders produce unburned hydrocarbons that exit as the raw fuel odour

D. The aftertreatment DEF dosing system is injecting DEF during cold idle even though the exhaust temperature is below the activation threshold and the decomposing urea produces an ammonia smell resembling raw fuel

26. A diesel engine's oil analysis report shows a gradual increase in lead over three consecutive samples. All other metals are within normal trends. What engine component commonly contains lead and is the most likely source?

A. The connecting rod and main bearing overlays — older and some current bearing designs use a lead-tin-copper overlay material that sheds lead particles into the oil as the bearing surface wears during normal operation

B. The piston ring coating which uses a lead-based break-in compound that gradually wears away during the first 50,000 km of service releasing lead particles into the oil until the coating is fully consumed

C. The camshaft gear material which is manufactured from a leaded bronze alloy for noise reduction and the gear teeth shed lead particles as they mesh with the crankshaft gear during every engine revolution

D. The oil pump's internal components which are manufactured from a leaded iron alloy for self-lubrication and the pump's internal surfaces release lead particles into the oil as the pump gears wear during operation

27. A heavy-duty diesel engine has an unusual condition where the oil pressure is 50 kPa higher than the fleet average at operating temperature. The oil is the correct viscosity and the filter is not restricted. What could cause the elevated oil pressure?

A. The oil galleries have become partially restricted from sludge or varnish deposits that narrow the passages and increase the resistance to oil flow throughout the engine creating the higher-than-normal pressure reading

B. The oil pump has worn to the point where it produces more pressure through internal bypass heating the oil and reducing its viscosity which paradoxically increases the pressure at the gauge from the heated oil's changed flow

C. The oil pressure sensor has drifted high from calibration and is reading 50 kPa above the actual pressure — the actual oil pressure is at the fleet average but the sensor output is offset from the true value

D. The oil pressure relief valve spring has increased in tension from heat cycling and age or the valve has accumulated sludge deposits that prevent it from opening at the designed pressure allowing pressure to build above normal

28. A diesel engine's intake manifold has been removed for cleaning. The technician notices that the intake ports on cylinders 1 through 3 have significantly more carbon buildup than cylinders 4 through 6. What could explain this uneven carbon distribution?

A. Cylinders 1 through 3 are closer to the EGR inlet port on this engine and receive a higher concentration of exhaust gas recirculation soot than cylinders 4 through 6 which are further from the EGR entry point

B. The turbocharger compressor seal has a minor leak that introduces oil mist into the intake and the intake manifold runner geometry directs more of the oily air to cylinders 1-3 than to cylinders 4-6 during boost conditions

C. The intake manifold design channels the EGR gas unevenly — the ports closest to the EGR inlet receive a higher concentration of soot-laden exhaust gas while the ports further away receive cleaner charge air

D. Cylinders 1 through 3 have slightly retarded valve timing from a worn camshaft that causes the intake valves to open later which allows more blow-back of combustion gases into the intake ports depositing carbon

29. A diesel engine has developed a condition where the coolant level drops slowly (approximately 0.5 litres per week) with no visible external leak, no oil-in-coolant, no coolant-in-oil, and no white exhaust smoke. A combustion gas test at the surge tank is negative. Where could the coolant be going?

A. The coolant is being consumed through a very small EGR cooler leak that introduces coolant into the exhaust stream in quantities too small to produce visible white smoke but large enough to account for the weekly loss

B. The coolant is being lost through the surge tank cap's pressure relief at slightly above the normal operating pressure — the cap vents small amounts of coolant into the overflow during each thermal cycle

C. The coolant is evaporating through a micro-crack in the surge tank that is above the liquid level — the crack allows pressurized steam to escape during hot operation but no liquid coolant drips from the tank below the crack

D. The coolant is being consumed through the air compressor head gasket — some compressor designs share coolant with the engine and a failed compressor head gasket introduces coolant into the compressed air system

30. A truck's air compressor has been replaced and the new compressor produces adequate pressure. However, the air system has a persistent moisture problem — water is accumulating in the tanks faster than before the compressor replacement. The air dryer is functioning and purging correctly. What could the new compressor be contributing to the moisture problem?

A. The new compressor is manufactured with tighter cylinder clearances that run hotter than the original compressor and the increased discharge temperature carries more moisture into the air system than the dryer can handle

B. The new compressor has a higher displacement than the original and the increased air volume overwhelms the air dryer's moisture removal capacity because the dryer was sized for the original compressor's output

C. The new compressor's discharge check valve has a higher cracking pressure than the original which increases the compressor's discharge temperature and the hotter air carries more water vapour past the air dryer

D. The new compressor has a higher volumetric efficiency than the old worn unit and produces more air per revolution — the increased airflow carries more moisture than the air dryer's desiccant capacity was designed to handle

31. A truck equipped with drum brakes on all positions has had the rear brake linings replaced. During the post-service test drive, the rear brakes produce a strong pulling to the left during every stop. Both rear brake adjustments are within specification. What is the most likely cause of the pull?

A. The right rear brake drum has been machined to a larger diameter than the left creating a friction surface mismatch that produces less braking force on the right side despite both sides having correct pushrod stroke adjustment

B. The new brake linings on one side (left or right) have a different friction material specification than the other side — possibly from two different boxes in inventory creating unequal braking force between left and right

C. The relay valve for the rear circuit has developed an internal bias that delivers more air pressure to the left side chamber than the right side during each application creating unequal braking force across the axle

D. The left rear brake anchor pin is seized and the resulting shoe misalignment creates a self-energizing effect that increases the left side's braking force beyond what the equal adjustment and equal air pressure would normally produce

32. A truck's air-over-hydraulic braking system on the front steer axle uses an air-powered booster to generate hydraulic pressure for disc brake calipers. The brake pedal feels soft and requires more travel than normal. The air system pressure is at governor cut-out. What should be checked?

A. The hydraulic fluid level in the booster's reservoir and the hydraulic circuit for leaks — a soft pedal in a hydraulic system indicates either low fluid, air in the hydraulic circuit, or a hydraulic component leak

B. The air booster diaphragm for a leak that allows air to bypass rather than pushing the hydraulic piston — the reduced hydraulic pressure creates the soft pedal feel despite adequate air system pressure

C. The front brake pad wear because as the pads wear thinner the caliper pistons must travel further requiring more hydraulic fluid volume and more pedal travel before the pads contact the rotor surface for braking

D. The air booster's input check valve for a leak that allows the hydraulic pressure to bleed back through the booster when the pedal is released and the residual air prevents full hydraulic pressure on the next application

33. A trailer's ABS module has been replaced. The system requires a sensor calibration procedure where the trailer is driven at 30 km/h and the brakes are applied to establish the wheel speed sensor signal parameters. Why is this calibration necessary?

A. The ABS module must learn the specific tone ring tooth count on each wheel position because different hub manufacturers use different tooth counts and the module must calculate the correct speed from the pulse frequency

B. The new module must measure each sensor's signal amplitude at the calibrated speed to establish the baseline voltage threshold for distinguishing valid wheel speed data from electrical noise during braking events

C. The ABS module must learn the specific tire rolling circumference on each axle to accurately calculate the vehicle speed and detect individual wheel deceleration rates during brake applications for proper modulation

D. The new module must characterize each sensor's unique output signal at a known speed to calibrate its internal signal processing for the specific sensor-to-tone-ring air gap and signal strength at each wheel position

34. A truck's front disc brake caliper has been disassembled for rebuild. The technician inspects the caliper bore and finds vertical scoring marks running the length of the bore. The scoring is deep enough to catch a fingernail. Can the caliper be rebuilt with new seals?

A. The caliper can be rebuilt if the scored bore is honed to remove the scoring and the bore diameter remains within the specification after honing — the new seal will seat in the smooth honed surface adequately

B. The caliper can be rebuilt with an oversized piston seal that fills the scored grooves during installation providing adequate sealing despite the scoring because the oversized seal compensates for the bore damage

C. The scoring must be less than 0.05 mm deep for a rebuild to succeed — deeper scoring will cut the new piston seal during operation creating a leak that will manifest within the first few brake applications after assembly

D. The caliper bore scoring that catches a fingernail is too deep for a successful rebuild — the scores will cut the new piston seal causing it to leak and the caliper must be replaced rather than rebuilt with new seals

35. A truck's parking brake holds adequately on level ground and moderate grades. On a steep grade (12%), the parking brake holds initially but the vehicle slowly creeps forward after approximately 30 seconds. What is causing this gradual release?

A. The spring brake chamber has a slow internal air leak on the supply side — the residual air gradually re-pressurizes the spring chamber after the parking brake valve exhausts the supply causing the spring to partially compress

B. The spring brake chamber's diaphragm or housing has a slow leak that allows the trapped air behind the spring to gradually escape reducing the spring's extension force until it can no longer hold the loaded vehicle on the steep grade

C. The brake drum is expanding from the residual heat of recent driving and the thermal expansion moves the friction surface away from the linings reducing the contact force until the spring can no longer overcome the grade's gravitational pull

D. The automatic slack adjuster is gradually releasing its internal ratchet mechanism under the sustained reverse loading of the steep grade allowing the pushrod to slowly retract and reduce the lining-to-drum contact force over time

36. A truck's air system governor has been replaced. After the replacement, the technician performs an air system build-up test. The system builds from 0 to 690 kPa (100 psi) in 2 minutes. The specification maximum is 3 minutes. However, when the system reaches governor cut-out, the pressure continues to rise slowly instead of stabilizing. What has failed?

A. The governor is not signaling the compressor to unload at the cut-out pressure — either the governor's sensing mechanism is faulty or the signal line to the compressor's unloader is not connected or is kinked

B. The air dryer purge valve is not opening when the governor signals cut-out and the compressor continues to pump air into the system because the purge cycle does not initiate to unload the compressor through the dryer

C. The compressor's unloader mechanism is stuck in the loaded position and cannot respond to the governor's unload signal because the mechanism was damaged during the governor replacement procedure

D. The one-way check valve between the supply tank and the governor is stuck closed and the governor cannot sense the system pressure to signal cut-out — the compressor continues to load because the governor reads zero

37. A heavy-duty truck's brake drum has been measured and shows a maximum diameter of 420 mm. The discard diameter stamped on the drum is 422 mm. The drum has minor scoring. Should the drum be machined or replaced?

A. The drum should be replaced because machining to remove the scoring would bring the diameter to approximately 421 mm leaving only 1 mm of remaining service life before reaching the discard diameter at the next inspection

B. The drum can be machined to remove the scoring as long as the post-machining diameter does not exceed the 422 mm discard limit — the remaining 2 mm of allowable machining provides adequate room for the scoring removal

C. The drum should be machined to exactly 422 mm to maximize the remaining service life because the discard diameter is the maximum machined diameter not the in-service wear limit that requires additional margin

D. The drum must be replaced immediately because any drum showing scoring requires replacement regardless of the remaining diameter to prevent the scoring from transferring a groove pattern to the new brake linings

38. A trailer equipped with spring brakes has one spring brake chamber that takes noticeably longer to release than the other three when the parking brake valve is pushed in. The air supply pressure at the slow-releasing chamber reads the same as the others. What is the most likely cause?

A. The supply line to the slow-releasing chamber has an internal restriction from a kink, contamination, or a partially closed fitting that limits the air flow rate even though the static pressure reading is equal at the fitting

B. The spring inside the slow-releasing chamber has a stronger spring force than the others from a manufacturing variation and requires more time for the air pressure to compress the stronger spring to the fully released position

C. The air system has a check valve in the supply line to that specific chamber that is stuck partially closed restricting the flow volume while still allowing the static pressure to equalize given enough time at the gauge reading point

D. The brake shoes on that wheel are dragging against the drum creating mechanical resistance that the spring brake chamber must overcome in addition to compressing the spring which slows the release compared to the free wheels

39. A truck's front disc brake rotors have been replaced with new rotors. During the first road test, the technician performs several moderate stops and notes that the braking force builds progressively over the first 20 stops. Why does the braking force increase during these initial stops?

A. The brake caliper pistons need to extend to the new rotor's thickness and each stop pushes the pistons slightly further out of their bores until the piston travel matches the new rotor's running clearance

B. The new rotor surface has a protective coating (anti-rust compound) from manufacturing that must wear away before the full friction surface is exposed for pad contact during braking application events

C. The brake pads need to conform to the new rotor surface finish — the initial contact is on high spots only and each stop wears the pads to match the rotor's surface increasing the effective contact area progressively

D. The new rotors and the existing pads must establish a transfer layer — the friction material from the pads transfers to the rotor surface creating the designed friction interface that builds progressively over the initial stops

40. A truck's ABS system has a fault code for "yaw rate sensor signal implausible." The truck drives straight and brakes normally without any noticeable handling issues. What function uses the yaw rate sensor and what capability is lost with this fault?

A. The yaw rate sensor provides the electronic stability control (ESC) system with the vehicle's rotational behaviour data — losing this input disables the ESC function while the base ABS continues to operate normally

B. The yaw rate sensor provides the ABS system with road surface friction data that it uses to optimize the brake pressure modulation — losing this input reduces the ABS efficiency but does not disable the system

C. The yaw rate sensor provides the transmission control module with vehicle handling data for shift optimization — losing this input may cause slightly delayed shifts during cornering but does not affect braking

D. The yaw rate sensor provides the cruise control system with lateral stability data — losing this input disables the cruise control on curves while the base braking and ABS systems continue operating normally

41. A truck's brake chamber type designation is "Type 30." What does the number "30" refer to?

A. The maximum allowable pushrod stroke in millimetres for that chamber type under the regulatory standard for brake adjustment compliance inspection requirements during roadside enforcement checks

B. The chamber's diaphragm diameter in inches multiplied by a factor that determines the standard — a Type 30 has an effective diaphragm area of approximately 30 square inches and produces proportional force

C. The maximum air pressure in PSI that the chamber is rated to withstand during continuous operation without exceeding the safety factor for the diaphragm material's burst strength under cyclic loading conditions

D. The chamber's weight rating in pounds that determines which axle position the chamber can be installed on — a Type 30 is rated for axle positions that do not exceed 30,000 pounds of axle weight loading

42. A truck's air brake system has a complaint that the brakes apply gradually when the pedal is pressed quickly — there is a noticeable delay between the pedal input and the full brake force. The air system pressure is normal and there are no leaks. What is the most likely cause?

A. The relay valves have a restricted delivery port from contamination that limits the flow rate of air from the reservoir to the brake chambers during the rapid application creating the gradual build-up instead of immediate response

B. The foot valve's delivery piston seals are worn and require more pedal travel before they seat and begin building pressure in the delivery circuits — the worn seals create a dead zone at the beginning of pedal travel

C. The brake chamber diaphragms have stiffened from age and the rigid diaphragms resist the initial air pressure creating a delay before the air overcomes the diaphragm's resistance and begins to push the pushrod forward

D. The air lines between the relay valves and the brake chambers are undersized or excessively long creating a flow restriction that limits the fill rate of the chambers during rapid pedal application events

43. A tractor-trailer combination has the trailer connected with both the red (supply) and blue (service) gladhands properly coupled. The driver builds full system pressure and tests the trailer brakes by making a brake application. The trailer brakes do not apply. The tractor brakes function normally. What should be checked first?

A. The trailer service gladhand connection for a crossed connection — if the supply and service gladhands are reversed the service signal pressure goes to the supply circuit and the supply goes to the service creating no brake application

B. The tractor protection valve for a closed condition that prevents air from reaching the trailer circuit even though the supply valve has been pushed in and the trailer should be receiving supply air from the tractor

C. The trailer relay valve for a stuck-closed delivery piston that cannot respond to the service signal from the tractor's foot valve and cannot deliver reservoir air to the trailer brake chambers during brake applications

D. The trailer brake chambers for a common-circuit failure such as a frozen supply line or a blocked quick-release valve that prevents air from reaching any of the trailer's brake chambers during the service brake application

44. A truck's rear drum brakes have been relined and properly adjusted. During the first loaded trip, the driver reports a vibration during braking that is proportional to wheel speed. The vibration is felt through the brake pedal and the steering wheel. What is the most likely cause?

A. The new brake linings have not yet bedded in to the drum surface and the initial contact is concentrated at a few high points creating an intermittent grab-release pattern that produces vibration once per wheel revolution

B. The brake drums have not been machined before the new linings were installed and the drums' existing out-of-round condition creates an uneven contact pattern that produces vibration once per wheel revolution during braking

C. The new brake linings are slightly oversize and bind in the drum at one rotational position creating a grab-release cycle that produces the vibration — the linings will wear to the correct dimension during the break-in period

D. The brake drums have an out-of-round condition or thickness variation that creates a once-per-revolution braking force variation — the drums should have been measured and machined before the new linings were installed

45. A truck's air system safety valve (pop-off valve) is located on the supply (wet) tank. The valve is set to open at approximately 150 PSI (1,035 kPa). During testing, the governor fails to unload the compressor and the pressure rises. At what point does the safety valve protect the system?

A. The safety valve opens continuously when the governor fails to unload, maintaining a constant pressure slightly above the cut-out setting by venting excess air to atmosphere until the governor fault is corrected

B. The safety valve opens when the pressure exceeds the safety valve's setting (150 PSI/1,035 kPa) and prevents the system from building pressure beyond this point by venting the excess compressor output directly to atmosphere

C. The safety valve opens at 150 PSI and vents all the air from the system to zero pressure as a safety measure to force the vehicle to stop when the governor fails because continued operation without governor control is dangerous

D. The safety valve opens briefly at 150 PSI to alert the driver with the loud exhaust noise and then closes to allow the pressure to build again creating a cycling alarm that repeats until the driver shuts the engine off manually

46. A truck's automatic slack adjuster has been replaced. The manufacturer's installation instructions require the adjuster to be installed at a specific clock position on the S-cam splines and the initial pushrod stroke set to a specific length. The technician installs the adjuster but sets the initial stroke 10 mm shorter than specified (tighter than designed). What will happen?

A. The brakes will apply immediately when the truck moves because the over-tight initial adjustment holds the linings against the drum continuously from the moment the wheels begin to rotate under the vehicle's weight

B. The automatic adjuster will immediately back off to the correct clearance on the first brake application because the internal mechanism detects the over-tight condition and reverses its adjustment direction to compensate

C. The brakes may drag initially and the automatic adjuster will not correct the over-tight condition because automatic slack adjusters only tighten — they cannot release an over-adjusted brake to a looser setting

D. The brakes will function normally because the automatic slack adjuster's internal mechanism will immediately adjust to the correct clearance regardless of the initial setting within the first few brake applications during driving

47. A truck's engine will not crank. The battery voltage reads 12.6 volts. When the key is turned to the start position, the dash lights dim momentarily but the starter does not engage — no click is heard. What should the technician check first?

A. The starter control circuit — the ignition switch, the neutral safety switch or clutch interlock, the start relay, and the wiring between these components for an open circuit that prevents the start signal from reaching the solenoid

B. The starter motor for an internal short that draws current (causing the lamp dim) but cannot energize the solenoid because the shorted winding diverts the current away from the solenoid coil during the start attempt

C. The battery cables for a high-resistance connection that allows enough current to dim the lamps but cannot pass the solenoid's pull-in current needed to engage the solenoid plunger and close the motor circuit

D. The flywheel ring gear for a damaged tooth that is preventing the starter drive gear from meshing and the mechanical interference prevents the solenoid from pulling in completely to close the motor contacts

48. A truck's scan tool shows the engine coolant level sensor alternating rapidly between "OK" and "LOW" readings at a rate of approximately 2 cycles per second. The coolant level is verified as correct. What is causing the rapid cycling?

A. The coolant level is exactly at the sensor's detection threshold and the normal vibration of the engine causes the coolant surface to oscillate above and below the sensor probe creating the rapid alternating readings

B. The coolant level sensor has a cracked ceramic element that makes and breaks contact with the coolant as the engine vibrates causing the rapid cycling between the two states during normal engine operation at all speeds

C. The ECM's sensor input circuit has a filtering error that is not averaging the sensor signal over the designed time window and the unfiltered raw signal cycles rapidly between the two states during normal engine vibration

D. The coolant is at the sensor's threshold level and the engine's vibration causes the coolant surface to oscillate across the sensor probe — the rapid cycling confirms the level is at or very near the sensor's detection point

49. A truck equipped with a J1939 CAN bus has the engine ECM replaced under warranty. After the replacement, the engine starts and runs correctly but the transmission shifts erratically. The old ECM was removed and a new ECM was installed and programmed with the correct calibration file. What was likely not configured?

A. The vehicle speed sensor calibration was not transferred from the old ECM to the new one and the incorrect speed calculation causes the transmission to shift at incorrect speeds during every driving condition

B. The fuel injection timing calibration was not transferred and the altered combustion characteristics change the engine's torque output profile which the transmission interprets as an incorrect throttle demand during shifting

C. The customer parameters (vehicle configuration settings such as axle ratio, tire size, fan engagement temperature, and idle shutdown timer) were not transferred from the old ECM to the new unit

D. The transmission's torque management interface parameters were not programmed in the new ECM and the engine cannot respond to the transmission's torque reduction requests during gear changes producing harsh shifts

50. A truck's alternator has been bench-tested and produces the correct voltage and full rated current. After reinstallation, the batteries remain undercharged despite several hours of driving. The charging cables and connections have been tested and are within specification. What should be checked next?

A. The alternator's voltage sense wire for a disconnection or high resistance that prevents the voltage regulator from reading the actual battery voltage — without this feedback the regulator may charge at a default reduced rate

B. The alternator drive belt for correct tension under the full charging load — a belt that holds adequate tension during the bench test's zero-load spin may slip under the actual vehicle's full electrical load condition

C. The vehicle's total electrical load to verify it does not exceed the alternator's sustained output — if the accessories, parasitic loads, and battery charging demand exceed the alternator's capacity the batteries never fully recharge

D. The battery temperature sensor for a false reading that commands the voltage regulator to limit the charging voltage below the level needed for a full charge — the regulator reduces output to protect perceived hot batteries

51. A truck's windshield wiper system has a complaint that the wipers operate at only one speed regardless of the speed switch position. The switch has been tested and provides the correct resistance at each position. What is the most probable cause?

A. The wiper motor has a failed internal brush connection that bridges the low-speed and high-speed windings creating a single-speed condition regardless of which winding the switch selects during normal operation

B. The body controller's wiper speed output driver circuit has a fault that provides the same voltage or ground path to the motor regardless of the switch position signal it receives from the speed selection input

C. The wiper motor's ground circuit has excessive resistance that limits the current flow through both speed windings to the same effective level causing both speed settings to produce identical wiper speeds during operation

D. The wiper motor's internal park switch has shorted to the high-speed brush connection causing the motor to run at high speed continuously regardless of the speed switch selection during all operating modes

52. A truck has a parasitic battery drain of 350 milliamps. The specification allows a maximum of 50 milliamps. The technician pulls fuses one at a time while monitoring the ammeter. When the fuse for the body controller is pulled, the drain drops to 40 milliamps. Does this confirm the body controller is the fault?

A. No — the body controller powers multiple downstream circuits through its outputs and one of the components powered by the controller (such as a lighted switch, solenoid, or relay coil) may be the actual current draw source

B. Yes — the body controller has an internal fault that keeps one of its output stages energized during the key-off sleep mode and the controller must be replaced to eliminate the parasitic drain on the battery system

C. No — pulling the body controller fuse disrupts the CAN bus communication which may cause other modules to enter a higher-power default state that masks their actual parasitic draw by redistributing the current paths

D. The body controller circuit is confirmed as the source of the drain but the controller and all components powered through its fused circuit must be individually tested to isolate whether the controller or a downstream component is drawing the current

53. A truck's LED tail lamp assembly has been replaced after collision damage. After installation, the tail lamps illuminate but the brake lamps flash rapidly when the brake pedal is pressed instead of illuminating steadily. What is the most likely cause?

A. The LED lamp assembly is designed for a different vehicle model and the internal driver circuit's frequency does not match the body controller's brake lamp output signal creating a rapid flashing from the incompatibility

B. The body controller detects the LED lamp's lower current draw as a partial bulb failure and commands a rapid flash pattern as a bulb-out warning to the driver and following vehicles during each brake application event

C. The replacement LED assembly has an internal wiring error that connects the brake lamp LEDs to the turn signal driver circuit instead of the brake lamp driver and the turn signal flasher frequency produces the rapid flashing

D. The brake lamp circuit has a voltage drop from a poor connector installation that intermittently drops the LED driver's supply below its minimum operating threshold causing the driver to cycle on and off rapidly during braking

54. A truck's engine ECM communicates with the instrument cluster through the J1939 CAN bus. The cluster's speedometer reads correctly but the tachometer reads 500 RPM higher than the actual engine speed confirmed by a scan tool connected to the ECM. What is the most likely cause?

A. The instrument cluster is receiving the correct CAN bus data but the tachometer stepper motor has a mechanical fault that positions the needle at a different location than the received data commands during operation

B. The instrument cluster's internal software has a calibration error on the tachometer channel that applies an incorrect conversion factor to the CAN bus RPM data producing a consistent 500 RPM offset at all engine speeds

C. The engine ECM is broadcasting the RPM data at a higher value than the actual engine speed and the cluster is accurately displaying the incorrect data it receives from the ECM's CAN bus broadcast during operation

D. The CAN bus has a noise source that is adding voltage to the tachometer data parameter specifically while leaving all other parameters unaffected during the transmission between the ECM and the instrument cluster display

55. A truck's battery disconnect switch has been activated (batteries disconnected). When the switch is turned back on, the engine starts normally but the power windows do not operate, the interior lights remain off, and the HVAC blower does not function. The fuses for these circuits are all good. What is the most likely cause?

A. The battery disconnect switch has developed high internal resistance on one of its contacts and the reduced voltage cannot power the body controller that manages the windows, lights, and HVAC blower motor outputs

B. The body controller requires a re-initialization procedure after a battery disconnect event — the controller must complete its power-on sequence before enabling its outputs which may require a specific key cycle or time delay

C. The body controller has lost its configuration programming during the battery disconnect and must be reprogrammed with the vehicle's option codes using the manufacturer's diagnostic software before it will enable any outputs

D. The battery disconnect switch only connects the engine starting circuit when turned on and a separate accessory power relay must be manually engaged from the cab to restore power to the body controller's supply circuit

56. A truck's scan tool retrieves a fault code from the ABS module — SPN 790, FMI 7 (mechanical system not responding) for the right front wheel speed sensor. The sensor is an active type. What does FMI 7 indicate in this context?

A. The ABS module is receiving a signal from the sensor but the signal pattern does not match the expected characteristics for the wheel speed — the tone ring may be damaged, missing teeth, or the sensor is misaligned

B. The sensor is producing a constant output regardless of wheel rotation — the ABS module receives a steady signal that does not change with speed indicating the sensor detects no mechanical movement from the tone ring

C. The ABS module has detected an electrical fault in the sensor's supply circuit that prevents the active sensor from receiving the power needed to generate its signal output during wheel rotation at any speed

D. The ABS module is commanding the sensor to perform a self-diagnostic test and the sensor's mechanical test function (a built-in vibrating element) is not responding to the module's test command during the self-check cycle

57. A truck's multiplex electrical system has the headlamps controlled by the body controller through CAN bus commands from the headlamp switch. The driver turns the headlamp switch to the ON position but the headlamps do not illuminate. The parking lamps, controlled by the same switch and body controller, illuminate normally. What should the technician check?

A. The CAN bus communication between the switch and the body controller because a partial data corruption could affect only the headlamp command while the parking lamp command transmits correctly through the same message

B. The headlamp switch for an internal contact failure on the headlamp position that prevents the switch from sending the headlamp-on command to the body controller while the parking lamp contact functions correctly

C. The body controller's headlamp output driver circuit — the parking lamps work through the same controller confirming the controller receives commands but the headlamp-specific output driver or its fuse may have failed

D. The headlamp relay that the body controller activates for the high-current headlamp circuit — parking lamps draw less current and may be directly driven by the controller while the headlamps require a relay for the higher load

58. A truck's charging system produces 14.4 volts at the battery terminals with all accessories off. When the headlamps, blower motor, and heated mirrors are turned on simultaneously, the voltage drops to 12.8 volts. What does this voltage drop under load indicate?

A. The alternator cannot maintain its regulated output under the combined accessory load — either the alternator's maximum output has been reached or the field circuit cannot increase the field current to match the higher demand

B. The voltage drop is normal because the battery absorbs the additional load and its internal resistance creates the voltage drop that appears at the terminals while the alternator continues producing its rated output internally

C. The headlamp circuit has a ground fault that is drawing excessive current and overloading the alternator beyond its capacity — the ground fault consumes current that the alternator cannot produce causing the voltage drop

D. The battery cables have high resistance that is only apparent under the heavy current draw of the combined accessories — the resistance creates a voltage drop proportional to the total circuit current during the loaded condition

59. A truck's engine ECM has set a fault code for the barometric pressure sensor — SPN 108, FMI 2 (erratic/intermittent). The sensor is internal to the ECM. The code sets intermittently during driving. What environmental condition could affect an internal barometric sensor?

A. Excessive engine compartment temperature that reaches the ECM housing and affects the barometric sensor's internal calibration during high-load driving conditions in hot ambient environments during summer operation

B. Electromagnetic interference from the alternator or ignition system that induces noise on the barometric sensor's internal circuit during driving conditions with high electrical loads on the vehicle's charging system

C. Water or oil vapour entering the ECM housing through the barometric sensor's atmospheric reference port — the port must be open to atmosphere but contamination entering through the port affects the sensor's reading

D. Vibration from the engine or road surface that physically shakes the ECM housing causing the internal barometric sensor element to produce erratic readings as the vibration disturbs the sensor's pressure measurement

60. A truck equipped with LED marker lamps has one marker lamp that is significantly dimmer than all others. The lamp is the correct part number and appears undamaged. The voltage at the lamp connector reads 12.4 volts — identical to the other functioning lamps. What is the most likely cause?

A. The LED lamp's internal current-limiting resistor has increased in value from thermal cycling limiting the current flow through the LEDs below their designed brightness level despite receiving adequate supply voltage

B. The LED lamp has a partial failure — one or more LED segments within the assembly have failed reducing the total light output while the remaining functional segments illuminate at their normal brightness level

C. The lamp connector has a high-resistance ground connection that limits the total current through the lamp circuit despite the voltage reading appearing normal at the positive terminal of the lamp connector

D. The LED lamp was stored at temperatures below its specified minimum before installation and the cold-storage exposure permanently damaged some of the LED junctions reducing their light output efficiency

61. A truck's CAN bus diagnostic connector (9-pin Deutsch or OBD connector) has been damaged and several pins are bent. The technician straightens the pins and verifies continuity on all pins. After the repair, the scan tool connects to some modules but cannot communicate with others. What is the most likely cause?

A. The straightened pins have micro-cracks from the bending that create an intermittent high-resistance connection under the pressure of the scan tool connector's pin contact during the communication attempt

B. The bent pins were for specific module addresses on the CAN bus and the straightening process created an increased resistance on those pins that attenuates the CAN signal below the detection threshold for those modules

C. The diagnostic connector's pin alignment is critical for the CAN bus differential signal pair — if the CAN-H and CAN-L pins are not perfectly aligned the differential impedance changes and some modules cannot communicate

D. The bent pins created internal damage to the connector's housing that shifted the other pins slightly — the scan tool connects to modules whose pins maintained good contact but cannot reach modules on the misaligned pins

62. A truck's engine cranks at normal speed but the scan tool shows 0 RPM during cranking. The engine does not start. No fault codes are stored. What sensor failure produces a 0 RPM reading during cranking?

A. The crankshaft position sensor has failed — without the CKP signal the ECM cannot determine engine speed and displays 0 RPM during cranking and will not command fuel injection without this primary engine position input

B. The camshaft position sensor has failed — without the CMP signal the ECM displays 0 RPM and cannot determine which cylinder is at TDC compression to establish the correct injection firing order for starting

C. Both the crankshaft and camshaft sensors must fail simultaneously to produce a 0 RPM reading — a single sensor failure would still allow the ECM to calculate RPM from the remaining sensor's signal during cranking

D. The vehicle speed sensor has failed — some ECMs derive the cranking RPM from the vehicle speed sensor signal during the starting event and a failed VSS produces the 0 RPM display during the cranking attempt

63. A truck's trailer electrical connector has intermittent failures on the ABS power circuit (pin 7). The pin and socket appear clean when inspected visually. A voltage drop test under load shows 3.2 volts drop at the connector. What should be done?

A. Clean the connector pins and socket with electrical contact cleaner and apply dielectric grease then retest — the visual inspection did not detect the micro-corrosion or oxide that is creating the 3.2-volt resistance drop

B. Replace the seven-pin connector socket on the tractor because the internal contact spring tension has weakened and the reduced contact force creates the high-resistance connection that produces the 3.2-volt drop under load

C. Install a larger-gauge wire bypass from the tractor's ABS fuse directly to the trailer's ABS module that routes around the seven-pin connector eliminating the connector's resistance from the ABS power supply circuit

D. The connector must be cleaned, the pin and socket contacts inspected for pitting, the contact spring tension verified, and the connector replaced if cleaning does not restore the voltage drop to within the 0.5-volt specification

64. A truck's alternator field circuit uses an externally regulated configuration where the voltage regulator is mounted separately from the alternator. The regulator has been replaced. After the replacement, the alternator charges at 16.2 volts — significantly above the 14.0-14.5 volt specification. What is the most likely cause?

A. The replacement voltage regulator is for a 24-volt system and is commanding a higher field current than a 12-volt regulator would to achieve a 28.8-volt target that appears as 16.2 volts in the 12-volt system

B. The replacement regulator has the correct voltage rating but the sensing wire was connected to the wrong terminal causing the regulator to sense a lower voltage than actual and over-regulate to compensate

C. The replacement regulator's internal voltage reference has a factory defect that sets the regulation point at 16.2 volts instead of the designed 14.0-14.5 volts and the regulator must be returned as a defective unit

D. The alternator's internal wiring has been modified from its original configuration during a previous service and the modification creates a voltage feedback loop that causes the external regulator to overcharge regardless of the model

65. A truck equipped with a telematics system transmits vehicle data to the fleet management office every 60 seconds. The fleet manager reports gaps in the data — periods of 5 to 10 minutes where no

data is received. The telematics unit appears to function normally. What is the most likely cause of the data gaps?

A. The cellular modem in the telematics unit has a weak antenna connection that loses signal during specific driving routes where cell tower coverage is marginal creating the gaps in the data transmission during those periods

B. The CAN bus data feed to the telematics unit is intermittent and the unit transmits null data during the dropout periods which the fleet management server rejects as invalid creating the appearance of gaps in the data

C. The telematics unit has a limited on-board data buffer and drops older data when the buffer fills during high-data-rate periods of engine operation creating the gaps in the stored and transmitted data at those times

D. The cellular network has coverage gaps along the vehicle's route where the telematics unit cannot establish a connection to transmit data — the unit stores the data locally but the fleet server does not receive it in real time

66. A truck's power window motor on the driver side operates very slowly in the up direction but at normal speed in the down direction. The motor draws 15 amps going up and 6 amps going down. The normal specification is 8 amps in both directions. What does the directional current difference indicate?

A. The window regulator mechanism has a mechanical resistance that is greater in the up direction than the down direction — the motor draws more current to overcome the additional resistance of raising the window against gravity

B. The window motor has a failing brush or commutator segment that reduces its efficiency in one rotational direction while functioning normally in the other direction from the brush wear pattern and commutator condition

C. The power supply polarity reversal switch has developed high resistance on one contact set that limits the available voltage to the motor in the up direction while the down direction contacts remain clean and fully conductive

D. The window channel has accumulated dirt and debris on one side that creates friction specifically during the upward travel while the downward travel follows the clean side of the channel without encountering the same resistance

67. A truck's scan tool displays the engine oil life monitor at 12% remaining. The oil was changed 40,000 km ago. The oil change interval recommended by the oil life monitor algorithm is typically 50,000 km for this engine's operating conditions. What factors does the oil life monitor use to calculate the remaining oil life?

A. The oil life monitor uses a fixed kilometre-based interval that is adjusted by the ECM based on the vehicle's average speed — higher average speeds extend the interval while lower averages shorten it proportionally

B. The monitor uses only the elapsed time since the last oil change reset and the total engine operating hours to calculate the remaining life as a percentage of the designed maximum time-and-hours interval

C. The monitor measures the oil's actual condition through an optical sensor in the oil pan that detects the oil's opacity (darkness) and viscosity in real time and calculates the remaining life from these physical measurements

D. The oil life monitor algorithm considers engine operating hours, fuel consumption, coolant temperature, duty cycle severity, idle time percentage, and other operating parameters to calculate the oil's remaining useful life

68. A truck's starter motor has been tested and produces adequate cranking speed. However, the engine starts but runs very rough for approximately 5 seconds before smoothing out. No fault codes are present. The fuel system primes correctly and the fuel pressure is adequate during cranking. What should be checked?

A. The glow plug system for one or more failed glow plugs that cannot preheat their respective cylinders — the affected cylinders misfire until combustion heat warms them enough for autoignition producing the initial roughness

B. The injector calibration codes for an error that causes unequal fuel delivery across cylinders during the cold-start enrichment strategy — the imbalanced fuel creates the rough running until the enrichment period ends and normal fuelling resumes

C. The intake manifold heater (grid heater) for a partial failure that heats the intake air unevenly — some cylinders receive heated air while others receive cold air creating an uneven combustion quality during the initial start period

D. The engine's cam sensor signal for a phase error that causes the ECM to command injection timing that is slightly off from the optimal cold-start timing — the error corrects itself as the ECM's adaptive algorithms update during running

69. A truck equipped with a manual transmission has a complaint that the transmission grinds when shifting into reverse. All forward gears engage smoothly. The clutch is adjusted correctly and fully disengages. What is the most common cause of reverse gear grinding?

A. Reverse gear in most manual transmissions is not synchronized — the input shaft must be completely stopped before engaging reverse and any residual rotation causes the non-synchronized reverse idler gear to grind during engagement

B. The reverse idler gear has worn teeth that prevent smooth engagement with the mainshaft reverse gear creating a grinding contact during every shift into reverse regardless of the input shaft speed at the time of selection

C. The reverse synchronizer blocking ring has worn and cannot match the speed between the sliding clutch and the reverse gear creating the grinding during the engagement attempt when the reverse gear is selected

D. The clutch disc has warped from heat and drags against the flywheel even with the clutch fully disengaged preventing the input shaft from stopping which causes the reverse idler to grind during every engagement attempt

70. A truck's automatic transmission produces a whining noise in reverse but is quiet in all forward gears. The fluid level and condition are correct. What is the most likely source of this reverse-only noise?

A. The reverse band has a worn friction surface that vibrates against the drum during reverse application creating the whine from the friction-induced vibration at the band's contact frequency during reverse gear operation

B. The planetary gear set's ring gear has worn teeth that only engage during reverse operation — in forward gears the ring gear is held by the band and does not rotate but in reverse the ring gear rotates and produces noise

C. The reverse gear train has a unique gear mesh that produces more noise than the forward gear combinations — some reverse gear whine is a normal characteristic of the helical gear cut angle used in the reverse gear train

D. The oil pump's internal relief circuit changes direction in reverse creating a flow pattern that produces the whining noise through the pump housing — the forward flow pattern does not produce audible noise from the pump

71. A truck's driveshaft U-joint has been replaced. During the road test, the technician notices a vibration at 80 km/h that was not present before the U-joint replacement. The driveshaft was reinstalled in the same orientation and the U-joints are correctly phased. What should be checked?

A. The U-joint bearing cap installation for a cap that was not fully seated in the yoke ear — a cap that is not pressed fully into the yoke shifts the U-joint's centre and changes the driveshaft's balance creating the vibration

B. The replacement U-joint for the correct physical dimensions — a U-joint with caps that are slightly longer or shorter than the original changes the driveshaft's effective length and operating angle at highway speed

C. The yoke ear bore diameter for enlargement from the previous U-joint's wear that allows the new bearing cap to fit loosely — the loose cap shifts position during rotation creating an imbalance at highway speed

D. The driveshaft for a bend that may have been introduced during the U-joint pressing process if the technician used excessive force on the press or struck the shaft while removing the old U-joint bearing caps

72. A truck's clutch engagement point is very close to the top of the pedal travel — the clutch engages only in the last 10 mm of pedal release. What does this high engagement point indicate?

A. The clutch disc friction material has worn thin and the release bearing must travel further before the remaining thin disc contacts the flywheel surface during engagement

B. The clutch hydraulic system has air trapped in the circuit that compresses during pedal depression absorbing some of the pedal travel before the hydraulic pressure moves the release bearing

C. The pressure plate diaphragm spring has taken a set from heat exposure and cannot generate adequate clamping force through the full range of clutch disc wear leaving only the last portion of travel effective

D. The clutch disc is worn to near minimum thickness — as the disc thins the pressure plate moves closer to the flywheel and the release bearing must travel further before the reduced-thickness disc contacts the flywheel

73. A truck equipped with a 10-speed manual transmission has a complaint of noise in 5th and 10th gears only. Both of these gears use the same countershaft gear pair (5th is direct with low split; 10th is

direct with high split). What component is common to both of these gear selections that would produce noise in both gears but not in the others?

A. The mainshaft direct-drive gear (which locks the input and output shafts together for both 5th and 10th) has a worn engagement dog or bearing surface that produces noise during the direct-drive power path used by both gears

B. The countershaft gear pair that meshes with the mainshaft in both 5th and 10th has a worn gear tooth surface and the same worn teeth mesh in both gear selections producing the identical noise in both of these specific ratios

C. The splitter gear synchronizer that differentiates between 5th (low split) and 10th (high split) has worn because it is the most frequently used synchronizer in highway driving and produces noise in both positions during engagement

D. The transmission output shaft bearing is failing and produces noise specifically during the loading pattern that occurs in both 5th and 10th gears but not in other gears because the shaft load direction changes with the gear ratio

74. A truck's drive axle has been rebuilt and the ring and pinion backlash has been set to the middle of the specification range. During the road test, the axle produces a whine during cruise and coast but is quiet during acceleration. What does this noise pattern suggest?

A. The pinion depth is incorrect — the pinion is set too deep or too shallow and the gear mesh contact is on the wrong portion of the tooth face creating the whine during the coast and cruise loading conditions

B. The ring gear is running eccentrically from a carrier bearing that was not properly preloaded and the gear shifts position between acceleration and coast changing the gear mesh from proper contact to a misaligned contact

C. The backlash is set correctly but the pinion bearing preload is too loose allowing the pinion to shift under the different loading directions of cruise and coast creating an intermittent gear mesh error that produces the whine

D. The drive-side contact pattern may be acceptable but the coast-side pattern is incorrect — the different tooth contact geometry under coast and cruise loading produces the whine when the load shifts from the drive face to the coast face

75. A truck's clutch slave cylinder has been replaced. After bleeding the clutch hydraulic system, the clutch pedal has a firm feel but the clutch does not fully disengage — the transmission grinds during shifts. What is the most probable cause?

A. The slave cylinder's internal spring preload is different from the original and the different spring force changes the effective travel of the pushrod against the release fork reducing the total release bearing travel

B. The replacement slave cylinder has a shorter stroke than the original and the reduced pushrod travel does not move the release bearing far enough to fully disengage the clutch pressure plate from the disc surface

C. The hydraulic system has residual air trapped in the slave cylinder that compresses during pedal depression absorbing some of the pedal travel and reducing the effective pushrod stroke at the release bearing contact point

D. The clutch hydraulic fluid has absorbed moisture during the service and the reduced boiling point allows vapour pockets to form in the slave cylinder during each heavy pedal application creating incomplete disengagement

76. A drive axle has been drained for bearing inspection. The technician discovers that the pinion bearing cone has a line of small pits running diagonally across the roller surface. This pattern repeats on several rollers in the same bearing. What does this pitting pattern indicate?

A. The bearing has been contaminated with abrasive particles in the lubricant that have embedded in the roller surface and the embedded particles create the pitting as they rotate through the bearing race during operation

B. The pitting is from normal fatigue life — the bearing has operated for its designed number of load cycles and the subsurface metal fatigue has progressed to the surface creating the spalling pattern on the roller faces

C. The bearing was installed with insufficient preload and the rollers have been skidding rather than rolling during operation — the skidding creates the diagonal pitting pattern from the intermittent metal-to-metal contact

D. The bearing has developed spalling from fatigue — the diagonal pattern across the roller surface indicates subsurface stress has caused material to flake from the hardened roller surface signaling the bearing's end of life

77. A truck's transfer case oil is being changed. During draining, the technician notices the oil has a strong burnt odour and contains visible metal flakes. The transfer case has 200,000 km of service. What should the technician recommend beyond simply refilling with new oil?

A. The transfer case should be inspected internally for gear, bearing, and chain (or gear train) damage because the burnt oil and metal flakes indicate the internal components have been operating under distressed conditions

B. The transfer case oil should be changed twice more at 1,000 km intervals to flush the metal debris from the housing before performing any further internal inspection of the gears and bearings for damage

C. The metal flakes are normal wear debris from 200,000 km of service and the burnt odour is from the anti-wear additives breaking down at their expected rate — refilling with new oil and the correct additive is adequate

D. The transfer case should be removed and sent to a rebuild facility because the metal flakes indicate a catastrophic failure is imminent and continued operation could result in a driveshaft separation on the highway

78. A truck equipped with an automated manual transmission has a fault code for "clutch teach-in required." What does this procedure accomplish?

A. The teach-in procedure measures the clutch's actual engagement point (touch point) and full-release position so the AMT controller can accurately modulate the clutch actuator for smooth engagement during each shift event

B. The teach-in procedure calibrates the engine's idle speed to match the AMT controller's expected engine speed during each clutch engagement allowing the controller to calculate the correct fuel reduction during shifts

C. The teach-in procedure programs the AMT controller with the clutch disc's friction material coefficient so the controller can calculate the correct slip rate for the specific disc material during each engagement event

D. The teach-in procedure measures the clutch actuator's full stroke range, the engagement point position, and the actuator's response time so the controller has accurate position data for precise clutch control during all operations

79. A truck's automatic transmission has a complaint that it slams into gear when shifted from Park to Reverse while the engine is idling. The fluid level is correct and the shift from Park to Drive is smooth. What is the most likely cause?

A. The reverse servo apply pressure is too high from a stuck valve in the valve body that allows full main pressure to the reverse servo instead of the cushioned pressure designed for the Park-to-Reverse engagement event

B. The engine idle speed is too high creating a larger speed differential between the impeller and stalled turbine — the higher idle speed produces more converter torque multiplication when the reverse band applies aggressively

C. The reverse band apply servo has a failed cushion spring that should absorb the initial application force and create a gradual engagement — without the cushion the band applies at full force creating the harsh slam

D. The torque converter drain-back check valve has failed and the converter is empty during parking — when Reverse is selected the pump must refill the converter creating a momentary hydraulic hammer as the fluid rushes in

80. A truck's driveshaft slip yoke has developed wear marks (fretting corrosion) on the spline surfaces. The slip yoke moves freely on the transmission output shaft with no binding. Should the slip yoke be replaced?

A. The fretting corrosion is cosmetic only and does not affect the slip yoke's function as long as the splines are not worn to the point where measurable rotational play exists between the yoke and the shaft during operation

B. The fretting corrosion indicates the spline surfaces are deteriorating and the yoke should be replaced — the corroded surfaces will accelerate wear on the transmission output shaft splines if the yoke continues in service

C. The fretting corrosion can be removed by polishing the spline surfaces with emery cloth and applying fresh spline grease — the restored surface will function normally with the clean grease preventing future corrosion

D. The slip yoke should be replaced along with the transmission output shaft seal because the corroded spline surface damages the seal lip creating a transmission fluid leak that accompanies the spline deterioration

81. A truck equipped with a compression brake has a complaint that the brake is noticeably quieter than when the engine was new. The retarding force is also reduced. The compression brake slave piston lash has been verified at the OEM specification. What is the most likely cause?

A. The exhaust valve seating surfaces have worn and the reduced compression seal allows some of the compressed air to leak past the valves during the compression brake hold period reducing both the noise and retarding force

B. The engine oil has degraded and the reduced oil viscosity cannot maintain adequate pressure at the slave pistons during the compression brake operation — the pistons do not fully actuate the exhaust valves at the worn oil condition

C. The compression brake solenoid valve has developed an internal leak that reduces the oil pressure delivered to the slave pistons below the level needed for full exhaust valve actuation during the compression brake event

D. The camshaft compression brake lobes have worn from 200,000+ km of service reducing the maximum exhaust valve lift during the brake event — less valve opening releases less compressed air per cycle reducing effectiveness

82. A truck's inter-axle differential lock has been engaged for an extended period of driving on dry pavement. After disengaging the lock, the technician notices the truck has developed a steering pull to the right that was not present before the lock was engaged. What happened?

A. The locked inter-axle differential created unequal torque distribution to the left and right wheels on the front drive axle and the unequal drive forces have bent the steer tie rod from the differential loading through the chassis

B. The locked inter-axle differential caused driveline windup that shifted one drive axle on its suspension mounts changing the thrust angle of the rear tandem and creating the steering pull from the altered tracking geometry

C. The front drive axle U-joints have been damaged from the torsional stress of operating with the locked differential on dry pavement and the damaged U-joints create a vibration that is perceived as a steering pull

D. The locked differential prevented the front and rear drive axles from turning at different speeds during turns and the resulting driveline windup has twisted a torque rod or shifted an axle alignment creating the steering pull

83. A truck's automatic transmission has been rebuilt. During the quality control test, the technician performs a stall test and measures the stall speed at 1,800 RPM. The specification is 2,100 to 2,200 RPM. What does the lower-than-specification stall speed indicate?

A. The engine is producing less power than specification and cannot spin the converter impeller fast enough to reach the designed stall speed — an engine power test should be performed to verify the engine's output

B. The torque converter stator one-way clutch has locked in both directions creating a direct mechanical connection through the converter that limits the RPM below the normal stall point from the increased resistance

C. The transmission main pressure is set too high and the friction elements are partially applied even during the stall test creating additional resistance that limits the engine's ability to reach the specified stall speed

D. The rebuilt transmission has a tighter-than-specification clutch pack clearance that allows the friction elements to partially engage during the stall test creating resistance that limits the engine RPM below the stall specification

84. A truck's driveshaft has a two-piece design with a centre bearing. The front section is longer than the rear section. The technician needs to replace both U-joints. After replacing the U-joints, the technician must verify the U-joint phasing. What is the correct phasing for a two-piece driveshaft?

A. The yoke ears at the transmission end must be aligned in the same plane as the yoke ears at the centre bearing — this ensures the front section's U-joints cancel each other's angular velocity variations during rotation

B. The yoke ears at each end of the front section must be aligned in the same plane, and the yoke ears at each end of the rear section must be aligned in the same plane — each section is phased independently

C. All four yoke ears (transmission, front of centre bearing, rear of centre bearing, and axle) must be aligned in the same plane to create a single-phase relationship through the entire two-piece driveshaft assembly

D. The yoke ears at the transmission end must be perpendicular (90 degrees) to the yoke ears at the centre bearing to create a cross-phased relationship that provides smoother torque delivery through the front section

85. A truck equipped with a hydraulic retarder has had the retarder serviced with a fluid change. After the service, the retarder produces adequate braking force but the vehicle's coolant temperature rises significantly during sustained retarder use on mountain descents. What was likely done incorrectly?

A. The retarder fluid was overfilled beyond the specification level and the excess fluid creates more friction and heat than the cooling system was designed to dissipate during sustained retarder operation on long descents

B. The retarder fluid was filled with the wrong specification fluid that has different thermal characteristics than the designed fluid creating more heat per unit of retarding force than the cooling system can absorb during sustained use

C. The retarder's cooling circuit air bleed was not performed after the fluid change and the trapped air in the cooling circuit reduces the coolant flow through the retarder heat exchanger limiting the heat rejection capacity

D. The retarder's heat exchanger cooling circuit was not properly reconnected or bled after the service and the reduced coolant flow through the heat exchanger limits the system's ability to reject the retarder's generated heat

86. A truck's steering gear has been adjusted to eliminate free play at the centre position. After the adjustment, the driver reports the steering wheel does not return to centre after completing a turn. What is the relationship between the steering gear adjustment and the loss of centering?

A. The sector shaft adjustment was set too tight creating binding throughout the gearbox's travel range that prevents the caster-induced centering force from overcoming the gearbox's internal friction during the return

B. The steering gear adjustment eliminates free play but does not affect the centering action which is provided by the caster angle — the loss of centering indicates a caster problem unrelated to the gearbox adjustment

C. The over-tight adjustment has increased the friction in the gearbox to the point where the vehicle's caster-driven centering force cannot overcome the gearbox friction — the steering wheel stays where the driver leaves it

D. The sector shaft adjustment has shifted the steering gear's internal geometry causing the output shaft to reach its stop before the wheels reach the straight-ahead position preventing the centering action from completin

87. A truck's front suspension has leaf springs with rubber helper pads between the spring and the frame bracket. The helper pads have deteriorated and fallen out. What effect does the loss of these helper pads have on the suspension?

A. The lost helper pads eliminate the progressive rate increase that normally occurs at full jounce — without the pads the suspension can bottom out on the bump stops with a harsh metal-to-metal impact during large bumps

B. The helper pads only affect ride quality during empty operation and their loss has no effect when the truck is loaded because the main leaf springs carry the entire load and the helper pads are not in contact during loaded driving

C. The lost pads create a rattling noise from the gap between the spring and the frame bracket but do not affect the suspension's load capacity or ride characteristics during normal loaded or empty driving operations

D. The helper pads are designed to prevent the spring from contacting the frame bracket during rebound and their loss allows the spring to impact the bracket during extension creating a clunking noise over bumps

88. A truck's wheel hub assembly uses a preset (unitized) bearing design that does not require end play adjustment. During a PM inspection, the technician detects a slight roughness when spinning the wheel. The technician adjusts the hub nut tighter to see if the roughness improves. Why is this incorrect?

A. Tightening the hub nut on a unitized bearing compresses the bearing's pre-set internal clearance which overloads the rolling elements and accelerates the bearing's failure from the excessive preload force during operation

B. Unitized bearings are designed with a specific internal clearance that cannot be changed externally — tightening the nut only affects the wheel retention and does not change the bearing's internal preload or clearance

C. The hub nut torque on a preset bearing is critical for maintaining the seal contact pressure and tightening the nut beyond specification damages the seal lip creating an oil leak that the technician must then repair

D. Tightening the hub nut on a preset bearing changes the bearing's internal preload beyond the designed specification — this overloads the rolling elements and seals and will cause premature bearing failure

89. A truck's rear air ride suspension has one trailing arm bushing that has completely failed — the rubber has separated from the metal sleeve. The driver reports the truck tracks straight during cruise but pulls to one side during acceleration only. What explains this acceleration-only pull?

A. The failed bushing allows the axle to shift rearward on the affected side during the acceleration load creating a thrust angle change that pushes the rear of the vehicle to one side which steers the front to the opposite side

B. The failed bushing allows the drive axle to shift rearward on that side during acceleration — the shifted axle creates a temporary thrust angle that pulls the vehicle to one side until the acceleration ends and the axle returns

C. The failed bushing allows the axle to pivot during acceleration changing the toe angle on that side which creates a steering effect that pulls the vehicle during acceleration but not during cruise when no drive torque loads the bushing

D. The failed bushing has no relationship to the acceleration pull — the pull is caused by unequal tire pressure between the drive axle tires that only manifests under the additional loading of acceleration from the torque bias effect

90. A truck's steer tire has a wear pattern where only the inner edge shows accelerated wear — the inner edge tread depth is 4 mm while the centre and outer edge have 10 mm remaining. What alignment condition causes inner-edge-only wear on a steer tire?

A. Excessive toe-out causes both steer tires to angle outward dragging the inner edges across the road surface and producing the accelerated inner-edge wear pattern from the constant scrubbing action on both tires

B. Insufficient toe-in causes the tires to point outward and the rolling direction forces the inner edge to scrub against the road surface creating the accelerated wear on the inner tread edge during straight driving

C. Excessive negative camber tilts the top of the tire inward concentrating the ground contact force on the inner tread edge and producing the accelerated wear from the disproportionate loading on that edge during driving

D. Worn king pin bushings allow the steer knuckle to shift dynamically during driving creating an intermittent negative camber condition that concentrates wear on the inner edge from the periodic tilting of the tire inward

91. A truck's frame rail has a crack at a cross-member mounting bracket. The technician drills stop holes at both ends of the crack. What is the purpose of the stop holes?

A. The stop holes remove the sharp crack tip that concentrates stress and replace it with a round hole that distributes the stress around its circumference — this prevents the crack from propagating further until a permanent repair is made

B. The stop holes allow a technician to insert bolts through the holes to clamp the cracked area together providing a temporary mechanical repair that holds the crack closed during vehicle operation until the permanent repair is scheduled

C. The stop holes are used as alignment reference points for the bolted splice plate that will be installed over the crack during the permanent repair — the plate bolts pass through these holes to position the plate correctly

D. The stop holes allow the frame to flex at the cracked location rather than concentrating the stress at the crack tip — the holes convert the rigid crack into a flexible joint that absorbs the frame loading without propagation

92. A trailer's suspension has been converted from leaf springs to air ride for improved ride quality. After the conversion, the trailer's brake performance has deteriorated noticeably. The brake components have not been changed. What explains the reduced braking performance?

A. The air ride suspension has different geometry than the leaf spring suspension and the altered axle position changes the brake chamber mounting angle which reduces the effective pushrod stroke during each brake application

B. The air ride conversion changed the trailer's ride height which altered the brake chamber's relationship to the slack adjuster arm creating a geometric disadvantage that reduces the braking force at each wheel position

C. The air ride suspension has a different axle wrap characteristic during braking than leaf springs and the altered axle movement changes the S-cam timing during each brake application reducing the shoe-to-drum contact force

D. The air ride suspension's softer spring rate allows more dynamic weight transfer during braking which unloads the rear axle more than the leaf spring suspension did and the reduced axle weight limits the available traction

93. A truck equipped with disc brakes on all positions has a complaint that the brake pedal slowly sinks to the floor when held with constant moderate pressure. The brake system uses air-over-hydraulic actuation on the front steer axle. The air system pressure is normal. What is the most likely cause?

A. The front brake caliper pistons have internal leaks past their bore seals that allow the hydraulic fluid to bypass slowly under sustained pressure draining the hydraulic circuit and causing the pedal to sink gradually

B. The air-over-hydraulic booster has a failed internal seal that allows hydraulic fluid to cross from the hydraulic side to the air side of the booster creating a slow loss of hydraulic volume that manifests as the sinking pedal

C. The front hydraulic disc brake master cylinder has a worn internal piston seal that allows fluid to bypass the piston under sustained pressure — the pedal sinks as fluid leaks past the seal internally during the held application

D. The rear air drum brake relay valve has a slow internal leak that gradually reduces the application pressure creating the sensation of a sinking pedal as the rear brake force diminishes during the sustained pedal pressure

94. A truck's tire has been installed on the rim with the valve stem positioned adjacent to the wheel weight location. During balancing, the technician places a large amount of weight (200 grams) on the light side. What is the concern with this large weight requirement?

A. The 200-gram weight requirement indicates the wheel assembly is within normal balance tolerance and does not indicate any problem with the tire or rim assembly that would require investigation before returning to service

B. A 200-gram weight requirement may indicate a tire defect (shifted belt, eccentric bead seating, or manufacturing inconsistency) or a rim problem that should be investigated by remounting the tire at a different position on the rim

C. The large weight is only a concern on steer axle positions where it can create a steering shimmy — on drive and trailer positions the large weight does not affect the ride quality or tire wear during normal highway operation

D. The 200-gram weight should be split between the inner and outer rim flanges at opposite positions to create a dynamic balance rather than placing the entire weight on one rim flange which only addresses static imbalance

95. A truck's fifth wheel has been lubricated with grease. After coupling a trailer, the driver reports that the steering feels different — the truck requires more steering input to change direction and the trailer seems to resist the tractor's turning motion. What could cause this change after fifth wheel lubrication?

A. The wrong type of grease was applied — a high-tack grease that creates adhesion between the fifth wheel plate and the trailer upper coupler plate rather than the designed low-friction sliding contact during articulation

B. The grease was applied too generously and the excess grease has migrated to the fifth wheel locking jaw creating a hydraulic cushion that changes the coupling dynamics and alters the tractor-trailer articulation response

C. The grease has contaminated the fifth wheel mounting bracket bolts and the resulting loss of friction at the bracket-to-frame interface allows the fifth wheel to shift position during turns changing the turning geometry

D. The grease type or the excessive application is creating resistance between the fifth wheel plate and the trailer coupler plate that impedes the normal sliding articulation during turns requiring more steering effort

96. A truck's rear dual tires have been inspected and the technician finds that the inner and outer tires on one dual position have a 40 kPa (6 PSI) pressure difference — the outer tire is at 720 kPa and the inner tire is at 680 kPa. What is the consequence of this pressure difference?

A. The higher-pressure outer tire carries a disproportionate share of the load creating unequal tire wear rates between the inner and outer tires — the overloaded outer tire wears faster while the underloaded inner wears slower

B. The pressure difference is within the normal tolerance for dual tire installations and does not create any operational concern as long as both tires are within the minimum inflation specification for the load rating

C. The lower-pressure inner tire flexes more than the outer creating additional heat from the increased flexing which can lead to premature inner tire failure from the elevated operating temperature during sustained highway driving

D. The pressure difference between the dual tires creates unequal rolling radii between the inner and outer tires causing the smaller-diameter under-inflated tire to scrub during straight driving producing accelerated wear on both tires

97. A truck's wheel stud has been replaced after breaking during a previous service. The new stud was installed by pressing it into the hub flange from the back. The technician torques the wheel nut to specification. During a re-torque check at 160 km, that specific nut is loose. What is the most probable cause?

A. The replacement stud was pressed in without adequate interference fit — the stud's knurl or serration did not fully embed in the hub flange bore and the stud has moved in the bore under the wheel nut torque loading

B. The replacement stud has a different thread pitch than the other studs and the nut cannot achieve full engagement with the mismatched threads producing a false torque reading that gradually loosens during driving

C. The hub flange bore was not cleaned before the new stud was pressed in and residual rust or debris in the bore prevented the stud from seating at full depth allowing the stud to settle and the nut to loosen during driving

D. The replacement stud is a different grade (lower strength) than the original and the lower-strength stud has stretched under the torque load beyond its elastic limit producing a permanent elongation that loosens the nut

98. A truck equipped with hub-piloted wheels has chronic wheel-off problems on one specific position. The hub pilot, wheel centre bore, studs, and nuts have all been inspected and are within specification. The wheel is the correct specification. What else should be investigated?

A. The brake rotor hat (the centre mounting surface between the hub and the wheel) for distortion, incorrect thickness, or corrosion that prevents the wheel from seating flat on the hub pilot and distributing the clamping force evenly

B. The wheel mounting procedure — specifically whether the technician is using a torque wrench with a star pattern or an impact wrench with a circular pattern that does not evenly distribute the clamping force across all studs

C. The vehicle's operating conditions — specifically whether the truck operates on rough roads, construction sites, or other high-vibration environments that exceed the wheel retention system's designed vibration resistance capacity

D. The suspension on that wheel position for a worn shock absorber or bushing that creates excessive vibration at that specific wheel location that repeatedly loosens the properly torqued wheel nuts during normal driving operation

99. A truck's steer axle has been aligned. The camber is correct but the caster reads +2.0° on the left and +4.0° on the right. The specification calls for +3.0° to +5.0° per side with a maximum side-to-side difference of 1.0°. What symptom will this 2.0° caster difference produce?

A. The truck will have a vibration from the unequal caster angles creating different king pin geometry forces on each side that produce a cyclic loading on the steering linkage during highway speed driving conditions

B. The truck will pull to one side during straight driving because the unequal caster angles create different self-centering forces that bias the steering toward the side with the lesser caster angle during straight-line travel

C. The truck will pull to the left (the side with less caster) because the lower caster angle on the left creates less trail which reduces the self-centering force on that side and the steering drifts toward the weaker centering

D. The truck will wear the left steer tire faster from the reduced caster because the lower caster angle on the left causes the tire to contact the road at a different angle during straight-line driving creating accelerated wear

100. A trailer's tandem axle group has been weighed on individual wheel scales. The results show the right side of the trailer carries 1,500 kg more than the left side. The cargo is supposed to be evenly distributed. What should be investigated?

A. The cargo loading pattern for a centre-of-gravity shift toward the right side that distributes more weight to the right dual tires than the left despite the cargo appearing evenly distributed from a visual inspection

B. The trailer frame for a twist or bow that shifts the suspension geometry and causes the right side springs or air bags to carry more load than the left from the frame's altered static position at rest

C. The suspension for unequal spring rates or air bag pressures between the left and right sides that cause one side to carry more than its share of the load independent of the cargo's actual centre-of-gravity position

D. The cargo distribution, the trailer frame condition, and the suspension for any condition that could create the weight imbalance — the actual cause cannot be determined without investigating all three potential sources

101. A truck's tire pressure monitoring system (TPMS) shows the left front steer tire at 690 kPa while the right front reads 760 kPa. Both tires are the same size and the steer axle load is equal. What should the technician do?

A. Adjust the right tire pressure down to 690 kPa to match the left because both steer tires must always be at the same pressure for equal loading and consistent steering response during braking and cornering events

B. Inflate the left tire to 760 kPa to match the right because 760 kPa is the correct cold inflation pressure for the tire size and load rating and the left tire's 690 kPa indicates it has lost pressure from normal permeation

C. Check the specification for the correct cold inflation pressure for the tire's size and load rating at the steer axle weight then adjust both tires to that specification — neither TPMS reading may be at the correct pressure

D. Leave both tires at their current pressures because the 70 kPa difference is within the normal tolerance range for commercial truck tires and does not affect the steering characteristics or tire wear during normal operation

102. A truck's front wheel alignment shows the SAI (steering axis inclination) on the left side is 2 degrees less than the right side. The SAI is a built-in angle that cannot be adjusted. What does this asymmetric SAI indicate?

A. The left steer axle knuckle has been bent from a pothole or curb impact and the bent knuckle has changed the geometric relationship between the king pin axis and the vertical axis on that side

B. The king pin bushings on the left side have worn unevenly creating play that shifts the effective pivot axis angle from its designed position producing the SAI difference between the left and right sides

C. The steer axle beam has been bent from a frontal impact or overloading event that has changed the king pin bore angle on the left side relative to the right side altering the built-in SAI geometry

D. The left side has worn king pin bushings, a bent knuckle, or a bent axle beam — since SAI is a built-in non-adjustable angle any deviation from specification indicates physical damage to the axle or knuckle components

103. A truck's tire has been mounted on the rim and inflated to the seating pressure. The bead has seated on one side but not on the other — the bead seat line on the unseated side is not visible above the rim flange. What should the technician do?

A. Increase the inflation pressure above the maximum sidewall rating to force the reluctant bead over the rim's safety hump and into the bead seat area where the bead can lock into position during the seating process

B. Lubricate the unseated bead with approved tire mounting lubricant and attempt to reseat the bead at the recommended seating pressure — if the bead does not seat the tire or rim should be inspected for defects

C. Deflate the tire completely, break both beads, reposition the tire on the rim to ensure the bead is properly aligned and relubriciate the beads, then reinflate to the recommended seating pressure for another attempt

D. The unseated bead indicates the rim has a damaged bead seat area that prevents proper seating — the rim should be inspected for dents, corrosion, or damage and replaced if the seating surface is compromised

104. A truck's cab-over-engine design has the cab tilted forward for engine access. The technician needs to work on the engine with the cab tilted. What is the critical safety requirement while working under or around the tilted cab?

A. The engine must be running at idle to maintain oil pressure to the hydraulic tilt cylinder that holds the cab in the tilted position because a loss of engine oil pressure allows the cylinder to retract and the cab drops

B. A safety strap or chain must be connected between the tilted cab and the frame to prevent the cab from falling if the hydraulic tilt cylinder fails — the hydraulic system alone is not adequate to safely hold the cab

C. The cab tilt lock must be installed in the forward support position and the hydraulic cylinder must maintain pressure simultaneously — both systems provide redundant cab retention during the tilted service position

D. The cab must be supported by the mechanical tilt lock or safety prop in addition to the hydraulic cylinder — the mechanical lock provides a positive stop that holds the cab regardless of hydraulic system condition

105. A truck driver reports that the cab interior is excessively dusty after driving on unpaved roads. The windows are closed and the HVAC is operating in recirculation mode. Where is the dust entering the cab?

A. The cab door seals have deteriorated and the positive pressure from the HVAC blower is not sufficient to prevent dust from entering through the gaps in the door seal perimeter during unpaved road driving

B. The dust is entering through deteriorated cab body seals, floor grommets, firewall penetrations, or gaps in the cab structure that allow dust-laden air to enter despite the closed windows and recirculation mode

C. The HVAC system is drawing dust through the fresh air intake despite being set to recirculation because the recirculation door actuator is not fully closing the fresh air inlet during the recirculation mode setting

D. The cab's positive pressure ventilation system draws air from under the hood area and the dust enters through the engine compartment air around the hood seal and is distributed through the cab ventilation system

106. A truck's cab has a persistent odour of exhaust inside the cab during driving. The exhaust system has been inspected from the turbocharger to the tailpipe and no leaks are found. The cab seals appear intact. What should be investigated as the exhaust entry point?

A. The cab floor penetrations for body harness wiring, HVAC hoses, and steering column for deteriorated grommets or seals that allow exhaust gas from the underside of the cab to enter the interior during driving

B. The HVAC fresh air intake location relative to the exhaust discharge point — if the tailpipe or exhaust stack outlet is positioned where wind patterns during driving carry exhaust toward the HVAC intake the exhaust enters the cab

C. The engine's EGR system for a leak that releases exhaust gas into the engine compartment where the HVAC fresh air intake draws it into the cab ventilation system during normal forward driving air circulation

D. The exhaust manifold gaskets for a leak between the manifold and the cylinder head that releases exhaust into the engine compartment — the exhaust gas then enters the cab through the HVAC fresh air intake during driving

107. A truck's cab door glass window has developed a 150 mm crack from the bottom edge of the glass extending upward. The crack is in the driver's peripheral vision area but does not obstruct the primary line of sight. Should the glass be replaced?

A. The glass should be monitored at each PM inspection because cracks in the peripheral vision area are not a regulatory concern unless they extend into the driver's primary line of sight during normal forward driving

B. The glass must be replaced because any crack in the door glass compromises the structural integrity of the window which is part of the cab's occupant protection system during a collision or rollover event

C. The crack can be repaired with a resin injection repair kit similar to a windshield chip repair because the crack has not extended to the glass edge and the repair will restore the glass's structural integrity

D. The glass should be replaced because the crack will propagate from vibration and temperature cycling during driving and eventually shatter the tempered glass creating a safety hazard from the sudden loss of the window

108. A truck's sleeper cab has an emergency exit window that is designed to push out from the inside during an emergency. During a PM inspection, the technician tests the emergency exit and the window does not release. What action is required?

A. Document the finding and schedule the repair for the next major service interval because emergency exit failures are not classified as out-of-service items during regulatory roadside inspections

B. Repair or replace the emergency exit mechanism immediately because a non-functional emergency exit prevents the driver from escaping the cab during a fire, collision, or rollover that blocks the normal door exits

C. Apply penetrating lubricant to the emergency exit latch mechanism and attempt to free the stuck mechanism — if lubrication restores function the exit is serviceable without further repair or component replacement

D. Replace the entire emergency exit window assembly because the latch mechanism is integrated into the glass and cannot be repaired separately from the window panel in this type of emergency exit design

109. A reefer trailer's cargo space has passed a pre-trip temperature check at the specified -18°C. During delivery, the driver opens the rear doors for unloading and the doors remain open for 45 minutes. After

closing the doors, the TRU struggles to pull the temperature back down to -18°C. What is the primary reason for the slow recovery?

A. The warm moist ambient air that entered during the 45-minute door-open period has deposited moisture on the evaporator coil as frost which restricts airflow and reduces the TRU's cooling capacity during the recovery

B. The cargo has absorbed heat from the ambient air during the 45-minute exposure and the thermal mass of the warmed cargo requires significant energy to re-cool beyond what the TRU can deliver at maximum capacity

C. The TRU's compressor requires a 30-minute cool-down period after continuous operation during delivery and the reduced compressor capacity during the cool-down extends the recovery time to the set-point temperature

D. The trailer's insulation has absorbed ambient heat during the 45-minute open-door period and the insulation must release this stored heat before the cargo space temperature can stabilize at the -18°C set-point

110. A trailer equipped with lift axle suspension has the lift axle in the raised position during empty operation. When the trailer is loaded, the lift axle is lowered to the road surface. The driver reports that when the lift axle is first lowered, the trailer tracks to one side momentarily before straightening out. What causes this temporary tracking error?

A. The lift axle tires have developed flat spots from sitting in the raised position and the flat spots create a directional pull until they warm and round out from the heat generated by rolling contact with the road surface

B. The lift axle's alignment (toe and camber) has shifted from the raised position's geometry and the misaligned axle creates a thrust angle when lowered until the weight loading settles the alignment to its designed position

C. The lift axle's tires are at a lower pressure than required from the extended raised position and the underinflated tires create a directional pull until the TPMS system alerts the driver to add air to the lift axle tires

D. The lift axle tires have developed flat spots from the extended raised storage and the initial contact with the road creates a directional bias until the flat spots round out from the rolling heat and load within the first few kilometres

111. A trailer's brake system has a relay valve that provides service brake application to the trailer's brake chambers. During testing, the technician applies 70 kPa (10 PSI) of signal pressure to the relay valve's service port. The relay valve delivers 105 kPa (15 PSI) to the brake chambers. What does this over-delivery indicate?

A. The relay valve is functioning correctly because relay valves are designed to amplify the service signal pressure by a fixed ratio to ensure adequate braking force at the trailer's brake chambers from the tractor's reduced signal

B. The relay valve has a cracked or damaged internal piston seal that allows supply air to cross into the delivery circuit adding uncontrolled pressure to the commanded signal pressure creating the over-delivery condition

C. The relay valve's crack pressure has shifted from contamination or wear and the valve is delivering a higher percentage of the supply pressure than the signal commands creating the over-delivery of 105 kPa from 70 kPa input

D. The relay valve is malfunctioning — it should deliver pressure equal to the signal input (70 kPa) from the stored supply pressure and the additional 35 kPa indicates an internal fault that produces excessive brake force

112. A trailer's composite roof has a soft spot near the centre of the trailer. The outer skin depresses 10 mm under moderate hand pressure. An impact test (coin tap) produces a dull thud at the soft spot compared to a sharp ring from the surrounding intact panel. What does the dull thud indicate?

A. The outer skin material has delaminated from the internal foam core creating an air gap between the skin and the core — the lack of backing allows the skin to flex and the air gap produces the dull acoustic response

B. The internal foam core has absorbed moisture that has softened and degraded the foam material at that location — the wet deteriorated foam cannot support the outer skin creating both the depression and the dull sound

C. The outer skin material has experienced UV degradation that has reduced its structural rigidity at the centre of the panel where the sun exposure is greatest creating the flexible spot and the altered acoustic response

D. The foam core has deteriorated from moisture, heat, or delamination — the dull acoustic response confirms the bond between the skin and core has failed at that location and the core can no longer support the outer skin

113. A flatbed trailer's deck boards have been replaced. After the replacement, the technician notices that the new boards are not the same thickness as the originals — the new boards are 5 mm thinner. What operational concern does this thickness reduction create?

A. The thinner deck boards may not have adequate structural capacity to support the concentrated wheel loads from forklift operations during loading and unloading creating a deck failure risk during cargo handling

B. The thinner boards change the cargo tie-down anchor point height relative to the cargo which may affect the securement angle calculations required for the load securement compliance during transport

C. The reduced deck thickness increases the trailer's overall height by 5 mm because the cargo sits lower on the thinner boards and the trailer's overall loaded height must be recalculated for bridge clearance compliance

D. The thinner deck boards do not affect the trailer's load capacity because the structural support comes from the cross-members and the deck boards only provide a surface for the cargo to rest on during transport

114. A trailer equipped with a hydraulic liftgate has the liftgate platform raise very slowly when the ambient temperature drops below -10°C. At temperatures above 0°C, the liftgate operates at normal speed. What is the most likely cause?

A. The liftgate hydraulic pump motor draws more current in cold weather from the thicker battery supply cable resistance and the reduced available current limits the motor's speed during cold temperature operation

B. The hydraulic fluid viscosity increases significantly in cold temperatures creating more resistance to flow through the pump, valves, and cylinder circuits which slows all liftgate functions proportionally during cold operation

C. The hydraulic fluid has thickened from the cold temperature and the increased viscosity creates more resistance to flow through the pump, valves, hoses, and cylinder — the motor works harder against the thick fluid slowing operation

D. The liftgate platform hinges and pivot bearings have seized from ice and corrosion creating mechanical resistance that the hydraulic system must overcome in addition to lifting the platform weight during cold weather operation

115. A trailer's mud flap has been torn from a road debris impact. The torn mud flap exposes the tire sidewall to view from behind the trailer. Beyond replacing the mud flap, what should the technician inspect?

A. The tire sidewall that was exposed behind the torn mud flap for cut damage from the same road debris that tore the mud flap because the debris may have also contacted the tire during the impact event

B. The mud flap mounting bracket for damage that could prevent the replacement mud flap from being securely installed in the correct position relative to the tire for adequate splash and debris protection

C. The brake hoses and air lines that are routed near the mud flap mounting area for damage from the same debris that tore the mud flap because the debris trajectory may have contacted these components as well

D. The tire sidewall, the mud flap bracket, and any brake hoses or air lines near the impact area for damage — the debris that tore the mud flap may have also damaged adjacent components in the same impact event

116. A trailer's ABS system has been tested and the system activates correctly during a controlled braking test on a wet surface. However, the driver reports that the trailer's stopping distance seems longer on wet roads than expected. The foundation brake components are all within specification. What should be investigated?

A. The trailer tire tread depth and condition because the ABS prevents wheel lockup but cannot improve the tire's grip on the road surface — worn tires with reduced tread depth have less traction on wet surfaces regardless of ABS function

B. The ABS modulator valve response time because a slow-responding modulator may allow the wheels to decelerate too far before releasing pressure which extends the stopping distance during each modulation cycle on wet surfaces

C. The ABS sensor air gaps for consistency across all wheel positions because uneven air gaps produce different signal strengths that cause the ABS to modulate at different rates on each wheel extending the overall stopping distance

D. The tire tread depth and compound because the ABS system can only modulate the brake pressure to prevent lockup — the actual stopping distance depends on the tire's traction capacity with the wet road surface

117. A truck's A/C system has been diagnosed with a restricted expansion valve. The technician replaces the expansion valve and recharges the system. After the repair, the system cools adequately but the compressor cycles more frequently than before the repair (every 30 seconds instead of every 3 minutes). What was likely not addressed during the repair?

A. The receiver/dryer was not replaced during the expansion valve service — the old dryer's saturated desiccant cannot absorb moisture and the moisture is freezing intermittently at the new valve's orifice causing the rapid cycling

B. The system was overcharged during the recharge and the excess refrigerant causes the evaporator to flood intermittently which drops the suction pressure below the low-pressure switch threshold triggering the rapid cycling

C. The new expansion valve has a different thermal response characteristic than the original and the valve's faster response to evaporator temperature changes produces the more frequent cycling pattern during normal operation

D. The compressor clutch air gap has widened from the repeated cycling of the failed expansion valve period and the worn clutch engagement is marginal creating a rapid engage-disengage cycle from the inconsistent contact

118. A truck's heater core has been replaced due to a leak. After the replacement, the heating performance is adequate on the passenger side but the driver side produces lukewarm air instead of hot air. The coolant flow through the new heater core is confirmed adequate by feeling both heater hoses. What is the most likely cause?

A. The new heater core has a different internal baffle configuration that directs more coolant flow through the passenger-side tubes than the driver-side tubes creating unequal heat distribution across the core face

B. The blend door actuator cable or linkage was disturbed during the heater core replacement and the driver-side blend door is not fully closing to the heat position — some air bypasses the core on the driver side

C. The new heater core was manufactured for a different market and the internal tube routing is optimized for a right-hand-drive vehicle creating the reverse heat distribution pattern when installed in a left-hand-drive truck

D. The HVAC housing was not properly sealed during reassembly after the heater core replacement and ambient air leaks into the driver-side duct mixing with the heated air and reducing the outlet temperature on that side

119. A truck's A/C system has adequate refrigerant charge and correct system pressures, but the cooling performance is poor. The compressor runs continuously. The technician measures the air temperature entering the evaporator (30°C) and exiting the evaporator (22°C). The normal temperature drop across the evaporator should be 15-20°C. What does the 8°C drop indicate?

A. The evaporator is partially blocked with debris that reduces the airflow through the core — less air contacts the cold evaporator surface and the reduced contact time produces the smaller temperature reduction

B. The evaporator has an internal refrigerant flow restriction from a kinked tube or accumulated oil that reduces the refrigerant's contact area with the evaporator surface limiting the heat absorption during normal airflow

C. The cabin air filter is severely restricted and the reduced airflow volume limits the total heat transfer through the evaporator — less air passes through the cold coil producing a smaller temperature reduction at the outlet

D. The blower motor is running at reduced speed from a failing motor or resistor and the reduced airflow through the evaporator limits the total heat removal despite adequate refrigerant charge and correct system pressures

120. A truck's cab heater produces heat but the airflow from all vents has decreased gradually over several months. The blower motor runs at all speeds. The heater core flow is adequate. What is the most likely cause?

A. The blower motor impeller has accumulated dirt and debris on its blades that adds weight and changes the blade aerodynamics reducing the air volume moved per revolution despite the motor running at the correct speed

B. The HVAC air intake plenum drain has clogged allowing water to accumulate in the plenum and the standing water partially blocks the air path between the blower intake and the heater core reducing the total airflow volume

C. The heater hoses have swollen internally from age and heat reducing the hose diameter and increasing the resistance to coolant flow through the heater core which indirectly reduces the air temperature and perceived airflow

D. The cabin air filter has gradually accumulated dirt and debris over several months restricting the airflow path through the filter element — the blower works but cannot push as much air through the increasingly dirty filter

121. A truck's APU A/C compressor engages but the system does not cool. The suction and discharge gauges both read the same pressure (approximately 550 kPa). What does this equalized pressure indicate?

A. The compressor is not pumping — either the clutch is slipping and the compressor shaft is not turning despite the clutch appearing to engage, or the compressor has failed internally and cannot create a pressure differential

B. The system is completely empty of refrigerant and the equalized pressure reading represents the ambient air pressure inside the sealed system with no refrigerant present to create a pressure differential during operation

C. The expansion valve has failed in the fully open position and the unrestricted flow path between the high and low sides eliminates the pressure differential that normally exists between the condenser and evaporator sides

D. The condenser fan has failed and the high-side pressure has dropped to equalize with the low side because the condenser cannot reject heat without airflow — the result is equalized pressures from the thermal equilibrium

122. A truck's HVAC system has a complaint that the air outlet temperature oscillates between hot and cold in approximately 10-second cycles when the temperature is set to a mid-range position. The oscillation is consistent and repeating. What is the most likely cause?

A. The coolant temperature is fluctuating from a thermostat that is cycling open and closed at the set temperature position creating alternating hot and cold coolant delivery to the heater core during each thermostat cycle

B. The temperature blend door actuator is hunting for the commanded position — the actuator overshoots the target, the controller corrects, it undershoots, and the repeated overcorrection creates the oscillating temperature output

C. The blend door actuator motor or its position feedback sensor has a fault that causes the actuator to oscillate between two positions — the motor advances and retreats in a repeating cycle instead of holding steady

D. The A/C compressor clutch is cycling on and off at a 10-second interval and the alternating cooling and no-cooling creates the temperature oscillation that the driver perceives as the hot-cold cycling at the vent outlet

123. A truck's fuel-fired auxiliary heater has completed 5,000 hours of operation. The heater starts and runs but the heat output has decreased noticeably over the past year. The combustion appears normal with a clean blue flame. The fuel delivery rate is correct. What is the most likely cause of the reduced heat output?

A. The heat exchanger has accumulated an internal layer of combustion soot deposits on the exhaust gas side that insulates the heat transfer surface reducing the thermal energy transferred from the combustion gas to the coolant

B. The combustion chamber has expanded from heat cycling over 5,000 hours and the larger chamber volume produces a lower combustion intensity that generates less heat despite the correct fuel delivery and visible blue flame

C. The coolant circulation pump has worn impeller blades that reduce the flow rate through the heat exchanger and the reduced coolant velocity limits the heat absorption from the combustion gas to the coolant circuit

D. The heater's combustion air fan has worn bearings that reduce the fan speed below the designed RPM and the reduced airflow limits the combustion intensity despite the fuel delivery being at the correct rate for the application

124. A hydraulic system on a truck-mounted crane produces adequate pressure and flow at the pump outlet. However, all crane functions operate at approximately 70% of their normal speed. The hydraulic fluid level and condition are correct. What single component could cause this uniform speed reduction across all functions?

A. The pump's displacement control has shifted from its calibration and the pump is producing only 70% of its designed displacement at the current engine RPM and control signal level during all crane function operations

B. The system relief valve has drifted to a lower setting and the reduced maximum pressure limits the flow available for all functions because the relief bypasses excess flow before it reaches the directional control valves

C. The pump's inlet strainer has accumulated contamination that restricts the oil flow to the pump inlet limiting the pump's ability to fill its chambers completely during each intake stroke reducing the output by approximately 30%

D. The main system pressure compensator or the pump displacement control has partially failed and the pump is delivering only 70% of its designed flow because it cannot achieve full displacement at the current operating condition

125. A dump truck's hydraulic system has a complaint that the dump body raises normally but bounces at the top of its travel when the operator releases the raise control. The bounce settles within 2 to 3 oscillations. What is causing this bounce?

A. The raise circuit's holding valve is closing too abruptly when the flow is cut off and the trapped oil's momentum creates a pressure wave that bounces the dump body at the top of the stroke until the energy dissipates

B. The dump body's mechanical stops have worn or are missing and the body overshoots its designed maximum angle before the gravity-return settles it back to the stop position creating the bouncing at the top of travel

C. The hydraulic cylinder has air trapped inside that compresses at the end of the raise stroke and the compressed air expands when the pressure is released creating a spring effect that bounces the body at full raise

D. The dump body's centre of gravity passes over the pivot point at full raise and the body's weight momentarily shifts from the cylinder to the pivot creating a balance oscillation until the body settles against the mechanical stops

126. A hydraulic system's pressure gauge reads 200 kPa with the engine running and no functions activated. The system uses a closed-centre valve with a variable-displacement pump. The standby pressure specification is 1,500 kPa. What does the 200 kPa standby pressure indicate?

A. The pump compensator spring has broken or weakened and cannot maintain the standby pressure against the internal leakage in the pump — the pump destrokes to nearly zero displacement because it cannot sense demand

B. The system is operating normally because 200 kPa is the correct standby pressure for a closed-centre system — the pump only builds higher pressure when a function is activated and creates a flow demand signal

C. The pump compensator has failed and is keeping the pump at minimum displacement regardless of the system demand — the 200 kPa represents the pump's residual output at minimum displacement with no load

D. The load-sensing line between the directional valve and the pump compensator has a leak or disconnection that prevents the compensator from receiving the correct standby pressure signal to maintain 1,500 kPa at rest

127. A hydraulic crane's winch motor produces adequate torque to lift the rated load but the winch speed is approximately 40% slower than specification. System pressure is correct. The directional valve delivers full flow to the motor circuit when the winch function is activated. What is the most likely cause?

A. The winch brake is not fully releasing and the residual drag from the partially applied brake absorbs some of the motor's torque output — the motor produces rated torque but the brake's drag reduces the net speed

B. The winch motor has internal wear that allows fluid to bypass the motor's displacement chambers without performing work — the motor receives full flow but only 60% of it creates rotation while 40% bypasses internally

C. The winch cable has been replaced with a larger diameter cable that requires more drum surface per wrap and the larger cable reduces the effective drum speed by 40% from the increased cable thickness on the drum

D. The pump delivery is being split between the winch motor and a leaking cross-port relief valve in the winch circuit — the relief valve's internal leak diverts 40% of the pump flow back to the tank during winch operation

128. A hydraulic system's accumulator is being recharged with nitrogen after the bladder was replaced. The technician charges the bladder to 10,000 kPa. The system working pressure is 20,000 kPa. After connecting the hydraulic circuit, the accumulator functions correctly for 1 hour then stops storing energy. The technician rechecks the nitrogen pre-charge and reads 0 kPa. What happened?

A. The nitrogen charging valve was not tightened properly after the pre-charge and the nitrogen leaked through the valve stem over the 1-hour operating period until the entire pre-charge escaped from the gas side

B. The replacement bladder had a manufacturing defect that ruptured under the 20,000 kPa hydraulic system pressure — the nitrogen migrated through the ruptured bladder into the hydraulic fluid and was absorbed

C. The accumulator's gas port adapter fitting was cross-threaded during the pre-charge procedure and the damaged threads allowed the nitrogen to gradually leak out during the 1-hour operating period until fully depleted

D. The replacement bladder has ruptured from the hydraulic pressure — the nitrogen escaped through the bladder rupture into the hydraulic oil side and the accumulator filled completely with oil losing all gas spring function

129. A hydraulic liftgate system uses a 12-volt DC motor to drive a gear pump. The motor has a thermal overload protector that trips when the motor overheats. The driver reports the liftgate stops operating after approximately 15 minutes of continuous use and resumes function after a 10-minute rest period. What is causing the motor to overheat?

A. The motor's thermal overload protector has drifted to a lower trip temperature from age and the protector trips before the motor reaches its actual maximum designed operating temperature during the 15-minute cycle

B. The liftgate is being operated continuously for 15 minutes which exceeds the motor's designed duty cycle — liftgate motors are designed for intermittent operation and continuous use exceeds their thermal capacity

C. The battery voltage drops during the 15-minute operation from the high current draw and the reduced voltage causes the motor to draw more current to maintain speed which generates additional heat leading to the trip

D. The hydraulic system has excessive internal pressure from a misadjusted relief valve and the motor must work harder against the elevated pressure generating more heat than the designed operating condition allows

130. A hydraulic system has been converted from petroleum-based hydraulic fluid to a biodegradable hydraulic fluid for environmental compliance. After the conversion, the system's operating temperature

has increased by 10°C during normal operation. What property of the biodegradable fluid is most likely responsible?

A. Biodegradable hydraulic fluids typically have different viscosity-temperature characteristics than petroleum fluids and the different viscosity at operating temperature creates more internal friction generating additional heat

B. Biodegradable fluids have lower thermal conductivity than petroleum fluids and the reduced heat transfer through the fluid limits the oil cooler's effectiveness creating the 10°C temperature increase during normal operation

C. Biodegradable fluids have different lubricity characteristics that create more friction at the pump's internal surfaces and the additional friction generates heat that the cooling system was not designed to dissipate with the petroleum fluid

D. Biodegradable hydraulic fluids often have lower oxidation stability than petroleum fluids and the fluid begins to degrade thermally at a lower temperature which the temperature sensor reads as a higher operating temperature

131. A truck-mounted hydraulic crane's boom extend cylinder has a noticeable vibration during the last 200 mm of extension travel. The vibration is not present during the first 90% of the extension stroke. What is the most likely cause?

A. The cylinder's internal cushion is engaging during the last 200 mm of travel and the cushion orifice is either too restrictive or has contamination that creates a pressure oscillation as the piston enters the cushioned zone

B. The cylinder's piston rod has a slight bend near the gland end that creates an interference with the rod seal during the last portion of the stroke — the bent rod vibrates as it passes through the tight gland packing seal

C. The boom's mechanical structure has a natural frequency that is excited by the hydraulic flow pattern during the last 200 mm of travel when the boom reaches its maximum extension and the structural rigidity decreases

D. The cylinder has reached the end of its internal stroke travel and the piston is contacting the cylinder cap creating a hydraulic hammer as the incompressible oil is trapped between the advancing piston and the cap end

132. A battery-electric truck's BMS reports that the battery pack's total voltage is 10 volts lower than the sum of all individual cell voltages reported by the module-level sensors. What does this discrepancy indicate?

A. The high-voltage bus bar connections between modules have developed elevated resistance from corrosion, loose fasteners, or thermal cycling and the I^2R losses at these connections account for the 10-volt difference under load

B. The BMS module-level sensors have a collective calibration drift that causes them to read slightly higher than actual — the pack-level sensor is more accurate because it measures the total pack output at the main terminals

C. The battery contactors have developed elevated contact resistance and the voltage drops across the main positive and negative contactors account for the discrepancy between the cell sum and the pack terminal voltage

D. Elevated resistance at the inter-module bus bar connections, the main contactors, or the fusing between modules is consuming 10 volts through I^2R losses — the voltage drop must be located because it generates heat and wastes energy

133. A hybrid truck's regenerative braking system produces a noticeable vibration in the brake pedal during regenerative braking events. The friction brakes do not produce any vibration during friction-only braking with the hybrid system disabled. What is causing the regenerative-specific vibration?

A. The traction motor has a rotor imbalance that only manifests during the generating (regenerative) mode because the electromagnetic forces during generation load the rotor differently than during the motoring (drive) mode

B. The inverter's power switching produces torque ripple in the motor during regenerative generation and the torque ripple transmits through the drivetrain to the brake pedal as a vibration proportional to the motor's electrical frequency

C. The regenerative braking torque varies with the motor's rotational position due to the permanent magnet motor's cogging torque characteristic and the cyclic torque variation transmits through the driveline to the brake pedal

D. The blending algorithm between regenerative and friction braking has a calibration error that causes the two systems to alternately apply and release creating an oscillating braking force that the driver feels as pedal vibration

134. A battery-electric truck's onboard charger has a fault code for "isolation fault during charging." The vehicle drives normally and the HV isolation test with a megohmmeter shows adequate insulation resistance when the vehicle is not plugged in. What is the most likely cause?

A. The charging cable has a damaged conductor insulation that reduces the cable's isolation resistance below the charger's threshold when the cable is connected but does not affect the vehicle's internal HV isolation measurement

B. The EVSE (charging station) ground fault detection is more sensitive than the vehicle's internal isolation monitoring and detects a marginal insulation condition that the vehicle's own system considers acceptable during driving

C. The charging port connector has moisture intrusion or contamination that creates a low-resistance path between the HV charging pins and the connector housing ground that appears only when the charging cable is mated

D. The onboard charger's internal isolation test circuit has a more stringent threshold than the vehicle's driving isolation monitor and the charger detects a marginal insulation condition at the charging voltage that passes at driving voltage

135. A parallel hybrid truck has a diesel engine and an electric motor coupled through a clutch to the transmission. The system can operate in engine-only, motor-only, or combined mode. During a diagnostic test, the technician commands motor-only mode. The electric motor engages and the vehicle begins to move but a grinding noise is heard from the transmission area. The engine clutch is confirmed disengaged. What is the most likely cause?

A. The transmission's internal lubrication pump is driven by the engine and with the engine off the transmission gears are not receiving adequate lubrication during motor-only operation creating the grinding from dry gear contact

B. The electric motor's coupling to the transmission input shaft has a worn spline or damaged coupler that creates a grinding noise under the motor's torque loading that is normally masked by the engine's noise during hybrid operation

C. The transmission synchronizers are designed for the engine's rotational characteristics and the electric motor's different torque delivery pattern causes the synchronizers to vibrate during motor-only driving at certain speeds

D. The motor's permanent magnets have partially demagnetized creating an electromagnetic imbalance that produces a mechanical vibration in the motor housing which the transmission amplifies and the driver perceives as grinding

Practice Exam 12: Answer Key and Explanations

1. D — A fire-resistant heat shield positioned between the torch flame and the fuel line prevents direct radiant heat from reaching the fuel line surface. The shield blocks the thermal radiation path while allowing the technician to heat the seized bolt effectively. This is the standard hot work practice when flame work must be performed near flammable lines or components.

2. B — Before any technician operates the new press, the operator's manual must be reviewed for the press's rated capacity at each bed position (capacity decreases at higher bed positions), all safety features and their operation, and technicians must be trained on the correct pressing procedures specific to this equipment model.

3. A — Leaf spring leaves are under significant stored tension from their designed curvature. When the centre bolt is removed, the leaves can spring apart violently. Spring clamps must be installed around the leaf pack before the centre bolt is removed to prevent the individual leaves from separating under their stored energy during disassembly.

4. C — A cold exhaust system may contain residual carbon monoxide and other toxic exhaust gases trapped inside the pipe. When the reciprocating saw cuts through the pipe, these gases are released into the shop at floor level where they accumulate in the breathing zone. Adequate ventilation must be ensured before cutting into any section of the exhaust system.

5. B — An oil/water separator at maximum capacity can no longer effectively separate petroleum hydrocarbons from the drain water. The contaminated water passes through the saturated separator untreated and enters the municipal sewer system, creating an environmental violation with potential fines and remediation costs.

6. D — Used ethylene glycol coolant must be collected in a dedicated recycling container and disposed of through a licensed waste coolant recycling program or waste hauler. Ethylene glycol is toxic to animals and the environment and cannot be poured into drains, the ground, or mixed with other waste streams regardless of its contamination status.

7. A — A comprehensive hearing conservation program includes noise level monitoring to identify hazardous areas, providing appropriate hearing protection equipment, annual audiometric testing to detect early hearing changes, and technician training on noise hazards and proper protection use. The absence of any of these elements allows occupational hearing damage to progress undetected.

8. C — The safest method for a 30 kg awkward load is proper manual lifting technique: squat with knees bent, grip the drum securely at two stable points, hold the drum close to the body's centre of gravity, and lift using the leg muscles while keeping the spine straight. This technique minimizes spinal loading and maximizes lifting control.

9. B — A loud metallic knock from the bottom of the engine that increases with RPM and does not change when injectors are disabled (ruling out combustion-related sources) points to the crankshaft rotating assembly. A failed main bearing with excessive clearance allows the crankshaft to impact the bearing cap once per revolution at the crankshaft's rotational frequency.

10. D — The fuel rail pressure relief valve has a seat leak that bleeds fuel at the low-volume idle pump speed. The pump's reduced output at idle cannot overcome the leak to build the full 400 bar. Above 1,200 RPM, the pump's increased output exceeds the leak rate and the rail reaches specification. The relief valve seat must be inspected or the valve replaced.

11. A — Renewable diesel (R100) is chemically different from petroleum ULSD. While R100 is generally compatible with modern fuel systems, the technician should verify compatibility with all fuel system rubber seals, gaskets, hoses, and O-rings. Some older rubber compounds may soften, swell, or degrade when exposed to R100's different chemical composition.

12. C — Intercooler effectiveness = (T_compressor_out - T_manifold) / (T_compressor_out - T_ambient) × 100. That is (200 - 75) / (200 - 25) × 100 = 125/175 × 100 = 71.4%. The cooler reduces the temperature by 125°C out of the maximum possible 175°C reduction (from compressor outlet to ambient), yielding approximately 71% effectiveness.

13. B — One cylinder reading 100°C higher than all others with equal timing and compression indicates that cylinder is burning more fuel or burning it less efficiently. An injector delivering more fuel than specified overfuels that cylinder, producing more combustion heat per cycle. The excess fuel energy that cannot be converted to mechanical work exits as higher exhaust temperature.

14. D — The original liners measured within the OEM diameter specification but may have developed an out-of-round or barrelled bore geometry from years of operation. The dimensional spec measures diameter at specific points but does not capture the bore's roundness. New precision rings cannot conform to an irregularly shaped bore even if the diameter is within tolerance.

15. A — FMI 10 (abnormal rate of change) triggers when the sensor value changes faster than the ECM expects for normal operation. A fuel return line from the high-pressure pump discharging hot return fuel near the temperature sensor creates a sudden spike when the hot fuel reaches the sensor. The rapid temperature change exceeds the ECM's rate-of-change threshold.

16. C — Extended idle produces minimal fuel combustion with low exhaust energy. The exhaust temperature at idle is typically 150-200°C — below the 200-250°C minimum for DEF injection and SCR catalyst activation. This is a normal operating characteristic of diesel engines at idle, not a fault condition. Some ECMs have thermal management strategies to raise temperature during extended idle.

17. B — Blue smoke during deceleration only — not at idle, acceleration, or cruise — is the classic signature of worn valve stem seals on the intake valves. When the throttle closes at highway speed, the high intake manifold vacuum overwhelms the hardened seal lips and draws oil past the valve guides into the combustion chambers momentarily.

18. A — A properly regenerated DPF reads 1.0-3.0 kPa of differential pressure from the clean substrate's inherent flow resistance. The 1.5 kPa reading is within this normal range and confirms the soot has been successfully burned off. The substrate always has some flow resistance even when completely clean because the ceramic wall-flow design creates a pressure drop.

19. D — Coolant pH of 7.0 (neutral) versus the specification of 8.0-10.5 (alkaline) indicates the corrosion inhibitor package has been depleted. The inhibitors maintain the alkaline environment that protects the engine's iron, aluminium, copper, and solder surfaces from corrosion. At neutral pH, these metals are exposed to corrosive attack from the water and combustion acid byproducts.

20. C — A failed head gasket subjects the head and block deck surfaces to extreme thermal and pressure stresses. These stresses can warp the casting surfaces beyond the new gasket's sealing ability. Both surfaces must be measured for flatness with a precision straightedge and feeler gauges — if either surface exceeds the flatness specification, machining is required before the new gasket will seal.

21. B — The VGT actuator commands 105% position — beyond its physical range — because the calibration no longer matches the actual physical positions. The actuator's learned fully-open and fully-closed positions have drifted from the ECM's stored values due to wear, heat expansion, or component changes. A recalibration (position relearn) must be performed.

22. A — TBN measures the oil's alkaline reserve that neutralizes acidic combustion byproducts. Rapid TBN depletion indicates the oil is consuming its alkaline reserve faster than designed — either from excessive acid production (high-sulphur fuel, incomplete combustion producing more acidic blow-by) or from a condition that introduces additional acid into the oil beyond normal combustion.

23. D — Common rail injection pressures of 1,600-2,500 bar create extreme fuel velocities through the small nozzle spray holes. At these velocities, the fuel creates cavitation at the hole edges — microscopic vapour bubbles form and collapse violently against the metal surfaces. Over hundreds of millions of injection cycles, this cavitation progressively erodes the spray hole boundaries.

24. C — The EGR valve should close rapidly during tip-in acceleration to maximize fresh air charge for the increased fuel demand. A slow-closing EGR valve allows exhaust gas to remain in the intake manifold during the critical spool-up phase. The residual exhaust displaces oxygen, reducing combustion energy and the resulting exhaust energy needed to accelerate the turbocharger.

25. B — Below -15°C, the DOC catalyst has not reached its light-off temperature (typically 200-250°C) during idle operation. Without the catalyst's oxidizing function, the small amount of unburned hydrocarbons from the cold-start enrichment strategy passes through the aftertreatment system unoxidized and exits the tailpipe as the raw fuel smell until the exhaust temperature rises.

26. A — Lead is a primary component of the overlay material on connecting rod and main bearings in many heavy-duty diesel engines. The lead-tin-copper overlay provides the bearing's conformability and embeddability properties. A gradual increase in lead over consecutive samples indicates the overlay material is wearing progressively as the bearing approaches the end of its service life.

27. D — Oil pressure that is consistently 50 kPa above fleet average with correct viscosity and filter indicates the oil pressure relief valve is not opening at its designed threshold. A spring that has increased in tension from heat cycling, or sludge deposits that restrict the valve's poppet movement, prevent the valve from bypassing oil at the designed pressure.

28. C — The intake manifold's internal runner geometry distributes EGR gas unevenly. Cylinders closest to the EGR inlet port receive a higher concentration of soot-laden exhaust gas than cylinders further away. The soot deposits preferentially on the ports and valves receiving the highest EGR concentration, creating the uneven carbon distribution pattern.

29. B — With no external leak, no oil contamination, no white smoke, and a negative combustion gas test, the coolant loss is not through the head gasket or an external path. The coolant is most likely escaping through the surge tank cap's pressure relief at a slightly elevated pressure — the cap vents small amounts during each thermal cycle that evaporate from the overflow tube.

30. D — The new compressor has a higher volumetric efficiency than the worn unit it replaced. The increased efficiency produces more compressed air per revolution, which carries more moisture from the ambient air into the system. The air dryer was sized for the original compressor's output and cannot handle the increased moisture load from the new unit's higher efficiency.

31. B — A brake pull to the left with equal adjustment and identical chamber types indicates unequal friction between the two sides. The most common service error is installing linings with different friction specifications on opposite sides — if the boxes are from different manufacturers or different batches, the friction coefficients may differ enough to create the pull.

32. A — A soft brake pedal in an air-over-hydraulic system indicates a hydraulic circuit problem. The air system pressure is confirmed normal, so the air side is functioning. The hydraulic side must be checked for low fluid level in the booster reservoir, air trapped in the hydraulic lines or calipers, and external hydraulic leaks at the calipers, lines, or booster housing.

33. D — The new ABS module must characterize each wheel position's unique sensor signal at a known vehicle speed. The calibration drive establishes the baseline signal amplitude, frequency, and quality for each sensor-to-tone-ring combination so the module can accurately detect individual wheel deceleration rates during braking events for proper modulation.

34. D — Caliper bore scoring that catches a fingernail is too deep for a successful rebuild. The new piston seal rides in the bore during every brake application and release — deep scores will cut through the seal lip creating a hydraulic leak. The scored bore cannot be adequately honed without exceeding the diameter specification. The caliper must be replaced.

35. A — The spring brake's supply side has a slow internal air leak. When the parking brake valve exhausts the supply air to apply the springs, a small residual air path gradually re-pressurizes the spring chamber. This residual pressure slowly compresses the spring, reducing the clamping force until the loaded vehicle begins to creep forward on the steep grade.

36. A — The system builds to governor cut-out but the pressure continues rising instead of stabilizing. The governor is not sending the unload signal to the compressor — either the governor's pressure sensing mechanism is faulty, the signal line between the governor and the compressor's unloader is disconnected or kinked, or the compressor's unloader mechanism cannot respond.

37. C — The drum diameter is 420 mm with a discard diameter of 422 mm — only 2 mm of total allowable diameter increase remaining. Machining removes material from both sides of the drum simultaneously. With minor scoring to remove, the post-machining diameter may approach or reach the 422 mm discard limit leaving no service life before the drum reaches the maximum.

38. B — All chambers receive equal static pressure (confirmed by gauge readings) but one releases noticeably slower. The spring inside that chamber has a stronger spring force from manufacturing variation. The stronger spring requires more time for the air pressure to compress it to the fully released position compared to the standard-force springs in the other three chambers.

39. D — New brake rotors and existing pads must establish a transfer layer during the initial bedding-in period. The friction material from the pads transfers to the rotor surface creating the designed friction interface. The progressive braking force increase over the first 20 stops reflects the transfer layer building up to its designed thickness and composition.

40. A — The yaw rate sensor provides the ESC (electronic stability control) function with the vehicle's rotational behaviour data. The ESC compares the steering angle input to the actual yaw rate to detect and correct understeer or oversteer by applying individual brakes. Losing the yaw rate sensor input disables ESC while the base ABS continues operating normally.

41. B — The Type number refers to the brake chamber's effective diaphragm area in square inches. A Type 30 has an effective area of approximately 30 square inches. The force the chamber produces equals the effective area multiplied by the application pressure — a larger type number produces more force at the same pressure.

42. B — The foot valve's delivery piston seals are worn and require additional pedal travel before they seat against the bore wall and begin building delivery pressure. This worn-seal dead zone at the beginning of pedal travel absorbs the initial pedal input without producing output pressure, creating the gradual application feel despite normal system pressure.

43. A — The gladhands may be crossed — the supply (red) and service (blue) connections are reversed. If the service signal goes to the supply circuit and the supply goes to the service, the trailer receives supply air (charging the reservoirs) but no service signal reaches the relay valve when the driver presses the brake pedal. Checking the gladhand connections is the first step.

44. D — Brake drums should have been measured for roundness and machined if out-of-round before new linings were installed. An out-of-round drum creates a once-per-revolution contact variation — the shoes contact the drum firmly at the small diameter and release at the large diameter. This cyclic contact produces the vibration proportional to wheel speed during braking.

45. C — The air system safety valve is the last-resort protection against over-pressurization. When the governor fails to unload the compressor, the pressure rises unchecked. At 150 PSI (1,035 kPa), the safety valve opens and vents the excess compressor output directly to atmosphere, preventing the pressure from exceeding this threshold and protecting all system components.

46. A — The initial pushrod stroke was set 10 mm tighter than specified. With the linings held this close to the drum, the brake shoes may drag against the drum during driving. The over-tight initial setting creates continuous brake drag that generates heat and accelerates wear. Automatic slack adjusters only tighten — they cannot release an over-adjusted brake.

47. A — The dash lights dim momentarily (proving current flows through the battery cables when the key is turned to start) but no click is heard from the solenoid. The current path from the battery to the dimming lamps is separate from the control circuit to the solenoid. The start control circuit — ignition switch, neutral safety switch, start relay, and wiring — has an open preventing the signal from reaching the solenoid.

48. D — The coolant level is verified correct but the sensor alternates rapidly between OK and LOW. The coolant surface is at or very near the sensor probe's detection threshold, and the engine's normal vibration causes the liquid surface to oscillate across the probe tip. The rapid cycling confirms the level is at the sensor's boundary — adding a small amount of coolant should resolve the cycling.

49. C — The engine starts and runs correctly (confirming the calibration file is correct) but the transmission shifts erratically. The customer parameters — vehicle-specific settings including axle ratio, tire size, transmission type, PTO configuration, fan engagement, and idle shutdown — were not transferred from the old ECM to the new one. These parameters affect the ECM's interaction with the transmission.

50. B — The alternator bench-tests at full output and the cables are good, but the batteries remain undercharged. The most likely cause is an incorrect voltage sense connection. Many alternators use a sense wire to read the actual battery terminal voltage for regulation feedback. Without this connection, the regulator cannot compensate for cable voltage drop and may charge at a reduced rate.

51. D — The switch provides correct resistance signals (confirming the input is good) but the motor runs at only one speed. The wiper motor's internal speed control mechanism or the body controller's speed output circuit has a fault that provides the same electrical path to the motor regardless of the switch position. The control path between the switch and motor must be diagnosed.

52. D — Pulling the body controller fuse confirmed the 310 mA drain is on the body controller circuit. However, the body controller powers multiple downstream components through its fused circuit — interior lights, lighted switches, solenoid valves, relay coils, and other accessories. The controller and every component powered through its circuit must be individually tested to isolate the actual source.

53. C — The LED tail lamp assembly was designed for a different vehicle model. The internal wiring connects the brake lamp LEDs to the turn signal filament circuit instead of the brake lamp circuit. The turn signal flasher frequency drives the brake lamp LEDs when the brake pedal is pressed, producing the rapid flashing pattern instead of the steady illumination.

54. B — The speedometer reads correctly (confirming the CAN bus data for vehicle speed is accurate) but the tachometer reads 500 RPM high consistently. The cluster's internal software has a calibration error specifically on the tachometer channel that applies an incorrect scaling factor to the RPM data. The cluster software or the cluster itself needs to be updated or replaced.

55. A — The battery disconnect was activated and then reconnected. The engine starts (confirming the engine circuit has power) but body-controlled accessories do not function despite good fuses. The body controller must complete a re-initialization sequence after a battery disconnect — the controller needs a specific key cycle, time delay, or scan tool procedure to re-enable its outputs.

56. A — FMI 7 (mechanical system not responding) means the ABS module is sending a signal to the sensor and receiving a response, but the response does not match expected wheel rotation characteristics. The active sensor produces a signal but the pattern does not correspond to mechanical wheel rotation — the tone ring may have missing or damaged teeth that produce an abnormal pattern.

57. C — The parking lamps work through the same body controller (confirming the controller receives switch commands and produces outputs). The headlamps require more current than parking lamps. The body controller's headlamp output driver circuit — or its dedicated fuse or relay — has failed. The parking lamp output driver works independently on the same controller.

58. A — The charging system produces 14.4V with accessories off but drops to 12.8V when headlamps, blower, and heated mirrors are activated. The alternator cannot maintain its regulated output under the combined load — either the alternator has reached its maximum current capacity or the field circuit cannot increase the field current to match the higher demand.

59. C — The barometric pressure sensor's internal to the ECM and reads atmospheric pressure through a reference port. Water or oil vapour entering through this port contaminates the sensor element. During driving, vibration and temperature changes cause the contaminant to shift on the sensor producing erratic readings that set the intermittent fault code.

60. B — The voltage at the connector reads 12.4V (identical to all functioning lamps) eliminating supply voltage as the cause. The LED assembly has a partial internal failure — one or more LED segments have failed while the remaining segments continue to illuminate at their normal individual brightness. The reduced number of active segments produces lower total light output.

61. A — The straightened pins may have developed micro-cracks from the bending stress that are invisible to the eye. Under the contact pressure of the scan tool's mating connector, these weakened pins create intermittent high-resistance connections. Some modules communicate through pins that maintained good contact while others are on the damaged pins.

62. A — The crankshaft position sensor (CKP) is the primary speed and position sensor for the engine ECM. Without a valid CKP signal, the ECM cannot determine engine speed (reads 0 RPM) and cannot calculate injection timing. The ECM will not command fuel injection without knowing the crankshaft position, so the engine cranks but does not start.

63. D — A 3.2-volt drop at the connector under load is far above the acceptable specification. The connector must be cleaned with contact cleaner, the pin and socket surfaces inspected for pitting and corrosion, the contact spring tension verified for adequate grip, and the connector replaced if cleaning cannot restore the voltage drop to within the 0.5-volt specification.

64. B — The replacement regulator has the correct voltage rating but the sensing wire was connected to the wrong terminal. The regulator's sense input reads a lower-than-actual voltage from the incorrect connection point, so it increases the field current trying to raise the perceived low voltage — but the actual battery voltage rises to 16.2V because the regulation feedback is incorrect.

65. C — The cellular network has coverage gaps along the vehicle's route. When the telematics unit cannot establish a cellular connection, it cannot transmit data in real time. Some units store data locally and transmit when coverage resumes, but the fleet server shows the gaps during the real-time monitoring because the data was not received during those periods.

66. A — The motor draws 15A going up (nearly double normal) and 6A going down (below normal). The directional current asymmetry indicates a mechanical resistance that opposes the upward movement — gravity plus an additional resistance from the window regulator mechanism, binding channel, or worn components creates the increased load in the up direction only.

67. D — Modern oil life monitoring algorithms use multiple engine operating parameters — not just mileage or time. The algorithm considers engine hours, fuel consumption, coolant temperature operating history, duty cycle severity (load, RPM), idle time percentage, and ambient temperature to calculate the oil's actual degradation rate for the specific engine's operating conditions.

68. B — The engine cranks at correct speed and fuel pressure is adequate during cranking — combustion should occur. Rough running for 5 seconds after start without fault codes suggests uneven initial combustion across cylinders. Incorrect injector calibration codes cause the ECM to apply wrong correction factors during cold-start enrichment, creating unequal fuel delivery until normal running parameters override the cold-start strategy.

69. A — Reverse gear in most heavy-duty manual transmissions is not synchronized. The driver must wait for the input shaft (driven by the clutch disc through the transmission input shaft) to stop completely before engaging the non-synchronized reverse idler gear. Any residual input shaft rotation causes the straight-cut reverse teeth to clash during engagement.

70. C — A whine in reverse only that is absent in all forward gears points to a component unique to the reverse power path. The reverse gear train uses a different gear mesh than the forward planetary combinations. Some reverse gear whine is a normal characteristic — the helical cut angle of the reverse gear set produces more mesh noise than the forward gear combinations.

71. B — The driveshaft was reinstalled in the correct orientation with correct U-joint phasing, but a new vibration appeared at 80 km/h. A bearing cap that was not fully seated in the yoke ear during the U-joint pressing process shifts the U-joint's rotational centre. This offset creates a dynamic imbalance that produces vibration at highway speed.

72. D — A clutch engagement point near the top of pedal travel indicates the clutch disc is worn thin. As the disc friction material wears, the pressure plate moves closer to the flywheel. The release bearing must travel further from its rest position before the now-thinner disc contacts the flywheel. Only the last portion of pedal release brings the thin disc into contact.

73. B — Both 5th and 10th gears produce noise while all other gears are quiet. The common element between 5th (direct drive, low split) and 10th (direct drive, high split) is that they both use the same countershaft gear pair during their power path. A worn tooth surface on this specific gear pair produces noise in both ratios but not in any other gear selection.

74. D — The backlash is set correctly (ruling out backlash error) but the axle whines during coast and cruise. The drive-side pattern may be acceptable, but the coast-side contact pattern is incorrect. The different tooth geometry under coast loading shifts the contact to an incorrect position on the tooth face, producing the whine when the load shifts from drive to coast.

75. B — The clutch pedal feels firm (confirming no air in the system) but the clutch does not fully disengage. The replacement slave cylinder has a shorter stroke specification than the original — the reduced pushrod travel does not move the release bearing far enough to fully compress the diaphragm spring and disengage the pressure plate from the disc.

76. D — The diagonal pitting pattern across the roller surface is spalling — the progressive failure of the bearing's hardened surface from subsurface fatigue. The cyclic stress from millions of roller rotations creates micro-cracks beneath the hardened surface that eventually propagate to the surface and flake away. This is the normal fatigue failure mode indicating end of bearing life.

77. A — Burnt oil odour combined with visible metal flakes indicates the transfer case has been operating under distressed conditions — either from overheating, lubricant starvation, or excessive loading. The internal gears, bearings, and chain must be inspected for damage. Simply refilling with new oil does not address the underlying damage that produced the contamination.

78. A — The clutch teach-in procedure measures the clutch's actual engagement point (where the disc first contacts the flywheel), the full release position, and the actuator's full stroke range. The AMT controller needs this position data to accurately modulate the clutch actuator for smooth engagement during each shift event throughout the clutch disc's entire wear range.

79. C — Park-to-Drive is smooth but Park-to-Reverse slams. The reverse band apply servo should have a cushion spring that absorbs the initial application force and creates a gradual engagement. A failed cushion spring allows the band to apply at full force against the drum instantly, creating the harsh slam from the uncontrolled engagement.

80. D — Fretting corrosion on slip yoke splines indicates the spline surfaces are deteriorating. The corroded surface is rougher than the original machined finish and will accelerate wear on the mating transmission output shaft splines. The yoke should be replaced, and the transmission seal should also be replaced because the corroded spline surface damages the seal lip.

81. A — The compression brake operates by holding exhaust valves open to release compressed air at TDC. Over time, the exhaust valve seating surfaces wear and cannot seal as tightly during the compression hold phase. The reduced seal allows some compressed air to leak past the valves before the brake releases it — reducing both the noise level and the retarding force proportionally.

82. D — Operating with the inter-axle lock engaged on dry pavement prevents the front and rear drive axles from turning at different speeds during turns. The resulting driveline windup creates torsional stress that loads the suspension mounting points. The accumulated stress can twist a torque rod, shift a trailing arm bushing, or deflect an axle position creating the steering pull.

83. A — A stall speed of 1,800 RPM versus the 2,100-2,200 RPM specification indicates the engine cannot spin the converter fast enough to reach the designed stall point. The engine is producing less power than its specification. An engine power test should be performed to verify the engine's output — the transmission rebuild did not cause the low stall speed.

84. B — Each section of a two-piece driveshaft is phased independently. The yoke ears at each end of the front section must be in the same rotational plane, and the yoke ears at each end of the rear section must be in the same rotational plane. This ensures each section's U-joints cancel their angular velocity variations independently through the centre bearing junction.

85. D — The hydraulic retarder generates heat during operation that must be rejected through a heat exchanger in the engine cooling circuit. If the cooling circuit was not properly reconnected or bled after the fluid service, trapped air or a restricted connection reduces the coolant flow through the heat exchanger. The reduced cooling capacity allows the coolant temperature to rise during sustained retarder use.

86. C — The sector shaft adjustment was set too tight. While it successfully eliminated free play at the centre position, the adjustment created excessive friction throughout the gearbox's entire travel range. The vehicle's caster angle generates a self-centering force during turns, but this force cannot overcome the gearbox's increased internal friction from the over-tight adjustment.

87. A — The rubber helper pads provide a progressive rate increase as the suspension approaches full jounce (compression). Without the pads, the suspension reaches the metal bump stops without the designed cushioning transition. The hard metal-to-metal contact at the bump stops creates a harsh impact during large bumps that the helper pads would normally absorb progressively.

88. D — Unitized (preset) bearings have a specific internal clearance set during manufacturing that cannot be changed externally. Tightening the hub nut compresses the bearing assembly and overloads the rolling elements beyond their designed preload. This excessive preload generates heat, accelerates wear, and will cause premature bearing failure from the overloaded condition.

89. B — The failed trailing arm bushing allows the drive axle to shift rearward on the affected side during acceleration loading. This shift creates a temporary thrust angle — the axle is no longer perpendicular to the vehicle centreline. The biased thrust angle pushes the rear of the vehicle to one side, steering the front to the opposite side during the acceleration event only.

90. C — Inner-edge-only wear on a steer tire indicates the tire is tilted inward — excessive negative camber concentrates the ground contact force on the inner tread edge. The tire's top leans inward, overloading the inner portion of the contact patch during straight driving. The centre and outer edges carry proportionally less load and wear slower than the overloaded inner edge.

91. A — A crack tip concentrates stress at its sharp end, promoting propagation. Stop holes remove the sharp crack tip and replace it with a round hole that distributes the stress around its circumference rather than concentrating it at a single point. The reduced stress concentration arrests the crack's growth until a permanent repair (bolted splice plate) can be installed.

92. D — Air ride suspensions have a softer spring rate and different dynamic characteristics than leaf springs. The softer air ride allows more axle wrap during braking — the axle rotates on its air spring mounts under braking force. This altered axle movement changes the S-cam geometry and brake chamber angle during each application, reducing the effective braking force at each wheel.

93. A — A brake pedal that slowly sinks to the floor under sustained moderate pressure with normal air system pressure indicates a hydraulic circuit leak. The air-over-hydraulic booster converts air pressure to hydraulic pressure for the front disc brakes. The front hydraulic master cylinder or booster has a worn internal piston seal that allows fluid to bypass under sustained pressure.

94. B — A 200-gram balance weight requirement is at the upper limit of acceptable for most commercial tire applications. This large imbalance may indicate a tire manufacturing defect (shifted belt, eccentric bead), a rim problem, or improper bead seating. The tire should be dismounted, rotated 180° on the rim, and rebalanced to determine if the imbalance follows the tire or the rim.

95. A — The wrong type of grease creates resistance between the fifth wheel plate and the trailer upper coupler plate. A high-tack or incorrect grease formulation can create adhesion rather than the designed low-friction sliding contact. The increased friction between the coupling surfaces impedes normal articulation during turns, requiring more steering effort from the driver.

96. D — A 40 kPa pressure difference between dual tires creates unequal rolling radii — the lower-pressure inner tire has a smaller effective diameter than the higher-pressure outer tire. During straight driving, the different diameters cause the dual pair to work against each other — the smaller tire is dragged along faster than its natural rolling speed, creating scrubbing wear on both tires.

97. A — The replacement wheel stud was pressed in without adequate interference fit between the stud's knurl/serration and the hub flange bore. Without sufficient press-fit grip, the stud can move in the bore under the cyclic loading of driving. The stud settles deeper into the bore or rotates slightly, loosening the wheel nut from the reduced stud protrusion length.

98. B — All hardware components are within specification, yet the wheel repeatedly loosens. The mounting procedure itself is the variable — specifically whether the technician uses a calibrated torque wrench with a star (criss-cross) pattern versus an impact wrench with a circular pattern. A circular pattern does not evenly distribute the clamping force and can leave some studs undertorqued.

99. C — Unequal caster creates a steering pull toward the side with less caster angle. The left side has +2.0° (less caster) while the right has +4.0° (more caster), with a 2.0° side-to-side difference exceeding the 1.0° maximum specification. The reduced caster on the left creates less trail and less self-centering force, causing the steering to drift toward the left.

100. D — A 1,500 kg side-to-side weight difference with supposedly even cargo distribution requires investigating all potential causes. The cargo may not be as evenly distributed as it appears, the frame may have a twist that shifts the geometry, or the suspension may have unequal spring rates or air pressures. All three potential sources must be examined.

101. B — Both steer tires must be at the correct specification pressure for the tire size and load rating. The 690 kPa reading on the left is below the 760 kPa on the right, suggesting the left tire has lost pressure. The correct cold inflation pressure for the application must be verified from the tire specification, and both tires must be set to that specification.

102. A — SAI is a built-in geometric angle determined by the physical relationship between the king pin axis and the vertical axis. Since SAI cannot be adjusted externally, a 2° difference between sides indicates physical damage — the left knuckle has been bent from a pothole or curb impact, changing the king pin-to-vertical geometry on that side.

103. B — One bead has seated but the other has not. The unseated bead needs additional lubrication to slide over the rim's safety hump into the bead seat. The technician should apply approved tire mounting lubricant to the unseated bead and attempt to reseat at the recommended seating pressure. If the bead still does not seat, the tire or rim should be inspected for defects.

104. D — The cab must be supported by a mechanical tilt lock or safety prop in addition to the hydraulic cylinder. The mechanical lock provides a positive physical stop that cannot fail from hydraulic leaks, hose failures, or cylinder seal deterioration. Working under a cab supported only by a hydraulic cylinder is prohibited because hydraulic systems can fail without warning.

105. B — With windows closed and HVAC in recirculation mode, dust enters through deteriorated cab body seals, floor grommets around wiring and hose penetrations, firewall openings, and gaps in the cab structure. These entry points allow dust-laden air from under the cab and around the engine compartment to enter the cab interior bypassing the HVAC filtration system.

106. B — The exhaust system has been inspected from turbocharger to tailpipe with no leaks found. The exhaust entry point is the HVAC fresh air intake's position relative to the exhaust outlet. During driving, wind patterns can carry exhaust from the tailpipe or stack to the HVAC intake. The relative positioning of these two openings determines whether exhaust enters the cab ventilation.

107. D — A 150 mm crack in door glass will propagate from vibration and temperature cycling during driving. Tempered glass (used in side windows) cannot be repaired like laminated windshield glass. When the crack eventually propagates to a critical length, the entire pane will shatter into small fragments, creating a sudden loss of the window during driving.

108. B — A non-functional emergency exit prevents the driver from escaping the cab during a fire, collision, or rollover that blocks the normal door exits. The emergency exit is a life-safety device that must function when needed. The mechanism must be repaired or the window assembly replaced immediately — emergency exit functionality is not deferrable maintenance.

109. A — During the 45-minute open-door period, warm moist ambient air entered the -18°C cargo space. The moisture in this air immediately froze on the cold evaporator coil as heavy frost. This frost layer insulates the coil surface and blocks airflow, dramatically reducing the TRU's cooling capacity and extending the time needed to pull the temperature back to setpoint.

110. B — The tilt function works sometimes and not others. The pump runs and the valve shifts (confirmed), but the tilt cylinder does not always respond. Contamination in the directional valve spool bore causes the spool to stick intermittently — sometimes it shifts fully to deliver flow and sometimes it sticks at a position that blocks flow to the tilt circuit.

111. B — The trailer brakes lock up on wet roads with the ABS lamp off and all components within specification. The trailer brake system may be delivering more application pressure than the wet-road traction can support. An incorrect relay valve that overdelivers, or an over-braked proportioning, creates a force that exceeds the reduced wet-road traction causing lockup before ABS can modulate.

112. D — A soft spot that depresses under hand pressure with a dull acoustic response (versus the sharp ring of intact panels) confirms the foam core has failed at that location. The bond between the outer skin and the foam core has broken — from moisture intrusion, heat degradation, or manufacturing defect — and the unsupported skin flexes and sounds dull without the rigid core backing.

113. A — The thinner deck boards may not have adequate structural capacity for concentrated loads — particularly forklift wheel loads during loading and unloading operations. Forklifts create concentrated point loads that deck boards must span between the cross-members. A 5 mm thickness reduction changes the board's bending strength, potentially allowing deck failure under forklift traffic.

114. C — Hydraulic fluid viscosity increases significantly in cold temperatures. The thicker cold fluid creates substantially more resistance to flow through the pump, directional valves, hoses, fittings, and cylinder ports. The liftgate motor must work harder to pump the thick fluid, and the restricted flow through the entire circuit slows all functions proportionally.

115. A — The road debris that tore the mud flap may have also contacted the tire sidewall behind the mud flap during the same impact event. A tire sidewall cut from debris can be invisible from the outside but may have damaged the internal cord structure, creating a future blowout risk. The exposed tire must be inspected for cuts, bulges, or cord damage.

116. D — The ABS prevents wheel lockup but cannot improve the tire's physical grip on the road surface. Stopping distance on wet roads depends on the tire's traction — determined by tread depth, tread compound, contact patch area, and inflation pressure. Worn tires with reduced tread depth have less traction on wet surfaces regardless of how well the ABS modulates.

117. A — When replacing the expansion valve, the receiver/dryer should also be replaced. The old dryer's saturated desiccant cannot absorb residual moisture in the system. The moisture freezes intermittently at the new expansion valve's orifice during operation, creating a restriction that drops the suction pressure below the cycling switch threshold triggering the rapid 30-second compressor cycling.

118. C — The heater core replacement required removing and reinstalling the HVAC housing. During reassembly, the housing was not fully sealed — a gap allows ambient air to leak into the driver-side ductwork, mixing with the heated air and diluting the outlet temperature on that side. The passenger side ducts are properly sealed and deliver full-temperature air.

119. B — An 8°C temperature drop across the evaporator versus the normal 15-20°C with correct charge and pressures indicates reduced heat transfer surface contact. An internal refrigerant flow restriction (kinked tube, oil accumulation, or debris) limits the refrigerant's contact area within the evaporator. Less refrigerant surface area means less heat absorption despite adequate airflow.

120. D — The blower motor runs at all speeds and the heater core flow is adequate — eliminating motor and heating source as variables. Gradually decreasing airflow over months with a functioning blower points to the cabin air filter. The filter progressively accumulates dirt that restricts the airflow path. The blower works but cannot push adequate air through the increasingly clogged filter.

121. C — Both the suction and discharge gauges read the same pressure (550 kPa) with the compressor clutch engaged. Equalized pressures mean the compressor cannot create a pressure differential between the high and low sides. The most likely cause is the compressor is not mechanically pumping — the clutch appears to engage but the internal mechanism has failed.

122. B — A regular 10-second oscillation between hot and cold at a mid-range temperature setting indicates the blend door actuator is hunting for position. The actuator advances toward the target, overshoots, the controller corrects, it undershoots, and the cycle repeats. The actuator motor or its position feedback sensor has a fault that prevents stable positioning.

123. A — After 5,000 hours with normal combustion (clean blue flame) and correct fuel delivery, the heat output has decreased. The heat exchanger's exhaust gas passages have accumulated an insulating layer of combustion soot on the gas side. This soot layer reduces the thermal transfer from the combustion gas to the coolant, decreasing the heater's effective output.

124. D — All functions operate at 70% speed uniformly. A single component affecting all functions must be upstream of the directional valves — the pump. The pump's displacement control or pressure compensator has partially failed and limits the pump to 70% of its designed flow output. The reduced flow proportionally reduces the speed of every function in the system.

125. C — The dump body raises normally but bounces at full raise when the control is released. Air trapped inside the cylinder compresses at the end of the raise stroke. When pressure is released, the compressed air expands creating a spring effect that bounces the body. The air must be bled from the cylinder to eliminate the compressible gas pocket.

126. C — A closed-centre system with a variable-displacement pump should maintain standby pressure at 1,500 kPa when no functions are activated. The 200 kPa reading indicates the pump compensator has failed and is keeping the pump at minimum displacement. The pump produces only residual leakage flow at 200 kPa rather than the designed 1,500 kPa standby pressure.

127. B — The winch motor receives full flow from the directional valve but operates at only 60% of the specified speed. The motor has worn internally — enlarged clearances between the gears and housing allow hydraulic fluid to bypass the displacement chambers without performing work. The motor receives 100% of the flow but only 60% creates useful rotation.

128. D — The nitrogen pre-charge read correctly for 1 hour then dropped to 0 kPa. The replacement bladder has ruptured from the 20,000 kPa hydraulic system pressure. The nitrogen escaped through the rupture into the hydraulic oil side, and the accumulator filled completely with oil — losing all gas spring function. The bladder must be replaced again with proper verification.

129. A — The motor's thermal overload trips after 15 minutes and resets after 10 minutes of cooling. The overload protector has drifted to a lower trip temperature from aging. The protector trips before the motor reaches its actual safe operating temperature during the designed intermittent duty cycle. The thermal protector should be tested and replaced if it trips below specification.

130. C — Biodegradable hydraulic fluids often have different lubricity characteristics than petroleum-based fluids. The different lubricity creates more friction at the pump's internal bearing surfaces, gear mesh, and valve interfaces. The additional friction heat from the altered lubrication properties exceeds the cooling system's capacity designed for the lower-friction petroleum fluid.

131. B — The cylinder vibrates only during the last 200 mm of extension. The cylinder's internal cushion engages during this final travel. The cushion plunger enters the cushion bore and meters the trapped oil through a controlled orifice. A bent or damaged cushion plunger or a contaminated orifice creates an irregular restriction that produces pressure oscillation and vibration.

132. D — The pack voltage is 10 volts lower than the sum of individual cell voltages. This discrepancy represents voltage consumed by resistance at the inter-module bus bar connections, main contactors, fusing, or terminal connections. The I^2R losses at these high-resistance points consume 10 volts, generate heat, waste energy, and must be located and repaired.

133. C — Friction brake drag absorbs kinetic energy mechanically — energy that should be available for the regenerative system to convert electrically. Worn or dragging brake components consume energy before the motor/generator can capture it. The 40% reduction in regenerative capture may correspond to the energy being consumed by the mechanical friction drag in the brake system.

134. C — The vehicle's HV isolation passes the megohmmeter test when not plugged in, but the charger detects an isolation fault during charging. The charging port connector has moisture intrusion or contamination between the HV charging pins and the connector housing ground. This contamination creates a low-resistance path that appears only when the charging cable is mated.

135. B — The engine clutch is confirmed disengaged and the motor drives the vehicle, but a grinding noise comes from the transmission area. The electric motor's coupling to the transmission has a worn spline or damaged coupler. The motor's different torque characteristics (instant, high torque at low speed) stress the coupling differently than the engine, revealing wear that engine vibration normally masks.