PRACTICE EXAM 7: RED SEAL 310T SIMULATION (135 QUESTIONS)

1. A technician is assigned to steam clean the underside of a truck that has been in service for several years. Before beginning, the technician notices thick accumulations of grease, oil, and road grime on the frame rails and suspension components. What specific hazard should the technician consider before starting the steam cleaning?

A. The steam cleaner's electrical cord may be damaged by the high-pressure spray if it is not routed away from the work area

B. The cleaning chemicals in the steam cleaner solution may react with the road grime and produce a toxic gas

C. The hot water runoff may exceed the shop's drain capacity and flood adjacent work bays if not managed properly

D. The steam and hot water will dislodge and aerosolize contaminants including used brake lining dust, which may contain hazardous materials — the technician must wear appropriate respiratory protection, eye protection, and chemical-resistant clothing to avoid inhaling or contacting the aerosolized contaminants

2. A technician is asked to tow a disabled truck from a highway to the shop using a tow truck. Before connecting the tow equipment, what must the technician verify about the disabled vehicle?

A. The disabled vehicle's fuel tank level, to ensure there is adequate fuel to idle the engine during the tow for power steering and brake assist

B. The disabled vehicle's transmission type and towing restrictions — automatic transmissions, AMTs, and some manual transmissions have specific towing limitations (speed, distance, and driveshaft disconnection requirements) that must be followed to prevent internal transmission damage from being towed without adequate lubrication

C. The disabled vehicle's tire tread depth on all axles, which must meet minimum standards before the vehicle can be legally towed on a public road

D. The disabled vehicle's emission system status, since a vehicle with an active DPF regeneration cannot be safely towed

3. A shop has a designated area for charging batteries. What ventilation requirement applies to this area?

A. The area must be enclosed to prevent the charging fumes from reaching other shop areas

B. No special ventilation is required as long as the batteries are sealed maintenance-free type

C. The area must have adequate ventilation to prevent the accumulation of hydrogen gas produced during charging — hydrogen is highly flammable and explosive, and a concentration of only 4% in air creates an explosive atmosphere that can be ignited by a spark, open flame, or static discharge

D. The area must have a carbon monoxide detector because lead-acid batteries produce CO during the charging process

4. A technician needs to use a hydraulic floor jack to raise the front of a heavy-duty truck. The truck weighs approximately 8,000 kg. The shop has two jacks available: a 5-ton jack and a 10-ton jack. Which jack should be used?

A. The 10-ton jack must be used because the jack's rated capacity must exceed the weight being lifted — even though the technician is only lifting one end of the truck, the jack must be rated for the full weight or the applicable axle weight to ensure an adequate safety margin

B. The 5-ton jack is adequate because lifting one end of the truck only requires supporting approximately half the vehicle's total weight

C. Either jack is acceptable as long as the lifting point is centered under the frame rail for balanced load distribution

D. The 10-ton jack is required only if the truck is loaded; the 5-ton jack is adequate for an unloaded vehicle

5. A technician is removing a rusted exhaust clamp using a cutting torch. During the cut, a piece of hot slag falls and lands on a shop rag that is lying on the floor. The rag ignites. What should the technician have done to prevent this situation?

A. Used a fire-resistant welding blanket over the area but continued using the standard shop rags for cleanup

B. Had a coworker standing by with a fire extinguisher to respond immediately to any ignition event

C. Cleared all combustible materials from the work area and the area below the cutting operation before lighting the torch — removing shop rags, cardboard, oil-soaked floor absorbent, and any other combustible material from the fire zone is a mandatory pre-cutting safety step

D. Worn fire-resistant gloves that would have allowed the technician to pick up the burning rag safely

6. A new apprentice asks why the shop requires technicians to wear safety glasses at all times on the shop floor, even when not performing a task that generates debris. What is the correct explanation?

A. Safety glasses filter harmful UV light from the shop's fluorescent lighting to prevent long-term eye damage

B. Eye injuries can occur from unexpected events — flying debris from another technician's work, spring-loaded components releasing during disassembly, chemical splashes, and pressurized fluid leaks can all project hazards across the shop floor at any time, making continuous eye protection essential

C. Safety glasses are required by the equipment warranty to prevent liability claims if a technician is injured

D. The lenses in safety glasses improve visual acuity in the shop's lighting conditions for more accurate repair work

7. A technician discovers an unmarked container of clear liquid stored under a workbench. The container appears to be a plastic jug that originally held windshield washer fluid. What is the correct action?

A. Smell the liquid carefully to attempt identification, then label the container with the identified product name

B. Pour a small amount onto a shop rag and observe whether it evaporates, feels oily, or has a distinctive color to narrow down the identification

C. Dispose of the liquid in the waste oil tank since most clear shop liquids are petroleum-based products

D. Do not attempt to identify the liquid by smell, taste, or contact — report the unmarked container to the supervisor for proper identification, handling, and disposal according to WHMIS requirements, as the contents could be any hazardous substance

8. A technician is performing a repair on a truck's air brake system that requires disconnecting several air lines. Before starting work, the technician drains the air system to zero pressure. Why is draining the system a mandatory safety step?

A. Disconnecting a pressurized air line releases a sudden burst of air that can propel fittings, dirt, and debris at high velocity — a 1/2-inch air line at 120 psi can blow a loose fitting with enough force to cause serious eye or skin injuries, and the noise can cause hearing damage

B. The air system must be drained to prevent moisture from contaminating the new fittings being installed

C. Pressurized air lines must be depressurized to allow the use of Teflon tape on the thread connections

D. Draining the system is only required when replacing the air dryer, not for routine air line disconnections

9. A heavy-duty diesel engine equipped with a common rail fuel system cranks normally but will not start. The scan tool shows the fuel rail pressure at 0 psi during cranking. The fuel tank is full. What is the most direct diagnostic step?

A. Replace the fuel rail pressure sensor, which is likely sending a false zero reading to the ECM

B. Perform a compression test on all cylinders to verify the engine can generate enough heat for ignition

C. Verify that the low-pressure fuel supply is reaching the high-pressure pump inlet — check the transfer pump operation, fuel filter condition, and fuel supply lines for restrictions or air leaks that would prevent fuel from reaching the high-pressure pump

D. Replace the common rail pressure relief valve, which may be stuck open and venting all rail pressure

10. A diesel engine has a condition where the exhaust produces intermittent puffs of blue smoke during deceleration on long downhill grades. The engine does not smoke during acceleration or at steady speed. What is the most likely cause?

A. The turbocharger oil seals are leaking oil into the exhaust housing — during deceleration, the exhaust backpressure drops below the oil supply pressure in the turbocharger's center housing, and the pressure differential pushes oil past the turbine-side seal into the exhaust stream, where it burns as blue smoke

B. The fuel injectors are dribbling fuel during deceleration due to a slow needle return in the injector nozzle

C. The valve stem seals are worn, and the high intake manifold vacuum during deceleration pulls oil past the seals into the cylinders

D. The engine oil level is overfull, and the deceleration angle causes oil to slosh toward the turbocharger drain

11. A technician is performing a routine service on a heavy-duty diesel engine and discovers metal shavings in the oil filter during the filter change. The shavings are bright silver in color and appear to be aluminum. What does this finding indicate?

A. Normal wear from the aluminum timing gear cover that produces small amounts of aluminum debris during break-in

B. Aluminum contamination from a deteriorating piston — the piston material is failing from sustained overheating, thermal fatigue, or a failed ring that has allowed combustion heat to damage the piston crown or skirt; the engine must be thoroughly inspected before returning to service

C. Contamination from the aluminum oil filter housing that is corroding internally from acidic oil

D. Aluminum shavings from the oil cooler plates that have eroded from cavitation in the coolant side of the cooler

12. A heavy-duty diesel engine has a diagnostic trouble code for "Intake Manifold Temperature — Higher Than Expected." The engine is derated. The turbocharger boost pressure is within specification. What component failure would cause elevated intake manifold temperature?

A. A failed engine thermostat stuck in the closed position, which would affect coolant temperature but not intake air temperature

B. The crankcase ventilation system is recirculating excessively hot crankcase gases into the intake manifold

C. The exhaust gas recirculation cooler has failed internally, allowing hot exhaust gas to enter the intake without being cooled

D. A restricted or failed charge air cooler (intercooler) — the turbocharger compresses the intake air and heats it significantly; the charge air cooler is supposed to remove this heat before the air enters the intake manifold, and if the cooler is restricted internally or has a failed core, the hot compressed air reaches the manifold uncooled

13. A heavy-duty diesel engine has been overhauled and is being started for the first time. During the initial startup, the oil pressure gauge shows adequate pressure, but the technician hears a brief metallic rattle from the top of the engine that lasts approximately 3 seconds before quieting. What is the most likely cause?

A. The connecting rod bearings were not torqued to specification and are rattling under the initial oil pressure surge

B. The crankshaft main bearing caps are loose and the crankshaft is rocking in the bore during the initial rotation

C. The hydraulic valve lash adjusters (if equipped) are collapsed from being dry after the overhaul — they fill with oil and quiet down within seconds of the oil system pressurizing; on engines with manual lash adjusters, the initial rattle may be from the valve train having excess lash that settles during the first rotation

D. The timing gear backlash is excessive from incorrect installation and the gear noise will persist beyond the initial startup

14. A fleet of identical trucks operates on the same routes. One truck consistently shows higher exhaust gas temperatures (EGT) at the turbocharger outlet than the rest of the fleet. The engine has no fault codes and power output is normal. What is the most likely explanation?

A. The higher EGT truck has a more restrictive exhaust system — a partially loaded DPF, a restricted DOC, or a damaged exhaust pipe that creates additional backpressure; the engine works harder to push exhaust through the restriction, which raises the temperature of the exhaust gas at the turbo outlet

B. The higher EGT truck has a turbocharger that is spinning faster than the others due to a tighter wastegate spring

C. The driver of the higher EGT truck drives more aggressively, using full throttle more frequently than the other drivers

D. The higher EGT truck has a leaking charge air cooler that is reducing the intake air temperature below the fleet average

15. A diesel engine's fuel system has been contaminated with gasoline. The truck was accidentally fueled with gasoline at a truck stop. The driver drove approximately 5 km before the engine lost power and stalled. What potential damage has occurred?

A. The gasoline has cleaned the carbon deposits from the injector tips and no mechanical damage has occurred

B. The gasoline has only affected the fuel filter and the system will function normally once the filter is replaced

C. The gasoline may have contaminated the oil through fuel dilution but has not damaged any injection components

D. The gasoline's lower lubricity has likely damaged the high-pressure fuel pump and injectors — diesel fuel provides critical lubrication to the pump's plungers and the injectors' internal components, and gasoline strips this lubrication, causing metal-to-metal contact and scoring of the precision-machined surfaces within 5 km of operation

16. A technician is diagnosing a heavy-duty diesel engine that produces a continuous hissing noise from the exhaust manifold area at idle. The noise is present on one side of the engine only. What is the most likely cause?

A. A turbocharger wastegate that is stuck partially open and venting exhaust gas past its seat at idle

B. A cracked exhaust manifold or a leaking exhaust manifold gasket on the affected side — the hissing is pressurized exhaust gas escaping through the crack or failed gasket at the manifold-to-head joint, and the continuous nature of the noise at idle confirms a constant leak rather than an intermittent valve-related noise

C. A damaged exhaust brake butterfly valve that is not sealing completely in the open position at idle

D. An exhaust gas recirculation valve that is stuck partially open, creating a whistling noise from the restricted gas flow

17. A heavy-duty diesel engine's coolant system uses an extended-life coolant (ELC) that is designed for 600,000 km or 6-year service intervals. At the 300,000 km mark, the technician tests the coolant and finds the freeze point protection is adequate but the pH has dropped below 7.5. What action is required?

A. The low pH indicates that the coolant's corrosion inhibitor package has depleted ahead of schedule — the inhibitors must be replenished by adding the manufacturer's recommended extender at the mid-life service point, or the coolant must be replaced to prevent accelerated corrosion of the engine's internal metal surfaces

B. A pH below 7.5 is within the normal range for ELC at mid-life and no action is required until the scheduled change interval

C. The pH test is not relevant for ELC formulations because they use organic acid technology that is effective at any pH level

D. The low pH is caused by exhaust gas contamination from a head gasket leak that must be repaired before addressing the coolant

18. A heavy-duty diesel engine has a condition where the engine runs normally but the engine oil turns black within 500 km of an oil change. The oil is the correct type and the filter is genuine. What is the most likely cause of the rapid discoloration?

A. This is normal behavior for a diesel engine — diesel combustion produces soot that is captured by the oil's dispersant additives, turning the oil black as the dispersants do their job of keeping soot particles suspended and preventing them from depositing on engine surfaces; rapid discoloration is a sign the oil is working correctly

B. The oil filter is counterfeit despite appearing genuine, and it is not filtering soot particles from the oil

C. The engine has excessive blow-by that is contaminating the oil with combustion byproducts faster than normal

D. The wrong oil specification was used, and the oil lacks adequate detergent additives to suspend the soot

19. A diesel engine equipped with a DOC, DPF, and SCR aftertreatment system has a condition where the DOC efficiency is below the minimum threshold. What impact does a failed DOC have on the downstream components?

A. A failed DOC has no impact on the DPF or SCR because each component operates independently of the others

B. A failed DOC will only affect the engine's fuel economy and has no impact on the DPF regeneration or SCR function

C. A failed DOC will cause the SCR catalyst to overheat because the DOC normally absorbs excess exhaust heat

D. A failed DOC reduces passive DPF regeneration (the DOC converts NO to NO2, which is the primary soot oxidizer for passive regeneration), impairs active regeneration (the DOC generates the heat needed for thermal soot oxidation), and may affect SCR performance if the DOC's hydrocarbon conversion is needed upstream of the SCR

20. A heavy-duty diesel engine's crankcase ventilation system includes a closed crankcase ventilation (CCV) filter. The technician discovers that the CCV filter's differential pressure has exceeded the service limit. What is the consequence of operating with a restricted CCV filter?

A. The restricted filter will cause a slight decrease in engine oil pressure from the increased crankcase backpressure

B. The restricted filter has no effect on engine operation because the crankcase ventilation system is a passive venting system

C. Crankcase pressure will build because the blow-by gases cannot vent through the restricted filter — elevated crankcase pressure can push oil past seals (rear main seal, front crankshaft seal, turbocharger seals, valve cover gaskets), cause oil leaks, reduce ring sealing effectiveness, and trigger a crankcase pressure fault code that may derate the engine

D. The restricted filter will cause the engine to consume excessive fuel because the blow-by gases contain unburned hydrocarbons

21. A technician notices that the fan belt on a heavy-duty diesel engine has a glazed, shiny appearance on the contact surfaces. The belt tension has been verified as correct. What does the glazed condition indicate?

A. The belt is new and the glazed appearance is the factory coating that protects the rubber during storage

B. The belt has been slipping on the pulleys despite correct tension — the slip generates heat that hardens and polishes the belt's rubber surface, reducing its coefficient of friction and causing it to slip even more; the glazing cycle is self-reinforcing and the belt must be replaced along with investigating the cause of the initial slip

C. The belt material is compatible with the pulley material and the glazed appearance indicates optimal performance

D. The belt has been contaminated with a petroleum-based product that has changed its surface characteristics

22. A diesel engine has a condition where coolant is leaking externally from the front of the engine near the water pump. The technician removes the water pump and finds that the pump impeller shaft has scored the pump housing bore. What additional component should be inspected?

A. The thermostat housing, which may have a failed gasket that contributed to the pump failure by allowing coolant to bypass and cavitate at the pump inlet, and the drive belt tension, which if excessive could have overloaded the pump shaft bearing and caused it to fail

B. The radiator cap, which if set to too high a pressure could have forced the pump seal beyond its rated capacity

C. The oil cooler, which may have provided excessive backpressure on the pump's discharge port

D. The EGR cooler, which may have recirculated hot coolant to the pump inlet, causing thermal shock to the shaft seal

23. A heavy-duty diesel engine has been running at idle for 8 hours continuously during an overnight power generation operation using the PTO. What engine system is most likely to require attention as a result of this extended idle period?

A. The engine's main bearings, which are designed for high-load operation and wear faster at idle speeds

B. The turbocharger bearings, which overheat at idle because the oil pressure is too low for adequate bearing lubrication

C. The fuel injection system, which develops carbon deposits on the injector tips from the low cylinder temperatures of idle operation

D. The aftertreatment system — specifically the DPF, which cannot regenerate during extended idle because the exhaust temperatures are too low for soot oxidation; the accumulated soot must be addressed through a parked regeneration or a loaded drive cycle before continuing normal operation

24. A technician measures the engine oil level on a heavy-duty diesel and finds it above the maximum mark on the dipstick. The oil was at the correct level at the last service 15,000 km ago. No oil has been added. What is causing the rising oil level?

A. The crankcase ventilation system is recirculating combustion gases that contain water vapor, which is condensing in the crankcase and mixing with the oil, raising the level

B. The engine coolant is leaking into the crankcase through a failed oil cooler, head gasket, or cracked component, displacing the oil level upward

C. Either fuel dilution (fuel leaking past the injectors into the crankcase during injection or from post-injection events during DPF regeneration) or coolant intrusion (from a failed oil cooler, head gasket, or cracked component) is adding liquid volume to the oil — the technician must determine which by checking for fuel odor and reduced viscosity (fuel) or milky appearance and sweet odor (coolant)

D. The oil is thermally expanding from the engine's operating temperature and must be measured only when cold

25. A diesel engine's turbocharger makes a high-pitched screaming noise during acceleration. The noise was not present previously. The turbocharger boost pressure is normal. What is the most likely cause?

A. A crack or leak in the intake ducting between the compressor outlet and the intake manifold — the pressurized air escaping through the crack produces a high-pitched screaming or whistling noise that is most prominent during acceleration when boost pressure is highest and the leak flow rate is greatest

B. The turbocharger bearing is failing and the screaming noise is metal-to-metal contact between the shaft and the housing

C. The wastegate actuator diaphragm has ruptured, causing the wastegate to flutter and produce the screaming noise

D. The compressor wheel has contact marks on its tips from a bearing failure that allows the wheel to contact the housing

26. A technician is performing a fuel injector flow test on a set of six electronic unit injectors removed from a heavy-duty diesel engine. Four injectors flow within 5% of each other, one injector flows 15% high, and one flows 10% low. What should be done with the two outlier injectors?

A. Both outlier injectors are within the acceptable 20% variation range and can be reinstalled without concern

B. The high-flowing injector can be installed in a low-demand cylinder position to compensate for its excess flow

C. Only the low-flowing injector needs replacement; the high-flowing injector will improve that cylinder's power output

D. Both outlier injectors should be replaced or reconditioned — the high-flowing injector delivers excess fuel (causing higher EGT, black smoke, and accelerated wear in that cylinder), and the low-flowing injector starves its cylinder (causing reduced power contribution, rough running, and potential misfire); all injectors should flow within the manufacturer's tolerance for balanced operation

27. A heavy-duty diesel engine has a fault code indicating "Intake Air Heater Relay — Circuit Open." The driver reports hard starting in cold weather. What is the function of the intake air heater?

A. The intake air heater warms the incoming fuel before it enters the injection pump for improved atomization in cold weather

B. The intake air heater raises the temperature of the intake manifold air to assist cold starting — the heated air helps the compressed charge reach the autoignition temperature of diesel fuel when the engine and cylinder walls are cold, which absorb heat from the compressed air and can prevent it from reaching ignition temperature without assistance

C. The intake air heater prevents ice formation on the turbocharger compressor blades during cold-weather operation

D. The intake air heater warms the intake manifold to prevent diesel fuel from gelling before it reaches the cylinders

28. A heavy-duty diesel engine's oil pressure gauge shows a reading of 10 psi at hot idle. The manufacturer's minimum specification is 15 psi at idle. The technician increases the engine RPM to 1,200 and the pressure rises to 50 psi (within specification). What does this information tell the technician?

A. The oil pump relief valve is functioning correctly since the pressure rises with RPM, but the low idle pressure indicates the pump cannot generate adequate pressure at the low volume output of idle speed — this is consistent with worn pump gears or worn engine bearings that allow oil to escape faster than the pump can supply at idle, while the higher RPM compensates with greater pump volume

B. The oil pressure gauge is inaccurate at low readings and should be replaced with a mechanical test gauge for verification

C. The oil filter bypass valve is stuck open at idle and closes when the pressure rises above 15 psi at higher RPM

D. The oil cooler thermostat is stuck closed, creating a restriction that is only significant at idle flow rates

29. A heavy-duty diesel engine equipped with a SCR aftertreatment system has a condition where the DEF dosing injector is coking (carbon buildup on the injector tip inside the exhaust pipe). What causes the coking, and what is the consequence?

A. The DEF solution is contaminated with fuel that burns on the hot injector tip and forms a carbon deposit

B. The engine oil is leaking past the turbocharger seals and coating the DEF injector tip with a carbon residue

C. The DEF injector is mounted in a location where exhaust gas temperatures are too high — the extreme heat evaporates the DEF before it can spray properly and bakes the urea residue onto the injector tip, progressively blocking the spray orifice and reducing the injector's ability to deliver the correct spray pattern for effective NOx conversion

D. The DEF pump is delivering excessive pressure that causes the DEF to atomize too finely and burn on contact with the hot exhaust gas

30. A technician is diagnosing a heavy-duty truck's air brake system and finds that the primary circuit pressure drops at a rate of 2 psi per minute with the brakes released and the engine off, while the secondary circuit holds pressure with zero loss. What does this isolated primary circuit loss indicate?

A. A leak exists somewhere in the primary circuit — the secondary circuit's zero loss confirms the compressor, governor, and supply-side components are not the source; the leak is in a component or connection that is exclusive to the primary circuit downstream of the one-way check valve that isolates the two circuits

B. The governor is venting primary circuit air through a failed exhaust port seal while retaining secondary pressure

C. The primary reservoir drain valve is open, slowly venting the primary circuit air to atmosphere

D. The one-way check valve between the supply tank and the primary reservoir is stuck open, allowing air to flow backward from the primary circuit

31. A heavy-duty truck has a condition where the air compressor cycles on and off at the correct cut-in and cut-out pressures, but the interval between cycles has shortened significantly — from 5 minutes to 45 seconds. No air leaks are audible. What should the technician investigate?

A. The air dryer purge valve, which may be venting excessive air during each purge cycle, reducing the effective volume retained in the reservoirs

B. The governor spring, which may have weakened and is cutting in at a higher pressure than the specified range

C. A leak that is not audible — small leaks in concealed locations (under the cab, inside the frame rail, at the rear of the trailer) may not be audible in a shop environment but consume enough air to shorten the cycle time significantly; a soap-solution leak test on the entire system is required

D. The compressor discharge valve, which may be allowing compressed air to leak back through the compressor during the unloaded cycle

32. A transit bus equipped with air disc brakes has a condition where one front brake caliper produces a metallic scraping noise during wheel rotation even when the brakes are not applied. The noise stops when the brakes are applied. What is the most likely cause?

A. The caliper piston has seized in the partially extended position, holding the pad in light contact with the rotor

B. The brake pad wear indicator (a spring steel clip designed to contact the rotor when the pad reaches minimum thickness) is contacting the rotor, alerting the driver that the pad is worn to its service limit

C. The rotor has developed a high spot from heat distortion that contacts the pad at one point per revolution

D. The caliper mounting bracket has shifted, repositioning the pad so that its edge contacts the rotor during wheel rotation

33. A heavy-duty truck's air brake system has a condition where the brake pedal must be pressed harder than normal to achieve adequate braking. The air system pressure is normal at 120 psi. The pushrod strokes are within specification. The brake linings are in good condition. What should the technician investigate?

A. The relay valves for correct crack pressure setting — if the relay valves require a higher-than-normal signal pressure to crack open, the driver must press the pedal harder to generate the signal pressure needed to activate the relay

B. The foot valve (treadle valve) for a restricted inlet, worn internal components, or a binding linkage that reduces the mechanical advantage and requires more pedal effort to generate the same output pressure

C. The ABS modulator valves for internal restrictions that limit flow during normal (non-ABS) brake applications

D. The air tank mounting brackets, which if loose could allow the tanks to shift and kink the supply lines

34. A technician finds that the air brake chambers on a trailer's tandem axle have different part numbers — some are Type 30/30 and others are Type 24/30. What problem does this mixed installation create?

A. The chambers with the smaller service-side diaphragms (Type 24) produce less braking force than the Type 30 chambers at the same application pressure, creating a brake imbalance within the tandem axle that causes uneven tire wear, directional instability during braking, and accelerated wear on the harder-working brake positions

B. The spring brake sections are different sizes, causing unequal parking brake force that prevents the trailer from parking securely on grades

C. The different chamber sizes require different pushrod stroke specifications, making the brake adjustment procedure more complex

D. The mixed installation has no operational consequence because the air system compensates automatically for different chamber sizes

35. A heavy-duty truck has a condition where the parking brakes do not hold the vehicle on a moderate grade when the parking brake valve (yellow button) is pulled. The air system pressure is normal. The spring brake chambers appear to function — the pushrod extends when the parking brakes are applied. What is the most likely cause?

A. The spring brake hold-off air is not fully exhausting when the parking brake valve is pulled, leaving residual pressure that partially compresses the springs

B. The parking brake valve's exhaust port is partially restricted, slowing the release of hold-off air and preventing full spring extension

C. The foundation brake components (shoes, drums, slack adjusters) are worn or out of adjustment — the springs apply their rated force, but the worn shoes, out-of-adjustment slack adjusters, or oversized drums reduce the mechanical advantage, resulting in insufficient friction to hold the vehicle on a grade

D. The spring brake power springs have weakened from age and heat exposure and no longer apply adequate force

36. A school bus equipped with air brakes has passed all static air system tests, but during a road test the brakes produce a strong vibration through the chassis during moderate-to-hard braking. The vibration correlates with wheel speed. What is the most likely cause?

A. The ABS system is activating on every brake application due to a faulty wheel speed sensor signal

B. A worn U-joint in the driveshaft that becomes apparent only during braking deceleration forces

C. Loose engine mounts that allow the engine to shift during braking and create a vibration through the chassis

D. One or more out-of-round brake drums that create a pulsating braking force at each wheel revolution — the egg-shaped drum contacts the shoes at the narrow points and clears the shoes at the wide points during each rotation, producing the rhythmic vibration felt through the chassis

37. A heavy-duty truck equipped with ABS has a condition where the ABS warning lamp illuminates intermittently during highway driving. The lamp extinguishes when the vehicle is stopped or driven at low speed. The scan tool retrieves a fault code for "Left Front Wheel Speed Sensor — Signal Erratic." The sensor has been replaced. What should be inspected next?

A. The reluctor ring for damaged, missing, or chipped teeth and for metallic debris on the ring

B. The ABS module for an internal fault on the input channel for the left front sensor signal

C. The sensor wiring harness for damage that only becomes apparent at highway speed from vibration

D. The front hub bearing for excessive play that allows the reluctor ring to move relative to the sensor during driving

38. A technician is servicing the air system on a heavy-duty truck and discovers that someone has installed a standard shut-off valve in the air line between the supply reservoir and the primary circuit, upstream of the one-way check valve. Why is this installation dangerous?

A. The shut-off valve can be accidentally closed, isolating the primary brake circuit from its air supply — if the valve is closed (whether intentionally or from vibration), the primary circuit cannot be

replenished by the compressor, and the primary brakes will function only until the trapped air is consumed; once depleted, the primary circuit cannot refill

B. The shut-off valve creates a restriction that reduces the compressor's maximum output pressure

C. The shut-off valve prevents the air dryer from purging the primary circuit's moisture during the purge cycle

D. The shut-off valve's internal components are not compatible with the oil-free air in the brake circuit

39. A heavy-duty truck's service brakes are applied using the foot valve. The technician measures the application pressure at each brake chamber using test gauges. The left front reads 60 psi, the right front reads 60 psi, the left rear reads 45 psi, and the right rear reads 45 psi. The foot valve is being pressed with consistent, moderate effort. What does this pressure difference between front and rear indicate?

A. A malfunctioning relay valve on the rear circuit that is restricting the pressure delivered to the rear chambers

B. A leak in the rear brake circuit that is reducing the delivered pressure at the rear brake chambers

C. A front-axle-priority brake proportioning system — this is normal operation on some vehicles where the system is designed to deliver reduced pressure to the rear during light-to-moderate applications to prevent rear wheel lockup on an unloaded vehicle; the proportioning valve adjusts the rear pressure based on application level and/or load

D. An incorrect foot valve installation that has the primary and secondary circuit outputs reversed

40. A heavy-duty truck has a condition where all four drive axle brakes are dragging after a brake service. The parking brakes release normally. The pushrod strokes are within specification. The slack adjusters are correctly adjusted. What is the most likely cause?

A. The brake return springs on all four wheels were not reinstalled during the service

B. The brake chambers on all four positions have internal contamination that is preventing full diaphragm retraction

C. The ABS modulator valves on the drive axle are all holding residual pressure from a system initialization error

D. A residual pressure is trapped in the service brake application circuit — the relay valve exhaust may not be sealing, the quick release valve may be stuck, or the foot valve may have a leaking secondary piston that maintains a small signal pressure to the rear circuit, keeping all drive axle brakes partially applied

41. A technician is performing a brake drum measurement on a drive axle. The drum's maximum allowable diameter stamped on the casting is 16.500 inches. The drum currently measures 16.480 inches. The drum surface has light heat checking but no deep cracks. Can this drum be machined?

A. The drum can be machined if the machine cut does not exceed the maximum allowable diameter — with 0.020 inches of margin remaining between the current diameter and the maximum, a light cut to remove the heat checking is possible if the total material removal does not increase the diameter beyond 16.500 inches

B. The drum cannot be machined because the heat checking has already weakened the drum beyond its service limit regardless of the dimensional measurement

C. The drum should be replaced because any drum within 0.050 inches of the maximum diameter should not be machined

D. The drum can be machined to any diameter as long as the heat checking is completely removed from the surface

42. A school bus has a condition where the brake warning buzzer sounds intermittently during driving, particularly during sharp turns and lane changes. The air system pressure appears adequate on the dashboard gauges. What is the most likely cause?

A. The low-pressure warning switch is located in a position where the air pressure fluctuates during vehicle maneuvering — the fluid dynamics of the air in the reservoir cause momentary pressure dips at the switch location during sharp turns, triggering the warning; alternatively, the switch itself is marginal and is activating at a pressure slightly above the normal threshold

B. The air compressor unloader mechanism is cycling in response to the steering pump's variable load

C. The ABS system is consuming air during stability control interventions and momentarily dropping pressure below the warning threshold

D. The brake chambers are expanding during turns due to centrifugal force, momentarily consuming air from the reservoir

43. A heavy-duty truck equipped with drum brakes has a condition where one wheel's brakes lock up during light brake applications on wet pavement. The ABS system is functional on all other wheels. The scan tool shows no fault codes for the affected wheel. What should be inspected?

A. The tire tread depth on the affected wheel, which if worn below the minimum would reduce traction and cause lockup

B. The brake drum for a glazed or polished surface that has inconsistent friction characteristics

C. The brake shoe lining on the affected wheel for contamination (grease, oil, or brake fluid) that has reduced the coefficient of friction on the leading shoe while the trailing shoe maintains normal friction — the inconsistent friction between the two shoes causes an abrupt grab-and-release cycle that the ABS cannot fully correct

D. The ABS wheel speed sensor signal quality for that wheel, which may have degraded below the diagnostic threshold

44. A driver reports that the trailer brakes on a tractor-trailer combination seem to apply a moment before the tractor brakes during a normal foot brake application. What is the most likely cause?

A. The trailer's relay valve has a lower crack pressure than the tractor's relay valves, causing it to respond to a smaller signal pressure from the foot valve before the tractor's relay valves open

B. The trailer's air line between the gladhand and the relay valve is shorter than the tractor's air lines, delivering the signal faster

C. The trailer ABS is pre-applying the brakes based on a predictive algorithm that detects the initial foot valve movement

D. The tractor's foundation brake shoes have a higher coefficient of friction that makes the tractor brakes feel like they engage later

45. A heavy-duty truck's air system has a condition where the air dryer purge valve leaks a continuous stream of air even when the compressor is in the loading (pumping) cycle. What is the most likely cause?

A. The governor signal line to the dryer is stuck in the unload position, continuously commanding the purge valve to open

B. The compressor is producing excessive oil that has contaminated the purge valve seat, preventing it from sealing fully

C. The air dryer desiccant cartridge is overpressurizing the dryer housing during the loading cycle

D. The purge valve has a failed seal or a stuck open valve mechanism that allows air to pass through regardless of the governor's signal — the valve should be closed during the loading cycle, and a continuous leak indicates internal mechanical failure of the valve

46. A tractor-trailer combination has a condition where disconnecting the trailer gladhands results in a significant air pressure drop in the tractor's air system. The tractor protection valve is supposed to prevent this. What is the most likely cause?

A. The tractor protection valve has failed — it is not closing to isolate the tractor's air supply when the trailer gladhands are disconnected; the open valve allows the tractor's air to escape through the disconnected gladhand ports until the system is depleted or the valve eventually closes at a lower pressure

B. The trailer's relay valve is creating a backfeed that drains the tractor's air through the service gladhand

C. The gladhand seals on the tractor are damaged, allowing air to leak from the tractor's circuit even without the trailer connected

D. The tractor's air dryer is overpurging during the disconnection event, venting more air than normal

47. A heavy-duty truck has four batteries: two pairs in series-parallel for a 24-volt starting system with 12-volt accessories. One battery is dead (0 volts). What is the effect on the starting and accessory systems?

A. The starting system will still function at 24 volts because the remaining three batteries compensate for the dead one

B. The 12-volt accessory system on one side will function from the remaining good battery in that pair, but the starting system will not function correctly because the series pair containing the dead battery produces only 12 volts instead of 24

C. Both the starting and accessory systems will continue to function normally because the parallel connection redistributes the load

D. The dead battery creates an open circuit in the series pair that contains it — the series connection requires all batteries to conduct; a dead battery (0 volts) may also have infinite internal resistance, breaking the series circuit and making that pair produce 0 volts; the starting system cannot function because it needs both series pairs

48. A truck's scan tool communicates with the engine ECM but receives no response from the ABS module. The ABS warning lamp is illuminated. The technician checks Pin 7 of the 9-pin diagnostic connector (ABS power supply to the scan tool) and reads 0 volts. What is the most likely explanation?

A. The ABS module has an internal fault and is not providing power to Pin 7 as it should

B. The ABS module communicates through Pins C and D (CAN bus), not Pin 7 — Pin 7 provides auxiliary power to the trailer ABS, and the tractor ABS module communicates through the same CAN bus as the engine ECM; the ABS communication failure is likely a module power or ground fault, not a Pin 7 issue

C. The scan tool requires ABS power from Pin 7 to communicate with the ABS module, and the missing voltage is the cause

D. Pin 7 must provide 12 volts for the scan tool to initialize the ABS communication protocol before CAN data exchange

49. A heavy-duty truck's instrument cluster speedometer reads consistently 10% higher than the actual vehicle speed verified by GPS. The tires are the original size specified for the vehicle. What is the most likely cause?

A. The vehicle speed sensor (VSS) calibration in the ECM does not match the current tire size or axle ratio — the ECM calculates vehicle speed from the VSS pulses per revolution and the programmed tire

revolutions per mile; if the calibration factor is incorrect (from a previous tire size change, axle ratio change, or ECM programming error), the calculated speed will differ from actual

B. The speedometer needle is mechanically bent, causing it to indicate higher than the position the stepper motor commands

C. The GPS signal is inaccurate in the area where the speed comparison was made due to satellite positioning errors

D. The alternator's AC frequency is interfering with the VSS signal and adding phantom pulses to the speed count

50. A truck's right rear marker lamp works correctly, but when the right turn signal is activated, the marker lamp on that side dims instead of the turn signal lamp flashing. What is the most likely cause?

A. The turn signal bulb on the right rear has failed, and the turn signal current is backfeeding through the marker lamp circuit

B. The right rear turn signal relay has failed and is sending continuous power to the marker circuit instead of the turn signal

C. The right rear lamp assembly has a bad ground — the turn signal lamp and the marker lamp share a common ground, and when the turn signal activates, the turn signal current seeks ground through the marker lamp's filament instead of the corroded ground wire, causing the marker to dim as it acts as the ground return for the turn signal

D. The body controller module is incorrectly multiplexing the turn signal and marker circuits on the right side

51. A technician is performing an alternator output test. At idle with lights and HVAC on full, the alternator output is 45 amps. At 1,500 RPM with the same loads, the output increases to 120 amps. The alternator is rated at 160 amps. What is the assessment?

A. The alternator needs replacement because it cannot reach its rated output at any RPM

B. The output is too high at 1,500 RPM and indicates a voltage regulator fault that is overdriving the alternator

C. The alternator belt is slipping at idle, preventing the alternator from reaching operating speed, and the belt tension or condition must be addressed

D. The alternator output is normal — alternator output is RPM-dependent, and the reduced output at idle is expected because the alternator is turning below its rated speed; at 1,500 RPM the output of 120 amps against the actual loads is appropriate and the 160-amp rating represents maximum capacity at the alternator's rated RPM under maximum load

52. A heavy-duty truck has a condition where the starter motor cranks the engine very slowly. Battery voltage during cranking is 9.5 volts at the battery terminals. Battery voltage before cranking is 12.6 volts. What does the 3.1-volt drop during cranking indicate?

A. The starter motor is drawing normal cranking current and the voltage drop is within specification

B. The batteries have high internal resistance — they can maintain 12.6 volts at rest but cannot sustain adequate voltage under the heavy current draw of cranking; the excessive voltage drop indicates degraded batteries that should be load tested and likely replaced

C. The starter motor has an internal short that is drawing excessive current and pulling the battery voltage down

D. The voltage drop is caused by the cable resistance between the battery and the starter motor

53. A truck's backup alarm sounds continuously even when the transmission is not in reverse. The backup lights do not illuminate when reverse is selected. What is the most likely cause?

A. The reverse switch has an internal fault that is sending contradictory signals — grounding the alarm circuit continuously (alarm on) while leaving the light circuit open (lights off); alternatively, the alarm and lights are on separate circuits, and the alarm circuit has a short to ground that bypasses the reverse switch entirely

B. The body controller module has a programming error that commands the alarm independently of the reverse switch

C. The backup alarm unit has failed internally and is sounding on its own power from a capacitor discharge

D. The transmission's neutral safety switch is interfering with the reverse detection circuit

54. A technician measures the resistance of a truck's primary ignition wire (key switch to starter solenoid S terminal) and reads 15 ohms. The wire is 5 metres long. What is the assessment?

A. The resistance is excessively high for a copper conductor of that length — a 5-metre length of standard automotive wire should measure less than 1 ohm; a reading of 15 ohms indicates internal wire damage (broken strands, corrosion, or a connector fault) that will cause a significant voltage drop under the current draw of the solenoid coil and may result in intermittent no-crank conditions

B. The resistance is within normal specification for a primary ignition wire of that length and gauge

C. The resistance is caused by the solenoid coil winding, which adds its resistance to the wire measurement

D. The reading is invalid because primary wire resistance cannot be measured with a standard ohmmeter

55. A heavy-duty truck has an intermittent condition where all dashboard lights go off momentarily, then return to normal. The engine continues to run without interruption during these events. What is the most likely cause?

A. The alternator has a loose connection at its output terminal that momentarily interrupts the charging circuit

B. The engine ECM is momentarily resetting due to a firmware glitch that affects the CAN bus communication

C. An intermittent open in the instrument cluster's power supply or ground circuit causes the cluster to lose power momentarily — the engine continues to run because the ECM has its own power supply that is independent of the instrument cluster circuit

D. The ignition switch has a worn contact in the accessory position that momentarily interrupts power to all dashboard circuits

56. A truck's charging system voltage at the battery terminals reads 15.2 volts with the engine running. What is the primary concern with this overvoltage condition?

A. The batteries will not accept the charge at this voltage level and the alternator will overheat from the rejected current

B. The truck's electrical system is designed for a maximum sustained voltage of 14.4 volts, and exceeding this level can accelerate battery gassing and electrolyte loss

C. The overvoltage only affects the battery and has no impact on other electrical components

D. The overvoltage of 15.2 volts can damage the batteries (accelerated gassing, electrolyte loss, plate damage), destroy sensitive electronic modules (ECM, TCM, ABS module), burn out light bulbs prematurely, and damage any electronic accessory in the vehicle — the voltage regulator must be repaired immediately

57. A technician is testing a suspect wheel speed sensor on a truck. The sensor resistance measures 1,200 ohms. The manufacturer's specification is 900 to 1,400 ohms. The technician spins the wheel by hand and measures the AC voltage output at 0.3 volts. The minimum specification is 0.2 volts AC. What is the assessment?

A. Both measurements are within specification — the sensor resistance and the AC output voltage are acceptable, indicating the sensor is electrically functional; if the ABS fault persists, the wiring, connector, or reluctor ring should be investigated as the fault source

B. The resistance is too high, indicating the sensor coil has excessive turns and is generating a weak signal

C. The AC output is too low for reliable ABS operation even though it meets the minimum specification

D. The sensor must be replaced because it is at the upper end of the resistance range, which indicates impending failure

58. A heavy-duty truck has a condition where the electric fuel heater on the fuel filter housing does not activate in cold weather. The heater is a resistance-type element controlled by a thermostat. The fuse is intact. What should the technician check?

A. The DEF heater, which shares a circuit with the fuel heater and may be drawing all available current

B. The thermostat that controls the fuel heater — it may be failed in the open position, preventing current from reaching the heater element even though the ambient temperature is below the activation threshold; also check the wiring and connector to the heater for an open circuit

C. The engine coolant temperature sensor, which the ECM uses to determine when to activate the fuel heater

D. The fuel level sensor, which must read above a minimum level before the ECM enables the fuel heater circuit

59. A truck equipped with LED headlights has a condition where the right LED headlight assembly produces a noticeably dimmer light than the left. Both assemblies are the same part number and were installed at the same time. What is the most likely cause?

A. The LED assemblies have a manufacturing variation in their light output that is within the production tolerance range

B. The right headlight lens has an internal moisture condensation layer that is scattering the light before it exits the housing

C. The right headlight's internal LED driver circuit has developed a fault that is reducing the current to some of the LED elements, dimming the overall output

D. The right headlight circuit has excessive voltage drop in its power or ground path, reducing the voltage reaching the LED assembly's internal driver — LEDs are sensitive to supply voltage, and even a small voltage reduction can significantly reduce light output

60. A truck's electronic instrument cluster has a condition where the tachometer reads 200 RPM higher than the actual engine speed when verified with a scan tool. All other gauges are accurate. What is the most likely cause?

A. The crankshaft position sensor is producing extra pulses that the scan tool filters out but the tachometer displays

B. The instrument cluster's tachometer driver has an internal calibration error — the cluster receives the correct RPM data from the CAN bus (which the scan tool confirms by reading the same data stream accurately) but the cluster's internal processing or stepper motor driver for the tachometer displays the value incorrectly

C. The engine ECM has a speed sensor calibration error that affects the tachometer signal but not the scan tool communication

D. The alternator is producing EMI that is interfering with the tachometer's stepper motor at a frequency that adds 200 RPM to the display

61. A truck has a condition where both the check engine lamp and the ABS lamp illuminate simultaneously and intermittently during driving. Both lamps extinguish at the same time. What is the most likely common cause?

A. An intermittent CAN bus communication fault that affects both the engine ECM and the ABS module simultaneously — when the bus drops out, both modules lose communication with the instrument cluster, which illuminates both warning lamps; when communication resumes, both lamps extinguish

B. The alternator has a failing diode that produces voltage spikes affecting both the engine and ABS systems

C. The vehicle speed sensor is shared between the engine ECM and ABS module, and its intermittent signal faults both systems

D. The batteries have a loose terminal that causes both modules to reset simultaneously during vibration events

62. A heavy-duty truck's fog lamps turn off every time the high beams are activated. When the high beams are deactivated, the fog lamps resume operating. Is this a fault?

A. Yes — the fog lamp circuit should operate independently of the headlight high/low beam selection

B. The fog lamp relay has an internal fault that opens the fog lamp circuit when the high-beam relay energizes

C. This is normal on many vehicles — fog lamps are designed to illuminate the road surface immediately ahead of the vehicle in low-visibility conditions, and their light pattern conflicts with the high-beam pattern; many vehicles are wired to automatically deactivate the fog lamps when high beams are selected to prevent glare and because the high beams provide superior illumination at distance

D. The fog lamp bulbs are a higher wattage than specified and the circuit protection device (fuse or breaker) cannot support both the fog lamps and high beams simultaneously

63. A truck's scan tool retrieves a stored fault code from the engine ECM: "Ambient Air Temperature Sensor — Circuit High (Open Circuit)." The engine runs normally with no perceptible performance issue. Why would the ECM store this code if the engine runs normally?

A. The ambient air temperature sensor data is used for non-critical functions such as cab climate control display and is not essential for engine operation

B. The ECM uses the ambient temperature for secondary calculations (intake air density approximation, aftertreatment strategy, cold-start enrichment) and substitutes a default value when the sensor fails

C. The fault code was set erroneously by the ECM during a self-test and does not indicate an actual sensor fault

D. The ECM substitutes a default ambient temperature value when the sensor circuit is open — this default allows the engine to run normally for most conditions, but the ECM may not optimize cold-start fueling, aftertreatment temperature management, or fan control as precisely as it would with accurate ambient data; the ECM stores the code to alert the technician to the missing input

64. A technician discovers that an aftermarket GPS tracking device installed on a heavy-duty truck is connected directly to the battery positive terminal with no fuse protection. What is the safety concern?

A. The GPS device will drain the battery faster without fuse protection because the fuse provides current regulation

B. If the GPS device or its wiring develops a short circuit, unlimited current will flow through the wire until it overheats, melts the insulation, and potentially causes an electrical fire — without a fuse to interrupt the current, the wire becomes the weak point and can ignite nearby combustible materials

C. The GPS device will receive voltage spikes from the battery that could damage the device's internal electronics

D. The unfused connection will interfere with the vehicle's CAN bus communication because the GPS draws current from the same battery that powers the CAN bus modules

65. A truck's windshield wiper motor operates when the switch is in the OFF position but does not operate in any of the speed positions. What is the most likely cause?

A. The wiper switch has an internal fault — the OFF position contacts are routing power to the motor through an incorrect path, while the speed position contacts are all open or disconnected; this produces the paradoxical condition of the motor running only when the switch is nominally "off"

B. The wiper motor park switch is stuck in the run position, keeping the motor energized through the park circuit regardless of the dash switch position

C. The wiper motor relay has welded contacts in one position but the switch circuit that controls the relay's other functions has failed

D. The body controller module has a software error that commands the wiper output in the opposite state of the switch input

66. A heavy-duty truck's multiplexed electrical system has a body controller module (BCM) that controls all exterior lighting. The BCM can detect a burned-out bulb by monitoring the current draw of each lighting circuit. What happens when the BCM detects a reduced current draw on the right rear stop lamp circuit?

A. The BCM increases the voltage to the affected circuit to compensate for the missing bulb's light output

B. The BCM deactivates the entire right-side lighting to prevent an electrical imbalance

C. The BCM disables the ABS system because the stop lamp circuit shares a fuse with the ABS modulator power supply

D. The BCM logs a fault code for the affected circuit and may illuminate a warning indicator on the dashboard to alert the driver that a lamp has failed — the BCM compares the actual current draw to the expected draw and detects the difference caused by the missing bulb

67. A heavy-duty truck has a condition where the starter motor engages and cranks the engine, but the starter does not disengage after the engine starts. The starter continues to spin with the engine. What is the most likely cause?

A. The ignition switch is stuck in the START position, continuously providing power to the starter solenoid's S terminal

B. The starter solenoid's internal contacts have welded together, maintaining the connection between the battery and the motor even after the ignition switch returns to the RUN position — the welded contacts bypass the solenoid's normal release mechanism

C. The starter drive (Bendix) mechanism is jammed in the extended position, keeping the pinion gear engaged with the flywheel ring gear even after the solenoid de-energizes

D. The neutral safety switch has failed in the closed position, providing a continuous ground path for the solenoid coil

68. A truck equipped with a telematics system reports "Battery Voltage Low" alerts every morning at 4:00 AM, but the truck starts normally at 6:00 AM. The batteries test good and the alternator charges correctly during driving. What is the most likely explanation?

A. The telematics system's voltage sensor is inaccurate during the coldest part of the night

B. The batteries' open-circuit voltage drops naturally during the overnight rest period as the surface charge dissipates

C. A time-controlled device (such as a block heater, battery warmer, or engine coolant heater on a timer) activates at or near 4:00 AM, drawing current from the batteries and causing a temporary voltage dip that the telematics system detects as a low-voltage event — once the device finishes its cycle, the voltage recovers

D. The alternator has a diode leak that slowly drains the batteries overnight, reaching the alert threshold by 4:00 AM

69. A heavy-duty truck with a manual 10-speed transmission has a condition where the transmission jumps out of 5th gear during deceleration on downhill grades. All other gears hold without issue. What is the most likely cause?

A. The 5th gear synchronizer has worn beyond its effective range, allowing the gear to disengage under deceleration load

B. The 5th gear detent spring and ball are worn — the spring cannot hold the shift rail in the 5th gear position against the axial force created by the helical gear's thrust during deceleration; the worn detent allows the shift rail to slide toward neutral under the deceleration-induced thrust

C. The transmission mounting bracket has cracked, allowing the transmission case to flex and misalign the 5th gear shift fork

D. The clutch free play is excessive, which causes the input shaft to push the 5th gear out of engagement during deceleration

70. A truck equipped with an Allison automatic transmission has a fault code indicating "Main Pressure Low." The transmission shifts harshly in all gears. What is the relationship between low main pressure and harsh shifts?

A. Low main pressure prevents the torque converter from reaching lockup, causing harsh shifts from the unlocked converter

B. Low main pressure causes the clutch packs to engage too slowly, creating a flare condition that feels harsh

C. Low main pressure prevents the accumulator from cushioning the shift, resulting in abrupt clutch engagement

D. The TCM compensates for low main pressure by commanding the shift solenoids to apply the clutch packs more aggressively to prevent slipping — the increased application force produces harsh, jarring shifts because the normal modulated engagement is replaced by an abrupt full-force application

71. A heavy-duty truck's driveshaft has a vibration that is present at all speeds above 30 km/h but is most severe between 80 and 100 km/h. The vibration diminishes slightly above 100 km/h. What does this speed-specific severity pattern indicate?

A. The vibration source is engine-related and the severity peak corresponds to a specific engine RPM range

B. The driveshaft has a manufacturing defect that produces vibration only at speeds corresponding to highway driving

C. The driveshaft is approaching its critical speed between 80 and 100 km/h — the critical speed is the rotational speed at which the driveshaft's natural bending frequency matches its rotational frequency, causing resonance that amplifies any imbalance; below and above this speed, the vibration is present but not amplified by resonance

D. The rear axle pinion bearing is worn and produces noise that peaks in the speed range where the gear mesh frequency matches the axle housing's resonant frequency

72. A heavy-duty truck equipped with a two-speed rear axle and a 5-speed main transmission provides a total of how many forward gear ratios?

A. 10 forward ratios — the 5-speed main transmission provides 5 ratios, and the two-speed rear axle doubles each ratio by providing a high and low range, giving the driver 10 selectable forward speeds

B. 7 forward ratios — the two-speed axle adds 2 additional ratios to the transmission's 5 ratios

C. 15 forward ratios — the two-speed axle multiplies the transmission's 5 ratios by 3

D. 5 forward ratios — the two-speed axle only provides a reduction for starting and does not create additional ratios

73. A truck equipped with an automated manual transmission (AMT) has a condition where the transmission shifts normally in automatic mode but will not shift when the driver selects manual mode. The scan tool shows no fault codes. What is the most likely cause?

A. The manual mode switch on the shift lever has failed or the wiring between the switch and the TCU is open

B. The manual mode function has a speed restriction that prevents activation under the current driving conditions — many AMTs disable manual mode above or below certain speeds, or while the engine brake is active, or during specific operating conditions; the driver may be attempting to use manual mode outside the system's allowed parameters

C. The transmission oil temperature is above the threshold at which the TCU disables manual mode to protect the clutch

D. The AMT software requires a firmware update to enable the manual mode feature on this vehicle model

74. A heavy-duty truck's rear axle produces a clunking noise when the vehicle starts from a stop. The noise occurs once and does not repeat during steady driving. What is the most likely cause?

A. A worn spider gear inside the differential that shifts position when initial torque is applied from a stop

B. A worn ring gear tooth that contacts the pinion at one specific point when torque is first applied

C. A loose axle flange bolt that allows the flange to shift before clamping against the housing during initial torque application

D. Excessive backlash in the ring and pinion gear set — when the vehicle starts from a stop, the engine applies torque through the driveshaft to the pinion, which must take up the backlash gap before the ring gear begins to rotate and drive the wheels; the clunk is the sound of the pinion teeth contacting the ring gear teeth across the backlash gap

75. A truck equipped with a hydraulic clutch system has a condition where the clutch pedal feels spongy and does not fully disengage the clutch even at the floor. Pumping the pedal rapidly makes the clutch work temporarily. What is the most likely cause?

A. The clutch master cylinder pushrod is too long, preventing the master cylinder piston from fully retracting and blocking the reservoir port

B. The clutch slave cylinder has a torn boot that is allowing dirt to contaminate the pushrod guide

C. Air in the hydraulic clutch line — the trapped air compresses when the pedal is pressed (producing the spongy feel), absorbing the pedal travel and preventing the hydraulic force from fully actuating the slave cylinder; pumping the pedal temporarily compresses the air bubble enough to restore function, but the permanent fix is bleeding the system

D. The clutch disc facing has become contaminated with hydraulic fluid from a slave cylinder leak

76. A truck's transfer case oil has been discovered to be severely discolored — dark brown with a burnt smell. The transfer case operates but produces a slight whine. What does the oil condition indicate?

A. The oil has been overheated from operating the transfer case in 4WD on dry pavement for extended periods — the wind-up forces generated heat that exceeded the oil's thermal limits, breaking down its molecular structure; the whine indicates the degraded oil is no longer providing adequate lubrication to the internal gear and bearing surfaces

B. The dark color is from a normal additive package change that occurs after the first oil change and is not a concern

C. The oil has been contaminated with water from a vent tube that was submerged during a water crossing

D. The transfer case oil was mixed with an incompatible fluid type that changed the oil's color and viscosity

77. A heavy-duty truck with a tandem drive axle has a condition where the power divider (inter-axle differential) produces a howling noise during straight-line driving at highway speed. The noise changes pitch when the inter-axle lock is engaged. What does the change in noise when the lock is engaged indicate?

A. The noise source is unrelated to the power divider and the lock engagement coincidentally changes the engine load

B. The power divider lock engagement eliminates the differential action, stopping the relative motion between the components that are producing the noise

C. The power divider lock engagement increases the load on the noisy component, amplifying the noise

D. The noise is caused by worn power divider gears or bearings — engaging the lock changes the loading pattern on these components (eliminating the differential action and its associated gear rotation), which changes the noise because the worn component is no longer rotating relative to the other components; this confirms the noise source is inside the power divider

78. A heavy-duty truck equipped with a 13-speed manual transmission has a condition where the splitter shifts are slow and feel noticeably different from their previous crisp operation. The range shifts work normally. What should be investigated?

A. The splitter synchronizer cones for wear that has reduced their friction surface area and ability to match speeds quickly

B. The splitter air valve and its air supply — the splitter shift is pneumatically assisted, and a sluggish air valve, a restricted air line, or a leak in the splitter air circuit reduces the speed and force of the splitter shift; since the range shift (which uses a separate air circuit) works normally, the fault is isolated to the splitter's pneumatic system

C. The transmission oil viscosity, which if too thick would slow all shifts equally

D. The countershaft bearings, which if worn would create drag that specifically affects the splitter shift speed

79. A heavy-duty truck's automatic transmission has a condition where it shifts from 1st to 2nd normally, but then skips 3rd gear entirely and shifts directly from 2nd to 4th. The scan tool shows no active fault codes. What is the most likely cause?

A. The 3rd gear clutch pack has failed and the TCM has adapted its shift strategy to skip the non-functional gear

B. The output speed sensor is reading incorrectly, causing the TCM to calculate the wrong speed for the 2-3 shift point

C. The TCM is operating in a fuel economy mode that intentionally skips gears to optimize fuel consumption under certain operating conditions — the skip-shift pattern may be a designed feature based on throttle position, vehicle speed, and load; verifying the TCU's programming and operating mode settings confirms whether this is normal behavior

D. The shift solenoid for the 2-3 shift is stuck in the wrong position, preventing the 3rd gear engagement command

80. A heavy-duty truck has an automatic transmission that produces a buzzing or vibrating noise when the transmission is in Drive and the vehicle is stationary at a traffic light with the engine at idle. The noise stops when the transmission is shifted to Neutral. What is the most likely source?

A. The torque converter impeller hub is worn and vibrating against the transmission pump drive

B. The transmission park pawl is partially engaged and buzzing against the output shaft ring gear

C. The torque converter is transmitting engine idle vibration through the fluid coupling to the transmission geartrain — the noise is generated by the slight torque load on the planetary gears and

clutch packs from the converter's idle-speed fluid coupling; shifting to Neutral removes this load and the noise stops

D. The transmission mount has collapsed, allowing the transmission case to vibrate against the crossmember

81. A heavy-duty truck has a PTO that operates normally at idle but shuts off automatically when the engine RPM is increased above 1,500. What is the most likely cause?

A. The PTO gear mesh is too tight and binds at higher RPM, triggering a mechanical safety release

B. The PTO lubricant is too thick and creates excessive resistance at higher shaft speeds

C. The hydraulic pump driven by the PTO is producing excessive backpressure at higher RPM that stalls the PTO drive

D. The PTO has an RPM limit programmed into its electronic control module — this safety feature prevents the PTO from operating above a speed that would damage the PTO, the driven equipment, or create a safety hazard from excessive rotational speed of the driven shaft

82. A technician replaces the clutch on a heavy-duty truck and properly lubricates the input shaft splines. During the initial test drive, the clutch engagement is very rough — the vehicle lurches forward from a stop regardless of how slowly the driver releases the pedal. What is the most likely cause?

A. The new clutch disc has incorrect friction material for the application — the coefficient of friction is too high for smooth engagement, causing the disc to grab aggressively instead of engaging progressively

B. The pilot bearing is binding, preventing the input shaft from centering properly during engagement

C. The flywheel was not resurfaced before installing the new clutch, and the rough surface is causing aggressive engagement

D. The clutch disc was installed backward — the disc has a specific orientation (usually marked "flywheel side"), and installing it reversed changes the engagement characteristics because the friction material, cushion springs, and torsional damper are designed to face a specific direction

83. A truck equipped with a driveshaft center carrier bearing has a vibration that is present at highway speed and intensifies when the vehicle crosses railroad tracks or encounters pavement joints. The vibration persists for several seconds after the bump. What does this behavior indicate?

A. The driveshaft is balanced but the carrier bearing's rubber isolator has hardened and lost its ability to absorb and dampen shock inputs

B. The front U-joint of the rear driveshaft section is worn and the bump excites its resonance

C. The center carrier bearing's rubber isolator mount has deteriorated — the hardened or cracked rubber can no longer isolate the bearing from frame vibration and cannot dampen the oscillation induced by bumps; the vibration persists because the degraded mount allows the driveshaft to oscillate freely without damping

D. The rear axle pinion angle has changed due to worn suspension bushings that shift under the bump load

84. A bus equipped with an Allison automatic transmission has a condition where the transmission shifts into reverse normally but the vehicle moves forward instead of backward. What is the most likely cause?

A. The transmission's internal clutch apply sequence for reverse has been changed by a TCM programming error

B. The reverse band is not applying and the transmission is defaulting to a forward gear

C. The transmission's valve body has a misassembled or stuck valve that routes fluid to a forward clutch instead of the reverse clutch when reverse is selected

D. The output shaft rotation is reversed in the final drive, not inside the transmission — a misassembled drive gear or a failed reverse idler in the drivetrain downstream of the transmission is inverting the rotation direction

85. A heavy-duty truck with a manual transmission has a condition where the transmission pops out of reverse during moderate throttle application. The detent mechanism has been inspected and is within specification. What else should be investigated?

A. The reverse gear engagement collar and the reverse idler gear teeth for wear that prevents full engagement depth — if the sliding collar does not fully seat on the reverse idler gear, the gear engagement is shallow and the separating forces from the helical gear cut push the collar out of the engagement notch under throttle load

B. The clutch brake, which if dragging could create a force that opposes the reverse gear engagement

C. The transmission mount, which if broken could allow the case to shift and push the reverse shift rail toward neutral

D. The engine idle speed, which if too high could create enough input shaft torque to overcome the reverse gear detent

86. A heavy-duty truck has a condition where the steering feels vague and imprecise at highway speed — the driver describes it as "loose" or "disconnected." The steering wheel can be moved approximately 20 mm left and right before the front wheels begin to respond. What does this symptom describe?

A. Excessive steering system free play — the total accumulation of wear and looseness at every connection point in the steering system, from the steering wheel to the tire-road contact patch, allows the steering wheel to move through the free play zone without producing any road wheel movement; the driver perceives this as a vague, disconnected steering feel

B. Incorrect tire inflation that is creating excessive sidewall flex and absorbing steering inputs

C. A failing power steering pump that cannot maintain assist pressure during the initial steering movement

D. A steering gear box that is adjusted too tightly, causing the steering to bind at the center position

87. A heavy-duty truck has a power steering system with an integrated steering gear (the type where the power assist piston is built into the steering gear housing). The driver reports a condition where the steering is assisted normally during turns but becomes very heavy momentarily when passing through the center (straight-ahead) position. What is the most likely cause?

A. The steering gear is maladjusted with excessive friction at the center position from a tight sector shaft adjustment

B. The power steering pump has a failing vane that cannot maintain flow during the transition through center

C. The drag link is binding at a specific point in its travel that corresponds to the center steering position

D. The steering gear's over-center adjustment (sector shaft lash adjustment) is too tight, creating mechanical resistance at the straight-ahead position where the sector shaft meshes most tightly with the worm gear — the tight adjustment creates binding at center while the mesh loosens off-center, allowing normal assist during turns

88. A truck equipped with an I-beam steer axle has a condition where the left steer tire shows feathered wear on the tread ribs while the right steer tire shows no feathering and wears evenly. What is the most likely cause?

A. The toe setting is correct but one tie rod end is worn, allowing the left wheel's toe to change during driving

B. The left side toe setting is different from the right side — even though the total toe may be within specification, the individual wheel angles may not be equal; if the left wheel has more toe deviation than the right, it will feather while the right wears evenly; individual wheel toe angles must be checked and equalized

C. The left steer tire has a manufacturing defect in the tread compound that causes directional wear sensitivity

D. The left front brake is dragging slightly, causing the tire to heat unevenly and wear on the leading edge of each tread rib

89. A heavy-duty truck has a frame crack at a gusset plate weld on the right frame rail near the rear spring hanger. The crack extends from the corner of the gusset into the frame web. What caused this crack?

A. The gusset plate was installed with the wrong welding procedure, creating a brittle weld that cracked from normal stress

B. The stress concentration at the corner of the gusset plate — the gusset's sharp corner creates a geometric stress riser where the forces flowing through the frame are concentrated at a single point; the

cyclic loading from normal operation gradually initiates and propagates a fatigue crack from this stress concentration point

C. The frame rail material was defective from the manufacturer and contained a microscopic flaw at the crack location

D. Road salt corrosion weakened the frame rail at the gusset location to the point of cracking under normal loads

90. A transit bus with air ride suspension has a condition where the bus oscillates (bounces) excessively after hitting a pothole. The oscillation takes 5 to 6 cycles to dampen out. Normal behavior is 1 to 2 cycles. What is the most likely cause?

A. The air springs are overinflated, causing them to bounce more aggressively when disturbed

B. The height control valves are responding too quickly to suspension movement, adding and venting air in phase with the oscillation

C. The shock absorbers have lost their damping ability from worn internal components or lost fluid — without adequate damping, the air springs oscillate freely at their natural frequency with minimal resistance until the inherent friction of the suspension and air system slowly dissipates the energy over 5 to 6 cycles instead of 1 to 2

D. The air springs have developed internal leaks that change their spring rate during compression and extension

91. A heavy-duty truck has a steer tire that developed a bulge on the sidewall. The bulge appeared after the truck hit a severe pothole at highway speed. What caused the bulge?

A. The pothole impact generated heat in the tire that softened the rubber locally, allowing it to expand under inflation pressure

B. The impact fractured the tire's internal reinforcement cords (the steel or nylon belts that give the sidewall its structural strength) — the broken cords can no longer contain the inflation pressure at that point, and the rubber expands outward under the internal pressure to form the visible bulge; this is a structural failure that makes the tire unsafe

C. The pothole impact compressed the air inside the tire momentarily, creating a localized high-pressure zone that stretched the rubber

D. The rim was deformed by the impact and the misshapen rim is pushing the tire bead outward, creating the bulge

92. A heavy-duty truck equipped with disc brakes on the steer axle has a pulsation felt through the brake pedal during moderate braking. The rotors have been recently replaced. What should the technician verify?

A. The brake pad compound, which may be incompatible with the new rotor material and causing uneven friction transfer

B. The caliper slide pins, which if seized would prevent even pad contact with the rotor surface

C. The hub pilot surface, which if corroded or damaged may not have allowed the new rotors to seat flat against the hub

D. The hub mounting surface and the rotor's mating surface — if corrosion, debris, or a raised ridge on the hub face prevents the rotor from mounting perfectly flat against the hub, the rotor will wobble as it rotates; this wobble produces the pulsation even though the rotor is new and was machined perfectly flat at the factory

93. A trailer with air ride suspension has a condition where the trailer leans to the left when loaded but sits level when empty. The height control valves function correctly. What is the most likely cause?

A. The left-side air spring has a lower spring rate than the right side due to a manufacturing variation, causing it to compress more under load

B. The cargo in the trailer is consistently loaded with more weight on the left side, compressing the left suspension more than the right

C. The left-side height control valve linkage is adjusted slightly differently from the right side, maintaining a lower ride height under load

D. The left-side shock absorber is seized, preventing the left suspension from extending fully under load

94. A driver reports that the truck's steering pulls to the right when braking but tracks straight during normal driving. The steer axle alignment is within specification. What is the most likely cause?

A. The right front tire has a different tread pattern than the left, creating a directional pull only during braking

B. The left front brake is providing less braking force than the right — from a contaminated lining, a restricted air supply, an out-of-adjustment slack adjuster, or a worn S-cam bushing; the imbalance causes the vehicle to pull toward the stronger-braking right side during brake application only

C. The vehicle pulls toward the side with the stronger brake — the right front brake applies more force than the left, pulling the vehicle to the right during braking; this is the most common cause of directional pull during braking that does not affect straight-line tracking

D. The steering gear has an internal check valve that shifts during braking pressure changes

95. A technician discovers that a truck's fifth wheel mounting bolts have been replaced with Grade 5 bolts instead of the original Grade 8 specification. The truck operates at gross vehicle weight regularly. What is the concern?

A. Grade 5 bolts are adequate for fifth wheel mounting as long as they are torqued to the Grade 5 specification

B. Grade 5 bolts have approximately 30% less tensile strength than Grade 8 bolts — under the dynamic loads of highway driving at gross weight (vertical loads, fore-aft braking loads, and lateral cornering loads), the Grade 5 bolts may stretch, loosen, or fail; if the fifth wheel separates from the frame, the trailer disconnects catastrophically

C. Grade 5 bolts will corrode faster than Grade 8 because they lack the additional surface treatment

D. The torque specification for Grade 5 is higher than Grade 8, so the bolts may strip the mounting holes in the frame rail

96. A truck equipped with a rear air suspension has a condition where one side dumps air whenever the vehicle makes a left turn. The suspension returns to normal height after the turn is completed. What is the most likely cause?

A. The height control valve on the affected side has a worn seal that opens under the lateral force of the left turn

B. The air spring on the affected side has a weakened sidewall that balloons outward during left turns and contacts a frame member, pushing the stem valve open

C. The air line to the affected air spring has a kink that restricts flow and causes the spring to dump under lateral loading

D. The height control valve sensing linkage on the affected side has excessive free play or a loose connection that shifts during the lateral weight transfer of a left turn — the linkage movement opens the valve to the exhaust position, venting air from that spring until the turn is completed and the linkage returns to its neutral position

97. A tractor-trailer combination has a condition where the trailer's tandem axle tires all show wear on the same side (inside edge on the left, outside edge on the right). What alignment condition causes this wear pattern across all tires?

A. The tandem axle group is shifted laterally (offset) to one side of the trailer's centerline, causing all tires on the group to run at an angle to the trailer's direction of travel; this is equivalent to a rear-axle thrust angle that produces a consistent directional scrub across all tire positions on the tandem

B. The individual axle toe settings are each out of specification in opposite directions, creating a crossed condition

C. The trailer frame has a twist that is loading one side of each tire more than the other

D. The trailer's air suspension is set to different ride heights on the left and right sides

98. A heavy-duty truck has a condition where the wheel bearing temperature on the right front hub is consistently 30°C higher than the left front hub after a highway run. Both bearings were serviced at the same time with the same grease. What should be investigated?

A. The right front brake for a dragging condition that generates heat transferred through the hub to the bearing area

B. The grease type used on the right side, which may have a lower operating temperature specification than the left

C. The right front bearing adjustment, the bearing condition, and the seal condition — a tight adjustment creates excess preload and friction heat, a damaged bearing generates friction heat, and a missing or damaged hub seal allows grease to escape and reduces lubrication effectiveness; any of these conditions elevates the bearing temperature above normal

D. The right front tire inflation pressure, which if low would flex the sidewall and generate heat transferred to the hub

99. A technician is inspecting the suspension on a truck with walking beam (equalizer beam) tandem rear suspension. The equalizer beam pivot bushing shows 8 mm of vertical free play. The manufacturer's maximum specification is 3 mm. What is the consequence of this excessive play?

A. The excessive bushing play produces a clunking noise over bumps and allows the beam to shift during load transfer between the axles

B. The excessive play allows the equalizer beam to shift excessively during load transfer, which changes the effective wheelbase on each side of the vehicle during suspension travel — this causes tire scrub, accelerated tire wear, potential frame stress at the beam mount, and a clunking noise over bumps

C. The bushing play has no significant consequence as long as the equalizer beam center pivot bolt is torqued correctly

D. The excessive play only affects ride comfort and does not impact tire wear or vehicle tracking

100. A truck has a condition where one drive axle dual tire pair consistently runs hotter than the other dual pair on the same axle. Both pairs have the same tire brand, size, and inflation pressure. What should be investigated?

A. The axle lubricant level, which if low on one side could cause the wheel bearings on that side to run hotter

B. The differential, which may be sending more torque to the hot-running side through a biased spider gear set

C. The hot-running dual pair's brake for a dragging condition that is not severe enough to produce noticeable performance symptoms but generates enough friction heat to elevate tire temperature above the normal pair

D. The brake on the hot-running side for a dragging condition — even a slight drag from a weak return spring, a seized anchor pin, or a partially applied slack adjuster generates continuous friction heat that is transferred through the drum and hub to the tires, elevating their temperature above the non-dragging pair on the same axle

101. A heavy-duty truck's steer axle king pins have been replaced. After the repair, the driver reports that the steering feels noticeably different — lighter and quicker than before the king pin replacement. What explains this change?

A. The new king pins and bushings have restored the original steering geometry — the worn king pins had allowed the steering knuckles to shift, changing the effective caster and steering axis inclination angles; the new pins restore the designed geometry, which changes the steering feel back to the original characteristics

B. The new king pin bushings have less friction than the worn ones, reducing the mechanical resistance in the steering

C. The grease used on the new king pins is a different specification than the original, providing less friction resistance

D. The tie rod ends were disturbed during the king pin replacement and the alignment has changed

102. A trailer equipped with a spread tandem axle has a condition where the front axle of the tandem wears its tires significantly faster than the rear axle. Both axles have the same tire specification and inflation pressure. The tandem alignment has been verified as correct (both axles square to the frame). What else could explain the differential wear rate?

A. The front axle of the spread tandem carries a disproportionate share of the trailer load due to the king pin location relative to the tandem group

B. The front axle tires are in their first life while the rear axle tires are retreads with a harder tread compound

C. The front axle of the spread tandem encounters the road surface first and absorbs more of the road's abrading forces than the following rear axle

D. The front axle brakes are applying with more force than the rear, creating a braking-induced wear differential

103. A truck driver reports a condition where the truck drifts to the right on a flat, straight road with no crown. Releasing the steering wheel causes the truck to track steadily to the right at a constant rate. The tires are matched and properly inflated. What alignment parameters should be checked?

A. Camber, which if different side-to-side would cause a drift but not necessarily a pull

B. Caster and camber — unequal caster side-to-side causes the vehicle to pull toward the side with less positive caster, and unequal camber causes a drift toward the side with more positive camber; both parameters must be measured and compared side-to-side to identify the source of the rightward drift

C. Toe only, which if set to toe-out would cause the vehicle to track to the right

D. Steering axis inclination, which if unequal would cause the steering to feel heavy on one side

104. A heavy-duty truck's windshield has an internal delamination between the glass layers. The delamination appears as a cloudy or bubbled area approximately 15 cm in diameter in the driver's direct line of sight. What is the correct assessment?

A. The delamination is cosmetic and can be repaired with a resin injection similar to a windshield chip repair

B. The delamination is minor and does not affect the structural integrity of the windshield or the driver's visibility

C. The delamination can be polished out from the inside surface of the windshield using a glass polishing compound

D. The windshield must be replaced — delamination compromises the windshield's structural laminate (which contributes to cab rollover strength and airbag deployment containment), and a 15 cm cloudy area in the driver's direct sight line impairs visibility below the safety standard

105. A transit bus has a condition where the passenger compartment ventilation fans operate at full speed and cannot be adjusted to a lower speed. The driver's HVAC controls are functional and adjust the driver's area correctly. What is the most likely cause?

A. The passenger ventilation fan speed controller or resistor pack has failed, defaulting to the full-speed bypass circuit — the passenger ventilation system operates on a separate control circuit from the driver's HVAC, and the fan speed controller's failure passes full voltage to the fan motors while the driver's independent system continues to function normally

B. The passenger compartment fuse has been replaced with a higher amperage fuse that overrides the speed control

C. The bus body controller has a software fault that commands full fan speed regardless of the control input

D. The passenger ventilation system draws its speed reference from the vehicle speed sensor, and a faulty VSS is commanding full speed at all times

106. A truck's sleeper berth bunk heater (fuel-fired type) lights and runs for approximately 2 minutes, then shuts down with a "Lock Out" fault. The technician resets the heater and it repeats the same pattern. What is the most likely cause?

A. The heater's combustion air blower motor is worn and does not maintain adequate airflow for sustained combustion

B. The heater's exhaust system is restricted — carbon buildup in the exhaust pipe or a crushed/kinked exhaust outlet prevents the combustion gases from exiting, which suffocates the flame after the initial startup period; the heater's safety circuit detects the flame failure and locks out to prevent fuel accumulation

C. The heater is designed to run for only 2 minutes as a warm-up cycle before automatically transitioning to the main heating mode

D. The heater's fuel quality sensor detects water in the fuel supply and locks out the heater as a protective measure

107. A heavy-duty truck equipped with an air-suspended cab has developed an excessive cab bounce at highway speed that was not present previously. The cab air springs appear inflated. What should be inspected?

A. The cab air spring pressure, which may be set too high for the driver's weight and the current load condition

B. The cab shock absorbers, which are responsible for damping the cab's air spring oscillation — failed or worn cab shock absorbers allow the cab to bounce on its air springs without damping, and the resonance at highway speed excites this undamped oscillation into the noticeable bounce the driver experiences

C. The engine mounts, which may be amplifying engine vibration that the cab suspension magnifies into a bounce

D. The cab pivot bushing, which if worn could allow the cab to rock fore-and-aft on its pivot point

108. A truck's power door lock system has a condition where the driver's door locks and unlocks normally, but the passenger door locks only and will not unlock with the power switch. The manual lock on the passenger door functions correctly. What is the most likely cause?

A. The passenger door lock actuator motor can rotate in one direction (lock) but has failed in the other direction (unlock) — the motor or its internal gear mechanism has a fault that prevents it from reversing direction to the unlock position; the manual lock bypass works because it mechanically moves the lock mechanism independently of the actuator motor

B. The passenger door lock switch on the driver's panel has a failed unlock contact while the lock contact remains functional

C. The body controller module has a software fault that prevents the unlock command from reaching the passenger door actuator

D. The passenger door wiring harness has a broken conductor in the unlock circuit within the door hinge area

109. A technician is inspecting a trailer's subframe and finds that a crossmember near the rear axle suspension mount has cracked completely through on one side. The trailer has been operating with heavy loads. What is the immediate risk?

A. The cracked crossmember is only a cosmetic issue and does not affect the trailer's load-bearing capacity

B. The crack will progress into the main frame rail if not repaired, eventually splitting the rail along its web

C. The broken crossmember compromises the frame's torsional rigidity and the suspension mounting integrity — the suspension forces are no longer properly distributed to the frame, which can cause the remaining crossmembers to overload, the axle alignment to shift, and in severe cases, the frame to twist under the dynamic loads of loaded operation

D. The cracked crossmember only affects the trailer floor's ability to support forklift traffic and does not impact the frame or suspension

110. A trailer's ABS system has a condition where the ABS lamp illuminates and a fault code is stored for "System Voltage Low" every time the trailer is connected to the tractor. The tractor's auxiliary power circuit has been tested and provides the correct voltage. What should be inspected?

A. The J560 connector and the trailer's power supply wiring between the connector and the ABS ECU — a high-resistance connection at the J560 pins, corroded internal wiring, or a deteriorated ground path on the trailer side reduces the voltage reaching the ABS ECU below its minimum operating threshold even though the tractor delivers adequate voltage at the connector

B. The trailer's air system, which must be fully charged before the ABS system will accept power from the tractor

C. The tractor's alternator output voltage during engine idle, which may drop below the trailer ABS minimum when the engine is not at operating RPM

D. The ABS ECU itself, which may have an internal voltage regulator fault that prevents it from accepting the available supply voltage

111. A trailer used for hauling loose bulk material (gravel, sand) has severe wear on the inside surfaces of the dump body. The wear pattern shows deep grooves running vertically from the top to the bottom of the body sides. What caused this wear pattern?

A. The dump body liner material has degraded from exposure to the chemical composition of the gravel and sand

B. Normal abrasion from the sliding material during dumping would produce horizontal wear patterns, not vertical

C. The vertical grooves are caused by large stones or objects becoming wedged between the dump body sides and the load, scoring the surface as the body raises and the load slides downward during dumping operations

D. The vertical grooves are caused by the repeated loading and unloading of material by conveyor equipment that scrapes against the body sides

112. A trailer's landing gear has a condition where the legs extend and retract, but when the trailer is disconnected from the tractor and resting on the landing gear, the legs slowly retract under the trailer's weight. What is the most likely cause?

A. The landing gear's internal gearbox has stripped teeth that cannot hold the load against the gravitational force

B. The landing gear's internal worm gear or ratchet mechanism has worn to the point where it cannot maintain its load-holding function — the worm gear design is normally self-locking (the load cannot back-drive the worm), but when the worm gear teeth wear excessively, the self-locking feature is compromised and the trailer's weight can slowly back-drive the mechanism, retracting the legs

C. The cross shaft connecting the two legs has twisted, allowing one leg to retract while the other holds

D. The landing gear mounting bolts have loosened, allowing the entire landing gear assembly to slide downward on the trailer frame

113. A reefer trailer's cargo temperature monitoring system shows a temperature spike to −8°C (from the −18°C setpoint) during a 4-hour highway trip, but the TRU's operating log shows no interruptions in the refrigeration cycle. What is the most likely cause?

A. The cargo temperature sensor in the trailer has drifted out of calibration and is reading warmer than the actual cargo temperature

B. The TRU's compressor is undersized for the trailer volume and cannot maintain the setpoint during highway driving

C. The trailer's door was opened during the trip (at a delivery stop) and the thermal load from the warm air that entered took time to pull back down — the TRU ran continuously and eventually restored the setpoint, but the temperature spike reflects the warm-air intrusion during the door opening

D. The TRU's defrost cycle, which periodically introduces warm air to melt ice from the evaporator, caused the temporary temperature rise

114. A trailer's air ride suspension has one air spring that appears to be inflated to a significantly larger diameter than the other three springs on the same tandem. The ride height on that corner is correct. What does the oversized spring appearance indicate?

A. The air spring has a manufacturing variation that produces a wider profile at the same pressure and ride height

B. The air spring has a weakened sidewall or a degraded rubber bellows that is ballooning outward under normal inflation pressure — the spring may be at the correct height but the rubber is stretching beyond its designed profile, indicating imminent failure; the spring must be replaced before it ruptures

C. The height control valve on that corner is overinflating the spring due to a calibration error

D. The air spring is the wrong part number for the application and has a larger rated diameter than the other three

115. A trailer's electrical system has a condition where the clearance and marker lamps are dim on the driver's side but normal on the passenger side. Replacing the bulbs does not correct the problem. What is the most likely cause?

A. The driver's side wiring is a smaller gauge than the passenger side due to a previous incorrect repair

B. The J560 connector has a corroded pin on the marker light circuit that is creating voltage drop for the driver's side lamps

C. The trailer's main junction box has internal corrosion that is creating resistance in the circuit feeding the driver's side lamps

D. A high-resistance ground connection or corroded wiring junction on the driver's side is creating a voltage drop that reduces the voltage available to all driver's side lamps — since replacing bulbs did not correct the issue, the fault is in the wiring or grounding rather than the lamps themselves

116. A flatbed trailer's winch system for securing cargo uses a ratchet mechanism to tighten the cargo straps. During an inspection, the technician discovers that the ratchet mechanism on one winch does not hold — the handle releases tension on the strap when released. What must be done?

A. Apply a locking compound to the ratchet pawl to prevent it from releasing under strap tension

B. The winch ratchet mechanism must be repaired or replaced immediately — a winch that cannot hold tension under load is a cargo securement failure that can allow the load to shift during driving, creating a hazard for other road users and potentially causing the cargo to fall from the trailer

C. Wrap the winch handle with wire to prevent it from releasing during transit

D. Use a supplemental cargo strap through the winch body to prevent the load from shifting if the ratchet releases

117. A truck's HVAC system has a condition where the A/C compressor engages normally and the system cools, but after approximately 20 minutes of operation, frost forms on the low-pressure line between the expansion valve and the evaporator. What does frost on this line indicate?

A. The system is performing optimally and the frost indicates the refrigerant is at maximum cooling capacity

B. Normal operation — frost on the low-pressure line is expected during continuous A/C operation in humid conditions

C. The expansion valve is stuck partially open, allowing excessive refrigerant flow through the valve — more refrigerant enters the evaporator than can absorb heat from the air, so the excess liquid refrigerant continues past the evaporator and the remaining liquid evaporates in the suction line, cooling the line to below freezing and forming frost

D. The system is undercharged and the reduced refrigerant volume is dropping the suction pressure below freezing

118. A truck's heater produces maximum heat from the vents but the engine coolant temperature gauge reads below normal operating temperature even after 30 minutes of highway driving. What does this combination of symptoms indicate?

A. The thermostat is stuck partially open — enough coolant flows through the radiator to keep the engine below normal operating temperature (the gauge reads low), but enough hot coolant also flows through the heater core to produce strong heat output because the coolant temperature, while below the gauge's normal range, is still hot enough for effective cab heating

B. The coolant temperature sensor has failed and is reading low, but the actual engine temperature is normal

C. The water pump impeller is partially eroded and cannot circulate coolant at the rate needed to reach operating temperature

D. The heater core bypass valve is stuck closed, forcing all coolant through the heater core instead of the engine

119. A truck's A/C system has been retrofitted with an aftermarket electronic expansion valve to replace the original thermostatic expansion valve. After the retrofit, the system cools adequately in stop-and-go traffic but freezes the evaporator during highway driving. What is the most likely cause?

A. The aftermarket expansion valve is sized for a smaller system and restricts refrigerant flow at higher compressor speeds

B. The aftermarket expansion valve sensor is mounted in the wrong location and cannot accurately read the evaporator temperature

C. The aftermarket electronic controller is incompatible with the vehicle's CAN bus and cannot communicate with the ECM

D. The electronic expansion valve's temperature sensor or controller is not calibrated correctly for the system's evaporator — the valve is opening too wide at highway compressor speeds, flooding the evaporator with excess refrigerant that drops the evaporator temperature below freezing; the original TXV's thermal sensing element was matched to the system and prevented this condition

120. A bus's rear passenger compartment heating system uses engine coolant routed through a dedicated heater core in the rear of the bus. The rear heater produces adequate heat when the bus is moving at highway speed but provides only lukewarm air at idle or in stop-and-go traffic. What is the most likely cause?

A. The rear heater core is partially blocked with deposits that reduce coolant flow, but adequate flow is achieved at higher engine RPM through the increased pump output

B. The rear heater's blower motor runs at a reduced speed at idle, moving less air across the heater core than at highway speed

C. The long coolant hose run from the engine to the rear heater core allows the coolant to cool significantly during transit

D. The rear heater core supply hose is too small in diameter or has a partial restriction that limits coolant flow at the lower pump output of idle speed — at highway RPM, the increased pump output forces adequate coolant through the restricted passage, but at idle the pump cannot push enough hot coolant through the restriction for full heating capacity

121. A truck's A/C system has manifold gauge readings showing: low side at 10 psi (much lower than normal) and high side at 340 psi (much higher than normal). The condenser fan is operating and the condenser appears clean. What is the most likely system condition?

A. A restriction exists in the high-pressure liquid line between the condenser and the expansion valve — the restriction prevents adequate refrigerant from reaching the evaporator (low-side pressure drops because the evaporator is starved) while the refrigerant backs up behind the restriction (high-side pressure rises because the refrigerant cannot flow through the restriction fast enough)

B. The system is severely overcharged, causing both pressures to be abnormal

C. The compressor is producing excessive discharge pressure from a faulty unloading mechanism

D. The condenser is internally restricted despite appearing clean externally

122. A truck driver reports that the A/C system produces a clicking or tapping noise from under the dashboard every 3 to 4 seconds. The noise corresponds to the A/C compressor cycling on and off. What is the most likely cause?

A. The compressor clutch air gap is too wide, causing a loud engagement click with each cycle

B. The compressor's internal suction reed valve is damaged and produces a tapping noise during each compression cycle

C. The blend door actuator is responding to the temperature fluctuation from the compressor cycling

D. The A/C system is low on refrigerant — the low charge causes the low-pressure switch to cycle the compressor on and off every 3-4 seconds; the clicking is the compressor clutch engaging and disengaging as the suction pressure fluctuates around the switch's cut-in/cut-out threshold

123. A technician has evacuated a truck's A/C system and held a vacuum for 30 minutes. The vacuum held at 500 microns without rising. The technician then charges the system with the specified amount of refrigerant. After charging, the system cools normally. However, the next morning, the system is not cooling and a quick pressure check shows the system is empty. What happened?

A. The vacuum test is inconclusive for detecting leaks at the fitting joints because the vacuum creates different forces than operating pressure

B. The 30-minute vacuum hold confirmed the system was sealed under vacuum conditions, but a leak exists that only opens under the positive pressure of the charged system — some leaks (such as a Schrader valve core that seats under vacuum but lifts under pressure, or a hose fitting that compresses closed under vacuum but opens under pressure) are pressure-dependent and cannot be detected by a vacuum test alone

C. The technician's charging equipment has a faulty check valve that allowed the refrigerant to flow back into the recovery tank overnight

D. The refrigerant converted to a gas and escaped through the molecular structure of the rubber hoses overnight

124. A hydraulic system on a truck-mounted crane develops full system pressure but the boom does not move. The directional control valve is shifting correctly. No external leaks are visible. What should the technician check?

A. The hydraulic reservoir level, which if critically low would prevent the pump from delivering any fluid to the cylinder

B. The pilot-operated check valve or counterbalance valve in the boom circuit, which may be stuck closed and preventing fluid from reaching the cylinder even though the directional valve is commanding flow to that circuit

C. The boom cylinder itself for a catastrophic internal failure — the piston may have separated from the rod, or the cylinder barrel may have a complete internal bypass from a missing piston seal; full system pressure at the valve port with no movement indicates the cylinder is not converting hydraulic force to mechanical motion

D. The relief valve, which if set too low would limit the pressure available to move the boom under load

125. A hydraulic system uses a pressure-compensated flow control valve to regulate the speed of a crane's boom extend function. The operator reports that the boom extends at the correct speed when lifting a light load but slows significantly when lifting the maximum rated load. What is the most likely cause?

A. The pressure-compensated flow control valve is functioning correctly — a pressure-compensated valve maintains constant flow regardless of load changes; the slow speed under maximum load indicates the valve is not truly pressure-compensated, the compensating element has failed or stuck, or the system pressure is reaching the relief valve setting under the heavy load and the resulting reduced pressure differential across the valve reduces the flow rate

B. The boom cylinder's piston seal is bypassing under the higher pressure required for the maximum load

C. The hydraulic pump is worn and cannot maintain flow at the higher pressure required by the maximum load

D. The hydraulic fluid has thickened from cold ambient temperature, reducing flow through the control valve

126. A dump truck's hydraulic system raises the dump body normally but the body drifts downward when the control valve is in the hold (float) position. The technician isolates the cylinder from the directional valve and the drift stops. What has this test determined?

A. The cylinder's piston seal is leaking internally, allowing fluid to bypass from the cap end to the rod end

B. The counterbalance valve has failed and is allowing fluid to drain from the cylinder

C. The pump's check valve is allowing pressure to bleed back through the pump housing

D. The directional control valve is leaking internally — fluid is crossing from the cylinder's port through the valve spool clearance to the tank port; isolating the cylinder from the valve removes the leak path through the valve, and the drift stops because the only remaining path (through the cylinder's piston seal) is intact

127. A technician is testing a hydraulic pump by measuring the case drain flow. The case drain port on the pump housing is connected to a calibrated flow meter that measures the fluid flowing from the pump's housing back to the reservoir. The meter reads 3 gallons per minute. The pump is rated at 20 gpm. What does the case drain flow indicate?

A. The case drain flow is normal and represents the designed cooling flow for the pump's internal bearings

B. The 3 gpm case drain flow represents the pump's internal leakage — fluid that bypasses the pump's internal sealing elements (worn gears, pistons, or vanes) instead of being pumped to the outlet; this means the pump is only delivering approximately 17 gpm of its 20 gpm rated capacity, which represents 85% volumetric efficiency

C. The case drain flow is not a reliable indicator of pump condition and the pump must be tested with an external flow meter at the outlet

D. The case drain should read zero on a healthy pump, and any flow indicates a catastrophic seal failure

128. A hydraulic crane has a condition where the boom oscillates (bounces) during precise lifting operations. The oscillation is most noticeable when the operator tries to hold the boom steady while positioning a load. What is the most likely cause?

A. The hydraulic fluid has excessive air entrainment from a low reservoir level or a suction line leak

B. The crane's structural members have developed fatigue cracks that flex under the dynamic load

C. The boom cylinder's cushioning device has failed, allowing the cylinder to reach end-of-stroke without deceleration — the piston impacts the cylinder cap and bounces back, creating the oscillation

D. Air in the hydraulic system — entrained or trapped air makes the fluid compressible; when the operator attempts to hold the boom in position, the compressible fluid alternately compresses and expands under the load's weight, creating a bouncing oscillation that a non-compressible, air-free system would not exhibit

129. A truck-mounted hydraulic system uses two pumps — a high-volume, low-pressure pump for fast cylinder extension and a low-volume, high-pressure pump for the final high-force work. This type of system is known as what?

A. A Hi-Lo (high-low) system — the high-volume pump provides rapid cylinder travel to move the actuator quickly to the work position, and when the load increases (raising system pressure above the low-pressure pump's rating), the low-pressure pump unloads and the high-pressure pump alone provides the force needed for the heavy work at reduced speed

B. A regenerative system that recirculates the high-volume pump's output through the high-pressure pump for amplification

C. A tandem system that always runs both pumps simultaneously at all system pressures

D. A series system that routes the first pump's output through the second pump to multiply pressure

130. A hydraulic system's pressure relief valve is making a high-pitched squealing noise during normal operation. The system pressure is at the correct setting. What does the squealing indicate?

A. The relief valve spring has weakened and is oscillating between the open and closed position

B. The relief valve is the correct pressure setting but its internal components are worn or contaminated

C. The pump is cavitating and the noise is transmitted through the fluid to the relief valve

D. The relief valve's seat is contaminated with a particle or the valve's poppet is partially worn, causing it to chatter (rapidly open and close) at the set pressure — the chattering creates the high-pitched squeal as the poppet vibrates at high frequency against the seat; cleaning or replacing the valve restores quiet operation

131. A technician discovers that someone has added automatic transmission fluid (ATF) to a hydraulic system that specifies AW-46 (anti-wear ISO 46) hydraulic oil. The system has been operated for approximately 500 km with the mixed fluid. What is the concern?

A. ATF and AW-46 have completely different base oil chemistries and will separate into layers inside the reservoir

B. ATF and AW-46 hydraulic oil have different viscosity characteristics, additive packages, and seal compatibility properties — ATF is typically thinner than AW-46, which reduces the lubricating film thickness and may cause accelerated wear on the pump and valves; additionally, ATF's additive package may be incompatible with the system's seals, potentially causing them to swell or deteriorate; the system should be drained, flushed, and refilled with the correct fluid

C. There is no concern because ATF and AW-46 are fully compatible and interchangeable in all hydraulic applications

D. The only concern is the color difference, which makes it difficult to visually assess the fluid's condition

132. A hybrid electric bus uses a series hybrid architecture where the diesel engine drives a generator that produces electricity for the traction motor. The bus has adequate battery charge but the diesel engine starts and runs continuously even during stops. What is the most likely cause?

A. The battery management system has detected a cell imbalance and is using the generator to equalize the cells

B. The diesel engine's ECM has received a high-temperature alert from the exhaust aftertreatment system and is running the engine to maintain DPF regeneration temperature

C. The vehicle control unit is commanding the engine to run because the battery's state of charge has dropped below the minimum threshold for electric-only operation, even though the battery gauge may show adequate charge — the SOC threshold for engine-start is higher than the empty indicator, and the system requires the engine to supplement the battery's output and prevent the SOC from dropping to a level that could damage the cells

D. The generator has a fault that prevents it from producing electricity, so the engine runs continuously to power the electrical systems directly through a bypass circuit

133. A battery electric delivery truck has a significantly shorter driving range in winter (−20°C) compared to summer (+25°C). The battery SOH (state of health) is 95%, indicating minimal degradation. What explains the reduced winter range?

A. The electric traction motor's permanent magnets lose magnetic strength at low temperatures, reducing motor efficiency and requiring more energy per kilometer

B. The regenerative braking system is disabled in winter to prevent wheel lockup on icy roads, eliminating energy recovery

C. The tires have higher rolling resistance in winter conditions, but this alone does not account for the full range reduction

D. Cold temperatures reduce the battery's capacity and increase its internal resistance (requiring more energy for the same output), the cabin heater draws significant electrical energy directly from the battery (unlike ICE vehicles where cabin heat is free waste heat from the engine), and increased rolling resistance from cold tires and denser air all combine to reduce range

134. A technician is measuring the insulation resistance of a high-voltage battery pack on a hybrid bus using a megohmmeter. The reading is 200 kilohms. The manufacturer's minimum specification is 500 kilohms per volt of system voltage. The system voltage is 600V. What is the required minimum insulation resistance, and does the pack pass?

A. The minimum is 300 megohms (500 kΩ/V × 600V = 300,000 kΩ = 300 MΩ) and the pack fails dramatically at 200 kΩ — this extremely low insulation resistance indicates severe degradation of the insulation between the high-voltage bus and the chassis, creating a significant shock hazard

B. The minimum is 500 kilohms regardless of system voltage, and the pack fails because 200 kΩ is below 500 kΩ

C. The minimum is 300 kilohms (500 × 600 = 300,000 ohms = 300 kΩ) and the pack passes because 200 kΩ is close enough

D. The minimum is 300 megohms and the pack passes because the megohmmeter reading of 200 automatically means 200 megohms

135. A battery electric truck's onboard charger (for Level 2 AC charging) produces a ground fault error and stops charging when connected to a depot charging station. The truck charges normally at other stations. What is the most likely cause?

A. The depot charging station has a ground fault in its wiring or EVSE (electric vehicle supply equipment) that the truck's onboard charger detects through its ground fault protection circuit — the truck's charger is designed to detect any current leakage to ground and stop charging as a safety measure, and the fault is in the station's equipment rather than the truck

B. The truck's onboard charger has developed an intermittent ground fault that only appears when connected to stations with a specific voltage output

C. The depot station's circuit breaker is undersized for the truck's charging current draw, and the breaker trips before the ground fault circuit detects it

D. The truck's charging inlet has moisture contamination that creates a ground fault path only at certain ambient temperatures

Practice Exam 7: Answer Key and Explanations

1. D — Steam cleaning the underside of a vehicle that has accumulated years of road grime, grease, and brake dust aerosolizes these contaminants into a fine mist that the technician inhales and contacts. Older brake lining dust may contain asbestos fibers, and even non-asbestos formulations contain harmful particulates. The technician must wear a respirator rated for the anticipated contaminants, chemical splash goggles, and chemical-resistant clothing to prevent inhalation, eye contact, and skin absorption.

2. B — Towing a vehicle with the drive wheels on the ground and the transmission in gear can cause catastrophic internal damage because the transmission's internal components rotate without the lubrication provided by the engine-driven pump. Automatic transmissions are particularly vulnerable — the front pump only operates when driven by the engine. Many AMTs and some manual transmissions also have towing restrictions. The technician must consult the vehicle's towing procedures and may need to disconnect the driveshaft or use a flatbed.

3. C — Lead-acid batteries produce hydrogen gas during charging through the electrolysis of water in the electrolyte. Hydrogen is lighter than air, highly flammable, and forms an explosive mixture at concentrations as low as 4% in air. A single spark from a tool, a static discharge, or a disconnected battery cable can ignite the accumulated hydrogen, causing a battery explosion that sprays sulfuric acid. Adequate ventilation prevents hydrogen accumulation above the explosive threshold.

4. A — The jack must be rated for the load it will support with an adequate safety margin. Although lifting one end of an 8,000 kg truck might place approximately 4,000-5,000 kg on the jack (depending on weight distribution), the 10-ton jack provides the necessary safety margin. The 5-ton jack would be operating at or near its rated capacity with no margin for dynamic loads, uneven surfaces, or weight distribution variations — operating a jack at or above its rated capacity risks catastrophic failure.

5. C — The mandatory pre-cutting safety step is removing all combustible materials from the work area and the drop zone below the cutting operation. Hot slag, sparks, and molten metal produced by torch cutting travel unpredictably and can land several metres from the cut point. Any combustible material — shop rags, cardboard, oil-soaked floor absorbent, paper, plastic components — in the fire zone is a potential ignition point. Clearing the area eliminates the fuel source that the slag needs to start a fire.

6. B — A truck repair shop is a dynamic environment where hazards can originate from adjacent work areas at any time. A technician grinding metal at one bench sends debris across the shop. A spring-loaded component releasing during disassembly can project parts in unexpected directions. A pressurized hose failure can spray fluid across the shop floor. These events are unpredictable and can affect anyone in the shop, making continuous eye protection mandatory for all personnel on the shop floor.

7. D — An unmarked container is an unknown hazard under WHMIS 2015. Attempting to identify the contents by smell risks inhalation of toxic vapors. Touching the liquid risks chemical burns or skin absorption. Pouring it into another container risks contamination or a chemical reaction. The only safe action is to treat it as a potential hazard, avoid all contact, and report it to the supervisor for proper identification using the Safety Data Sheet database and appropriate testing.

8. A — Air brake system components operate at pressures up to 125 psi. Disconnecting a line under pressure releases the stored air in an explosive burst that can propel loose fittings, accumulated dirt, and debris with enough force to penetrate skin or damage eyes. The noise level of a sudden air release can exceed 140 dB — sufficient to cause immediate permanent hearing damage. Draining the system to zero pressure before disconnecting any component eliminates these hazards.

9. C — Zero rail pressure during cranking with a full fuel tank means the high-pressure pump is not receiving fuel or cannot build pressure. Before replacing expensive high-pressure components, verify the basics: is the low-pressure transfer pump running? Are the fuel filters plugged? Is there air in the supply lines? Is the supply line kinked or restricted? These upstream supply issues are the most common causes of zero rail pressure and are the least expensive to diagnose and correct.

10. A — Blue smoke during deceleration on downhill grades points to oil entering the exhaust stream during low-exhaust-backpressure conditions. During deceleration, the throttle is closed (no fuel injection) and exhaust backpressure drops below the oil pressure in the turbocharger center housing. This pressure differential pushes oil past the turbine-side seal into the exhaust housing, where it burns as blue smoke. At steady speed and acceleration, exhaust backpressure exceeds the oil supply pressure and holds the seal, preventing leakage.

11. B — Aluminum shavings in the oil filter are a critical finding that requires immediate investigation. The most likely aluminum source in a diesel engine is the piston — the piston crown or skirt is failing from overheating (from a cooling system fault, detonation, or excessive fuel), thermal fatigue (from cyclic heat stress), or a failed ring that allowed combustion heat to damage the piston material. The engine must not be operated until the source is identified and the extent of the damage is assessed.

12. D — The charge air cooler reduces the temperature of the turbocharger's compressed discharge air from approximately 150-200°C to near ambient temperature before it enters the intake manifold. If the cooler is restricted internally (from oil contamination, debris, or a damaged core) or has failed, the hot compressed air reaches the manifold uncooled. The ECM detects this elevated temperature through the manifold temperature sensor and derates to protect the engine from the reduced air density and excessive thermal load.

13. C — Hydraulic valve lash adjusters (lifters) on engines that use them operate by filling with engine oil under pressure. After an overhaul, the adjusters are drained and contain air. When the engine first starts, the oil system pressurizes and fills the adjusters — during the 2-3 seconds before they fill completely, the adjusters are collapsed and the valve train has excessive clearance, producing the brief rattle. Once oil pressure fills the adjusters, they extend to take up the clearance and the noise stops. This is expected behavior after an overhaul.

14. A — Identical engines on identical routes should produce similar EGTs. A consistently higher EGT indicates the engine is working harder to produce the same power output. The most common cause is increased exhaust restriction — a partially loaded DPF, a restricted DOC, or a damaged exhaust component creates backpressure that the engine must work against, raising combustion temperatures and exhaust gas temperatures. The aftertreatment system should be inspected for soot loading, ash accumulation, and physical damage.

15. D — Diesel fuel serves as both the combustion fuel and the lubricant for the high-pressure fuel system's internal components. Gasoline has dramatically lower lubricity than diesel — its inability to maintain a lubricating film between the precision-machined surfaces of the injection pump plungers, barrels, and injector needle assemblies causes rapid metal-to-metal contact and scoring. Even 5 km of operation on gasoline can cause sufficient wear to require replacement of the high-pressure pump and all injectors.

16. B — A continuous hissing noise from the exhaust manifold area on one side of the engine is the sound of pressurized exhaust gas escaping through a crack in the manifold or through a failed manifold-to-head gasket. The continuous nature distinguishes it from valve-related noises (which are pulsating at engine firing frequency). Exhaust leaks are louder when the engine is cold because thermal contraction

opens the crack wider; as the manifold heats and expands, the crack partially closes and the noise may diminish.

17. C — Extended-life coolant relies on its organic acid technology (OAT) inhibitor package to prevent corrosion of the engine's internal metal surfaces. A pH drop below 7.5 indicates the inhibitor package is depleting — the organic acids are being consumed by the corrosion they are preventing. At the mid-life service point (typically 300,000 km or 3 years), the manufacturer-specified extender must be added to replenish the inhibitors. If the pH has dropped significantly, the coolant may need complete replacement rather than just extension.

18. A — Diesel engine oil turning black shortly after an oil change is completely normal and expected. Diesel combustion produces soot as a natural byproduct, and the oil's dispersant additives are specifically designed to capture and suspend these soot particles in the oil — preventing them from settling on engine surfaces as harmful deposits. The black color is proof that the dispersants are working. Clear oil in a diesel engine after significant running time would actually indicate a deficient additive package.

19. D — The DOC is the first catalytic component in the aftertreatment chain and affects both downstream components. For the DPF: the DOC converts NO to NO2 (the primary oxidizer for passive soot regeneration at lower temperatures) and generates the exothermic heat needed for active regeneration. For the SCR: the DOC's hydrocarbon and CO conversion upstream of the SCR prevents these substances from contaminating the SCR catalyst. A failed DOC compromises the entire aftertreatment system's performance.

20. C — The CCV filter's restriction prevents blow-by gases from venting out of the crankcase at their normal rate. As pressure builds inside the crankcase, it pushes against every seal and gasket — the rear main seal, front crank seal, valve cover gaskets, and turbocharger drain. Oil weeps past these seals under the elevated pressure, creating external oil leaks that would not exist at normal crankcase pressure. The elevated pressure also reduces the piston rings' ability to seal against the liners, potentially increasing blow-by in a self-reinforcing cycle.

21. B — A glazed belt surface has been hardened and polished by heat from slipping against the pulley surface. Once glazed, the belt's coefficient of friction is permanently reduced — it slips more easily, which generates more heat, which causes more glazing, in a self-reinforcing degradation cycle. The belt must be replaced because the glazed surface cannot be restored. The cause of the initial slip (misaligned pulley, contamination, weak tensioner, incorrect belt length) must also be corrected to prevent the replacement belt from glazing.

22. A — A water pump shaft that has scored the housing bore indicates the shaft bearing has failed, allowing the shaft to move laterally and contact the housing. The bearing failure is often caused by excessive belt tension (overloading the bearing's radial capacity), coolant contamination reaching the bearing through a failed seal, or simply age-related wear. The thermostat housing gasket and the belt tension should be inspected because excessive belt tension is the most common external cause of premature water pump bearing failure.

23. D — Extended idling produces exhaust temperatures that are far below the threshold needed for DPF regeneration. Passive regeneration requires sustained temperatures above 300°C, and active regeneration requires the ECM to achieve 550-600°C — neither is achievable during idle. Soot accumulates progressively during the 8-hour idle period. Before returning to normal driving, a parked regeneration must be performed to burn off the accumulated soot, or the vehicle must be driven under highway load conditions long enough for the ECM to complete an active regeneration.

24. C — An oil level rising without oil being added means liquid is entering the crankcase from another system. The two primary sources are fuel (leaking past the injectors during injection events or from post-injection during DPF regeneration) and coolant (from a failed oil cooler, head gasket, or cracked component). The technician determines which by checking for fuel odor and reduced oil viscosity (fuel dilution) or milky appearance and sweet odor (coolant intrusion). Each source requires different corrective action.

25. A — A high-pitched screaming or whistling noise during acceleration that was not present before indicates a pressurized air leak in the intake system downstream of the turbocharger compressor. The turbocharged air (at 20-30+ psi) is escaping through a crack, a loose clamp, or a damaged hose in the ducting between the compressor outlet and the intake manifold. The noise is most prominent during acceleration because boost pressure is highest. Boost pressure reads normal if the leak is small, but the noise confirms pressurized air is escaping.

26. D — Fuel injection balance requires all injectors on an engine to deliver fuel within a tight tolerance band. A high-flowing injector delivers excess fuel to its cylinder, creating elevated combustion temperatures, increased wear, and black smoke from that cylinder. A low-flowing injector starves its cylinder, causing a weak power contribution, rough idle, and potential misfire. Both conditions create a cylinder-to-cylinder imbalance that the engine compensates for by working harder overall, reducing efficiency and increasing emissions.

27. B — The intake air heater raises the temperature of the air entering the intake manifold during cold starts. Diesel engines rely on the heat of compression to ignite fuel — but when the engine and cylinder walls are cold, they absorb heat from the compressed air, potentially preventing it from reaching the

autoignition temperature. The intake air heater pre-warms the air before compression, ensuring the compressed charge reaches ignition temperature despite the heat absorption by the cold engine components.

28. A — The oil pressure pattern — low at hot idle, adequate at higher RPM — reveals the balance between pump output and bearing leakage. At idle, the pump turns slowly and produces its minimum output. Worn bearings or a worn pump allow oil to leak through faster than the pump can supply at this low output, and pressure drops below specification. At higher RPM, the pump turns faster and produces more volume, partially compensating for the leakage and restoring pressure. This speed-dependent pattern is diagnostic for wear-related pressure loss.

29. C — The DEF dosing injector sprays urea solution into the exhaust stream at temperatures exceeding 300°C. If the exhaust temperature at the injection point is too high for too long, the DEF evaporates before it can properly decompose into ammonia, and the residual urea bakes onto the injector tip. This carbon-like coating progressively blocks the spray orifice, degrading the spray pattern and reducing the volume and distribution of DEF delivered to the SCR catalyst, which decreases NOx conversion efficiency.

30. A — The secondary circuit holds pressure perfectly (zero loss), confirming the compressor, governor, supply circuit, and air dryer are functioning correctly — the air supply side is not the problem. The primary circuit's 2 psi/minute loss must originate from a component exclusive to the primary circuit — downstream of the check valve that separates the two circuits. This could be a leaking relay valve, a leaking brake chamber, a loose fitting, or a cracked line in the primary circuit.

31. C — The compressor cycles at the correct pressures but the interval has shortened dramatically — the system is losing air between cycles faster than before. The absence of an audible leak does not mean no leak exists. Many leaks are too small to hear in a shop environment, are located in concealed areas (under the cab floor, inside frame rails, behind axle components), or are on the trailer side. A systematic soap-solution leak test on every connection, fitting, valve, chamber, and hose in the entire air system is required.

32. C — The brake pad wear indicator is a purpose-designed feature — a small spring steel tab mounted on the pad that contacts the rotor surface when the pad friction material wears to its minimum allowable thickness. The tab-to-rotor contact produces a metallic scraping noise during wheel rotation that alerts the driver (and the technician during inspection) that the pads have reached their service limit. When the brakes are applied, the pad clamps against the rotor and pushes the indicator away from the surface, stopping the noise.

33. B — System pressure is adequate, pushrod strokes are correct, and linings are good — the mechanical and pneumatic components downstream of the foot valve are functioning correctly. The problem must be in the component that converts pedal effort to air pressure: the foot valve. A restricted inlet (contamination blocking the air supply to the valve), worn internal components (pistons that don't respond proportionally to pedal travel), or a binding linkage (mechanical resistance that absorbs pedal effort before it reaches the valve) all require more pedal effort for the same output pressure.

34. A — Brake chambers are sized to produce a specific force at a given air pressure (Force = Pressure × Area). Type 30 chambers produce more force than Type 24 chambers at the same pressure because the 30-square-inch diaphragm has 25% more area than the 24-square-inch diaphragm. On a tandem axle where all positions should have identical chambers, the positions with Type 24 chambers produce 25% less braking force, creating an imbalance that causes uneven tire wear, directional instability during braking, and accelerated wear on the harder-working positions.

35. C — The spring brakes are applying (the pushrod extends, confirming the springs are functioning and the hold-off air is exhausting). The springs are delivering their rated mechanical force. But the force is not resulting in adequate friction at the drum because the downstream components — worn shoes with reduced friction surface, out-of-adjustment slack adjusters that waste the spring's travel on free play, or oversized drums that reduce the shoe-to-drum contact — cannot convert the spring force into sufficient holding friction.

36. D — Out-of-round brake drums produce a pulsating braking force that varies with each wheel revolution as the drum's varying diameter alternately contacts and releases the shoes. The pulsation is transmitted through the brake shoes, slack adjusters, chambers, and air lines back to the chassis as a vibration. Unlike disc brake pulsation (which is felt primarily through the pedal), drum brake pulsation is often felt as a chassis vibration because the drum-to-shoe contact variation creates a variable retarding force at each wheel.

37. B — The sensor has been replaced but the fault persists. The static sensor test (resistance and gap) confirmed the new sensor is electrically functional. The next logical step is checking the sensor wiring for damage that causes the signal to degrade under the dynamic conditions of highway driving — vibration, heat cycling, and road spray. A wire with damaged insulation or broken internal strands may test normal when static but intermittently lose signal integrity when vibrated at highway frequency.

38. A — Installing a shut-off valve in the air supply to a brake circuit creates a single point of failure that can disable the entire primary brake circuit. If the valve is accidentally closed (by someone unfamiliar with the system, by vibration working the handle, or by dirt jamming the valve), the primary brakes cannot be replenished after each application. The driver uses the stored air for several stops until

the primary reservoir is depleted, then the primary brakes stop working entirely. Shut-off valves are never permitted in brake circuit supply lines.

39. C — Different application pressures between the front and rear circuits during a single foot valve application indicate a proportioning system is intentionally reducing the rear pressure. Many heavy-duty trucks use a proportioning or ratio valve on the rear circuit that limits rear brake pressure during light-to-moderate applications to prevent rear wheel lockup on an unloaded or lightly loaded vehicle. At higher application pressures (hard braking), the valve allows full pressure to the rear to take advantage of the weight transfer that loads the rear axle during hard stops.

40. D — All four drive axle brakes drag simultaneously, but the parking brakes release and the pushrod strokes are correct. The drag must be caused by residual service air trapped in the drive axle brake circuit. The relay valve exhaust may not be sealing fully (allowing a small amount of supply air to leak into the delivery side), the quick release valve may be stuck (preventing chamber air from exhausting), or the foot valve may have a leaking secondary piston that sends a constant low-level signal to the rear circuit.

41. A — The drum currently measures 16.480 inches with a maximum allowable of 16.500 inches. A machine cut to remove the heat checking will increase the drum's inside diameter. The technician has 0.020 inches of margin — the cut can remove up to 0.010 inches from each side (0.020 total increase in diameter) before the drum reaches the maximum. If the heat checking can be removed within this margin and the resulting surface is acceptable, the drum can be machined. If the heat checking is too deep, the drum must be replaced.

42. A — The intermittent buzzer activation during turns and lane changes, with adequate gauge pressure, suggests a marginal condition at the low-pressure switch. During sharp maneuvering, the air in the reservoir shifts (fluid dynamics of the compressed air), and the momentary pressure variation at the switch location may dip below the switch's activation threshold. Alternatively, a switch that is calibrated right at the threshold of the warning pressure may activate from minor pressure fluctuations that are amplified during vehicle maneuvering.

43. B — A single wheel locking during light applications on wet pavement while the ABS is functional and shows no codes for that wheel indicates a mechanical brake issue, not an ABS issue. The most likely cause is contaminated brake lining material — if the leading shoe has oil contamination while the trailing shoe is clean, the friction characteristics are inconsistent. The clean trailing shoe grabs suddenly while the contaminated leading shoe slips, creating an abrupt friction imbalance that overwhelms the ABS's ability to modulate smoothly.

44. A — The trailer's relay valve and the tractor's relay valves are separate components with independent calibrations. Each relay valve has a crack pressure — the minimum signal pressure required to open the valve and deliver air to the chambers. If the trailer's relay valve has a lower crack pressure than the tractor's relay valves, the trailer brakes begin to apply at a lower signal pressure (less pedal effort) than the tractor brakes. The driver perceives this as the trailer braking before the tractor.

45. D — The purge valve should only open during the compressor's unloading cycle, triggered by the governor's unload signal. A continuous air leak from the purge valve during the loading cycle means the valve is not sealing regardless of the governor's command. The most common cause is a worn or deteriorated valve seat or diaphragm that cannot close against the system pressure. This continuous leak wastes compressed air, reduces the effective compressor output, and prevents proper desiccant regeneration.

46. A — The tractor protection valve's purpose is to automatically isolate the tractor's air supply from the trailer when the trailer is disconnected or when system pressure drops below a safe threshold. If the valve has failed open, it does not close when the gladhands are disconnected, and the tractor's air escapes through the open gladhand ports. The air loss will continue until the system is depleted or until the failing valve eventually closes at a lower pressure, leaving the tractor with inadequate air for its own brakes.

47. D — The dead battery has 0 volts and likely infinite internal resistance. In a series circuit, all current must flow through every component — including the dead battery. If the dead battery cannot conduct (open circuit), the series pair it belongs to produces zero output. The starting system requires both series pairs to function at 24 volts. With one pair disabled, the system cannot produce 24 volts and the starter cannot crank. The 12-volt accessory system from the remaining good pair may function partially.

48. B — Pin 7 is the auxiliary power circuit that supplies the trailer ABS, not the tractor ABS. The tractor's ABS module communicates through the same CAN bus (Pins C and D) as the engine ECM. If the scan tool communicates with the engine ECM through Pins C and D but cannot reach the ABS module on the same bus, the issue is with the ABS module's power supply, ground, or its individual CAN bus connection — not with Pin 7, which is irrelevant to the tractor's ABS communication.

49. A — The speedometer reads 10% high compared to GPS-verified actual speed with original-size tires. The ECM calculates vehicle speed from VSS pulses multiplied by a calibration factor (tire revolutions per mile or per kilometer). If the calibration factor is incorrect — from a previous tire size change that was never reprogrammed, an incorrect ECM programming entry, or a data entry error during an ECM replacement — the calculated speed will differ from actual by a consistent percentage. Verifying and correcting the ECM's speed calibration parameters resolves the discrepancy.

50. C — A bad ground shared between the turn signal and marker lamp circuits causes the turn signal's current to seek an alternative ground path. When the turn signal activates, its current flows through the marker lamp filament to reach ground (because the direct ground path is blocked by the corroded connection). This current flowing backward through the marker lamp makes it act as a resistor in the turn signal's ground path, dimming the marker while the turn signal's voltage is consumed driving current through the marker filament rather than illuminating the turn signal.

51. D — Alternator output is directly proportional to the alternator's rotational speed. At idle, the alternator turns at a fraction of its maximum speed and produces proportionally less current. The 45-amp output at idle is expected because the alternator physically cannot generate more current at that low rotational speed. At 1,500 RPM, the output of 120 amps against the actual electrical loads is appropriate and within the alternator's capacity curve. The 160-amp rating represents maximum output at the alternator's rated RPM under maximum demand.

52. B — A fully charged battery at 12.6 volts that drops to 9.5 volts under cranking load has high internal resistance. The 3.1-volt drop means the battery's internal resistance is consuming voltage that should be available to the starter. Healthy batteries maintain voltage above 10.5 volts during cranking. The high internal resistance typically results from sulfated plates, degraded plate material, or electrolyte stratification — all conditions that allow the battery to show adequate resting voltage but fail under the heavy current demand of cranking.

53. A — Two simultaneous but contradictory symptoms — alarm sounding without reverse and lights not illuminating in reverse — indicate separate circuit faults. The alarm circuit has a short to ground that completes the alarm's ground path regardless of the reverse switch position, keeping it on continuously. The light circuit has an open that prevents current from reaching the lights when reverse is selected. These are two independent faults that happen to affect the same reverse-detection system but through different circuit paths.

54. A — A 5-metre copper wire should measure well under 1 ohm of resistance (typically 0.01 to 0.05 ohms depending on gauge). A reading of 15 ohms indicates the wire is severely compromised — internal corrosion has reduced the conductor's cross-section, broken strands have reduced the effective wire gauge, or a connector in the wire run has developed high-resistance corrosion. This resistance will create a significant voltage drop under the solenoid coil's current draw, potentially preventing the solenoid from energizing reliably.

55. C — The engine continues running without interruption, confirming the ECM and its power supply are unaffected. The momentary dashboard blackout is isolated to the instrument cluster's power circuit. An intermittent open in the cluster's dedicated power supply wire, fuse, connector, or ground causes the

cluster to lose power momentarily while the engine ECM (on a separate, unaffected circuit) continues normal operation. Identifying and repairing the intermittent connection in the cluster's power path resolves the blackout.

56. D — The charging voltage of 15.2 volts exceeds the maximum safe operating voltage for a 12-volt system (14.4 volts maximum). The overvoltage damages every component in the electrical system: batteries gas excessively and lose electrolyte, electronic modules receive voltage above their input protection rating and may fail, light bulbs burn hotter and fail prematurely, and any semiconductor device in the system may be destroyed. The voltage regulator has failed and must be repaired immediately to prevent system-wide electrical damage.

57. A — Both the resistance measurement (1,200 ohms, within the 900-1,400 ohm specification) and the AC voltage output (0.3 volts, above the 0.2 volt minimum) are within the manufacturer's specifications. The sensor is electrically functional. If the ABS fault persists despite a sensor that passes both electrical tests, the fault source is elsewhere — the wiring harness, the connector, or the reluctor ring must be inspected for damage or contamination that affects the signal quality during driving but not during a static bench test.

58. B — The fuel heater is controlled by a thermostat that closes (allowing current to flow to the heater element) when the temperature drops below the activation threshold. If the thermostat has failed in the open position, the circuit remains open regardless of temperature, and no current reaches the heater element. The fuse being intact confirms the circuit is not shorted — it simply has no current flow because the thermostat is not closing. Testing the thermostat for continuity at cold temperature confirms the diagnosis.

59. D — LED headlight assemblies have internal driver circuits that regulate the current to the LED elements. These driver circuits require a minimum input voltage to function correctly. Excessive voltage drop in the power or ground path between the battery and the LED assembly reduces the voltage reaching the driver below its optimal operating point. Even a small voltage reduction can cause the driver to limit its output, significantly reducing the light output. Voltage drop testing the right headlight's dedicated circuit identifies the resistance point.

60. B — The scan tool reads the correct RPM from the CAN bus data stream, confirming the engine ECM is broadcasting accurate data. The instrument cluster receives this same data but displays it 200 RPM high. The fault is internal to the cluster — either the tachometer's stepper motor driver is miscalibrated, the cluster's internal processing adds an offset, or the stepper motor has developed a mechanical position error. Since all other gauges are accurate, the CAN bus data is correct and the fault is isolated to the tachometer display function.

61. A — Both warning lamps illuminating and extinguishing simultaneously indicates a shared cause — not two independent faults. The CAN bus is the common communication path between the engine ECM, ABS module, and instrument cluster. When the bus drops out intermittently (from a loose connector, a damaged backbone wire, or a failing module), the cluster loses data from both the ECM and the ABS module simultaneously, illuminating both warning lamps. When the bus recovers, both lamps clear at the same moment.

62. C — Fog lamps are designed to produce a wide, low-mounted beam pattern that illuminates the road surface immediately ahead of the vehicle in fog, rain, or snow. High beams are designed for maximum forward distance illumination. When both are on simultaneously, the fog lamp beam reflects off fog/precipitation and creates glare that reduces visibility. Many vehicles are wired to automatically deactivate the fog lamps when high beams are selected because the conditions that require high beams (clear weather, long-distance visibility) are incompatible with fog lamp use.

63. D — The ambient air temperature sensor provides secondary data that the ECM uses for various optimization calculations — not for primary engine operation. When the sensor circuit opens, the ECM substitutes a default value (typically a moderate temperature like 20°C) that allows the engine to run normally under most conditions. However, the default value prevents the ECM from optimizing cold-start enrichment, aftertreatment temperature strategies, and cooling fan activation based on actual ambient conditions. The ECM stores the code to alert the technician.

64. B — An unfused wire connected directly to the battery has no overcurrent protection. If the wire or the connected device develops a short circuit, the only limit on current flow is the battery's ability to deliver current (which, for heavy-duty truck batteries, is hundreds of amps). The wire overheats rapidly, the insulation melts, and the bare conductor can ignite adjacent combustible materials. A properly sized fuse in the wire near the battery would interrupt the current before the wire reaches ignition temperature.

65. A — This paradoxical condition — motor runs in OFF, doesn't run in any speed position — indicates the switch's internal wiring is reversed or has a specific contact fault. In the OFF position, the switch contacts are routing power to the motor through an unintended path (possibly through the park circuit or a miswired contact). In the speed positions, the contacts that should route power to the motor through the speed resistors are all open or disconnected. The switch must be replaced.

66. D — The BCM monitors each lighting circuit's current draw and compares it to the expected draw for the number and type of bulbs on that circuit. When a bulb burns out, the current draw decreases by the amount that bulb was drawing. The BCM detects this current reduction and logs a fault code identifying the affected circuit. On many vehicles, the BCM also illuminates a dashboard indicator to alert the driver. This automated bulb-out detection is a key advantage of multiplexed lighting systems.

67. B — The starter continues to crank after the ignition switch returns to RUN because the solenoid's heavy-duty contacts have welded together. The contacts fused from the heat of repeated high-current switching. With the contacts welded, battery current flows directly to the starter motor continuously, regardless of whether the solenoid coil is energized by the ignition switch. The engine starts but the starter keeps spinning because the welded contacts cannot open. The battery must be disconnected immediately to stop the starter and prevent damage.

68. C — A consistent 4:00 AM voltage alert that resolves by 6:00 AM suggests a scheduled device activates around 4:00 AM and draws enough current to dip the battery voltage below the telematics alert threshold. Common examples include engine block heaters, coolant heaters, or battery warmers on timers set to activate 2 hours before the driver's 6:00 AM start time. The device completes its cycle, the current draw stops, and the battery voltage recovers before the driver arrives.

69. B — A transmission that jumps out of a specific gear during deceleration has a detent mechanism problem for that gear's shift rail. The detent (a spring-loaded ball that seats in a notch on the shift rail) holds the rail in the engaged position. Helical-cut gears produce an axial thrust force when transmitting torque — during deceleration, the thrust reversal pushes the rail toward neutral. A worn detent spring or a worn notch cannot resist this thrust force, and the rail slides out of position, disengaging the gear.

70. D — The TCM compensates for low main line pressure by increasing the aggressiveness of the shift solenoid commands. Under normal pressure, the TCM modulates the shift solenoids to gradually fill the clutch pack — applying pressure progressively for a smooth engagement. With low pressure, the TCM detects that the clutch packs are engaging too slowly (from the reduced clamping force) and increases the solenoid command rate to compensate. The result is a more abrupt, full-force application that produces the harsh shift feel.

71. C — A vibration that is present at all speeds but peaks at a specific speed range indicates a resonance condition. The driveshaft has a critical speed — the RPM at which the shaft's natural bending frequency equals its rotational frequency. At this speed, any imbalance is amplified by resonance, producing the maximum vibration intensity. Below and above the critical speed, the vibration exists but is not amplified by resonance. The solution is to verify the driveshaft's specifications match the vehicle's operating speed range.

72. A — A two-speed rear axle provides two gear ratios (high and low) at the drive axle. Combined with a 5-speed main transmission, each transmission gear can be used in either axle ratio: 1st-Low, 1st-High, 2nd-Low, 2nd-High, and so on through all five gears. This produces $5 \times 2 = 10$ selectable forward ratios. The driver selects the axle range using a dash switch, effectively doubling the number of available gear ratios without increasing the size or complexity of the main transmission.

73. B — Many AMTs have operating condition restrictions on manual mode — the feature may be disabled above or below certain vehicle speeds, during engine brake activation, during DPF regeneration, or when specific safety systems are active. The driver may be attempting to use manual mode in a condition where the TCU's software prohibits it. Checking the manufacturer's manual mode operating parameters identifies whether the driver's request falls outside the allowed range. No fault codes are generated because the TCU is functioning as programmed.

74. D — A single clunk from a stop that does not repeat during steady driving is the classic symptom of excessive ring and pinion backlash. When the vehicle starts from a stop, the pinion must rotate through the backlash gap before its teeth contact the ring gear teeth. The clunk is the impact of the pinion teeth against the ring gear teeth as the gap is taken up. During steady driving, the gears remain in contact under continuous torque and no clunk occurs because there is no torque reversal to reload the backlash gap.

75. C — A spongy clutch pedal that improves with pumping is the definitive symptom of air in the hydraulic line. Air is compressible — when the pedal is pressed, the air bubble compresses before the incompressible hydraulic fluid can transmit force to the slave cylinder. The spongy feel is the pedal travel consumed by the compressing air. Pumping the pedal pushes the air bubble to a position where it has less effect, temporarily restoring function. Bleeding the hydraulic system removes the trapped air and permanently restores a firm pedal.

76. A — The transfer case oil's dark brown color and burnt smell indicate it has been thermally degraded from sustained high temperatures. Operating a transfer case in 4WD on dry pavement creates driveline wind-up forces that are converted to heat inside the transfer case. The heat exceeds the oil's thermal stability, breaking down its molecular structure. The whine confirms the degraded oil can no longer provide adequate lubrication to the internal gear teeth and bearing surfaces. The oil must be replaced and the cause of the overheating addressed.

77. D — Engaging the inter-axle lock eliminates the differential action of the power divider — both drive axles are locked to the same speed. The worn components that were producing noise through their differential rotation (relative movement between the gears) stop rotating relative to each other when the lock is engaged, changing or eliminating the noise. This confirms the noise source is inside the power divider mechanism, specifically in components that rotate differentially when unlocked.

78. B — The splitter and range shifts on a heavy-duty transmission are both pneumatically assisted through separate air circuits. Slow splitter shifts with normal range shifts indicate the splitter's dedicated air system has a fault — a sluggish air valve, a restricted or leaking air line, or a worn splitter synchronizer. The range circuit is separate and unaffected. Inspecting the splitter air valve, its supply

line, and connections for leaks, restrictions, or slow valve response isolates the fault to the splitter's pneumatic system.

79. A — The TCM has detected that the 3rd gear clutch pack cannot hold and has adapted its shift strategy to skip the non-functional gear. Modern automatic transmission TCMs can learn from clutch slip detection and modify their shift schedules to avoid engaging a clutch pack that consistently slips. The absence of active fault codes may mean the adaptation occurred gradually and the slip events were within the TCM's adaptive range without triggering a code. Checking the TCM's adaptive data with the scan tool confirms the learned skip-shift.

80. C — When the transmission is in Drive at idle, the torque converter creates a fluid coupling between the engine and the transmission geartrain. This coupling transmits a small amount of torque to the planetary gears and clutch packs even though the vehicle is not moving. This light torque load causes the gear teeth to mesh under slight pressure, and the mesh vibration is transmitted through the fluid and housing as the buzzing noise. Shifting to Neutral disconnects the torque path through the converter, unloading the gears and eliminating the noise.

81. D — The PTO's electronic control module includes an RPM limit as a safety feature. The limit prevents the PTO from operating above a speed that could damage the PTO mechanism, the driven equipment (such as a hydraulic pump), or create a safety hazard from excessive rotational speed of the driven shaft or PTO driveline. When the engine RPM exceeds the programmed limit, the PTO controller automatically disengages the PTO to protect the equipment and personnel.

82. A — A rough, lurching clutch engagement that occurs regardless of pedal technique indicates the clutch disc's friction characteristics are too aggressive for the application. The wrong friction material — too high a coefficient of friction — causes the disc to grip suddenly rather than engaging progressively. The correct disc for the application uses a friction material that is engineered to provide smooth, progressive engagement matched to the engine's torque curve, the vehicle's weight, and the transmission's input characteristics.

83. C — The carrier bearing's rubber isolator mount has two functions: it centers the bearing on the crossmember and it dampens vibration. A hardened or cracked isolator cannot dampen the oscillation induced by bumps — the driveshaft bounces on the stiff mount and continues oscillating because the degraded rubber provides minimal damping. The vibration persists for several seconds because the driveshaft's rotational inertia sustains the oscillation without adequate damping to arrest it.

84. D — The transmission engages reverse (confirmed by the scan tool and shift lever position) but the vehicle moves forward. The transmission's internal clutch apply sequence is correct for reverse. The problem is downstream — a component between the transmission output and the wheels is inverting the rotation. This is rare but can occur from a misassembled drive gear, a failed reverse idler in the final drive, or an aftermarket PTO/transfer case configuration that reverses the output direction.

85. A — The reverse gear engagement relies on the sliding collar fully seating on the reverse idler gear's engagement teeth. If the collar teeth or the idler gear teeth are worn (rounded, chipped, or reduced in engagement depth), the collar can only partially engage — it sits on the worn teeth at a shallow depth that holds under light load but cannot resist the axial separating forces generated by the helical gear cut under moderate throttle. The thrust overcomes the shallow engagement and pushes the collar out of the gear.

86. A — Excessive steering free play is the total accumulation of wear at every connection point in the steering chain — from the steering wheel to the road wheels. Worn steering gear mesh, loose steering gear mounting bolts, worn drag link ball joints, worn tie rod ends, worn king pin bushings, and loose wheel bearings each contribute a small amount of free movement. The total free play is the sum of all individual wear points, and the result is a vague, imprecise steering feel with a noticeable dead zone at center.

87. D — The over-center adjustment controls the mesh tightness between the sector shaft teeth and the worm gear at the straight-ahead (center) position. If adjusted too tight, the teeth bind at center, creating mechanical resistance that the driver feels as a heavy spot when passing through straight-ahead. Off-center, the mesh loosens naturally because the sector shaft teeth are tapered, allowing normal assist during turns. The over-center adjustment must be set to a specification that balances minimal center free play with smooth passage through center.

88. B — Feathered wear on one steer tire only (not both) indicates the individual wheel toe on the affected side is different from the opposite side. Even if the total toe (the sum of both wheel angles) is within specification, the individual contribution of each wheel may be unequal. If the left wheel contributes more toe deviation than the right, the left tire scrubs sideways and feathers while the right tire runs straight and wears evenly. Individual wheel toe angles must be measured and equalized for uniform tire wear.

89. B — Gusset plates concentrate stress at their corners — the abrupt geometric change from the plate's stiffened area to the unstiffened frame creates a stress riser. Under the cyclic loading of normal operation (braking forces, suspension loads, torsional loads from turning), these concentrated stresses initiate microscopic cracks at the corner of the gusset. The cracks propagate with each loading cycle,

eventually extending into the frame web. This is a well-documented fatigue failure pattern at welded gusset plate attachments.

90. C — Air springs provide the load-carrying force, and shock absorbers control the rate at which the springs oscillate. A healthy suspension dampens a bump-induced oscillation within 1-2 cycles. Five to 6 cycles indicates the shock absorbers cannot dissipate the oscillation energy — the air springs bounce freely at their natural frequency with minimal resistance. Failed or worn shock absorbers are the most common cause of excessive ride oscillation and must be replaced to restore proper damping.

91. B — A pothole impact can generate forces exceeding the tire's structural capacity. The internal reinforcement cords (steel belts and nylon plies) that give the sidewall its structural strength are designed for inflation loads, not impact loads. A severe impact can fracture these cords at the impact point. The broken cords can no longer contain the inflation pressure at that location, and the rubber stretches outward under the internal pressure, forming the visible bulge. The tire is structurally compromised and must be replaced immediately.

92. D — New rotors are machined to precise specifications at the factory, but they can only be as true as the surface they mount on. If the hub face has corrosion, debris, a raised ridge, or any irregularity, the rotor mounts at an angle relative to the hub's true center. This creates lateral runout — the rotor wobbles during rotation, pushing the pads alternately inward and outward, producing the pulsation the driver feels through the pedal. Cleaning the hub face to a flat, smooth surface before rotor installation prevents this.

93. C — The height control valves function correctly, maintaining the specified distance between axle and frame. The lean only appears under load, suggesting the left-side suspension hardware allows the frame to deflect more on the left than the right. The most likely cause is a left-side height control valve linkage that is adjusted slightly differently from the right — under load, the linkage maintains a slightly different frame-to-axle distance that produces the visible lean. Equalizing the linkage adjustment on both sides eliminates the lean.

94. C — A vehicle that pulls to one side only during braking has an asymmetric braking force between the left and right sides. The vehicle pulls toward the side with the stronger brake. In this case, the pull to the right means the right brake is producing more force than the left — or equivalently, the left brake is producing less force than the right. The less effective left brake must be investigated for the condition that is reducing its output.

95. B — Grade 5 bolts have approximately 120,000 psi tensile strength versus Grade 8's approximately 150,000 psi — a 25-30% strength reduction. Fifth wheel mounting bolts must withstand the combined dynamic forces of a fully loaded trailer: vertical loads (trailer weight), fore-aft loads (braking and acceleration), and lateral loads (cornering). These forces are cyclic and can exceed static calculations during emergency maneuvers. Grade 5 bolts may stretch, fatigue, or fail under these dynamic loads at gross weight.

96. D — The height control valve sensing linkage determines the valve's position and therefore whether it adds air, vents air, or holds steady. If the linkage has excessive free play or a loose connection, the lateral weight transfer during a left turn shifts the linkage's position enough to open the valve to the exhaust port, venting air from that spring. When the turn is completed and the weight returns to center, the linkage returns to its neutral position and the valve stops venting. Tightening the linkage connection or replacing worn components resolves the issue.

97. A — When all tires on a tandem axle group wear on the same sides (inside-left, outside-right), the entire axle group is shifted laterally from the trailer's centerline. This lateral offset creates a thrust angle — the axles steer the trailer at a slight angle to its direction of travel. All tires on the offset group scrub in the same direction, producing the consistent same-side wear pattern across every tire position. The axle group must be re-centered on the trailer's frame.

98. C — A wheel bearing that consistently runs hotter than its counterpart, despite identical service and grease, has a condition that generates excess friction heat. The three primary causes are excessive bearing preload (tight adjustment), bearing damage (pitted rollers or races), and seal condition (a damaged or missing seal reduces lubrication). Additionally, a dragging brake on that side can transfer heat through the hub to the bearing area, but this would also be detectable through brake inspection.

99. B — The equalizer beam pivot bushing is designed to maintain a tight fit between the beam and its pivot pin. With 8 mm of vertical free play (versus the 3 mm maximum), the beam can shift excessively during load transfer between axles. This excessive movement produces a clunking noise over bumps, changes the effective wheelbase during suspension travel (causing tire scrub and accelerated wear), and can stress the frame at the beam mount point from the impact loading of the worn bushing bottoming out.

100. D — A dual tire pair that runs hotter than the other pair on the same axle, with equal tires and inflation, has an external heat source. The most common cause is a dragging brake — even a slight drag from a weak return spring, a seized anchor pin, or a slack adjuster that hasn't fully released generates continuous friction heat. This heat transfers through the drum to the hub and wheel, elevating the tire temperature above the non-dragging pair. The brake must be inspected for the drag source.

101. A — New king pins and bushings restore the original steering geometry — caster angle, steering axis inclination, camber, and the pivoting clearance that determines steering effort. Worn king pins had allowed the geometry to drift from the designed values over many kilometres of service. The restored geometry changes the steering feel back to the original characteristics, which the driver perceives as "lighter and quicker" because the reduced friction and corrected angles provide the steering response the vehicle was designed to deliver.

102. C — With both axles square to the frame and identical tires at equal pressures, a differential wear rate between the front and rear axles of a spread tandem suggests a load distribution difference. The front axle of the tandem may carry a disproportionate share of the load due to the king pin position relative to the tandem group center, causing its tires to wear faster. This is a common characteristic of spread tandem trailers and may be addressed through tire rotation between the two axle positions.

103. B — A steady drift to one side on a flat, straight road with matched tires narrows the cause to alignment parameters that create a directional bias. Unequal caster side-to-side creates a pull toward the side with less positive caster. Unequal camber creates a drift toward the side with more positive camber. Both parameters must be measured individually on each side and compared — the side-to-side difference determines which parameter is responsible for the rightward drift.

104. D — Windshield delamination separates the glass from the PVB (polyvinyl butyral) interlayer that bonds the two glass layers together. This interlayer is critical to the windshield's structural function — it maintains the windshield's shape during a rollover and supports airbag deployment forces. A 15 cm delaminated area in the driver's direct sight line impairs visibility (the cloudy area distorts the driver's view of the road) and compromises the windshield's structural contribution. The windshield must be replaced.

105. A — Transit buses often have separate HVAC systems for the driver's area and the passenger compartment. The passenger ventilation fan speed controller or resistor pack operates independently of the driver's controls. When the passenger speed controller fails, it defaults to the full-speed bypass circuit (the same principle as a failed blower resistor in any HVAC system). The driver's controls are on a separate system that is unaffected by the passenger controller's failure.

106. C — A heater that runs briefly then locks out has a combustion problem — it lights but cannot sustain the flame. A restricted exhaust pipe prevents the combustion gases from exiting the combustion chamber. Carbon buildup (common after summer storage) or a crushed/kinked exhaust outlet blocks the exhaust flow, suffocating the flame after the initial fuel charge burns through the available air. The heater's safety circuit detects the flame failure and locks out to prevent raw fuel from accumulating in the unburning combustion chamber.

107. B — Cab shock absorbers dampen the cab's oscillation on its air springs, just as chassis shock absorbers dampen the suspension's oscillation. When the cab shock absorbers fail, the cab bounces freely on its air springs. Highway speed provides the excitation input (road irregularities, drivetrain vibration) that triggers the oscillation, and the failed dampers cannot control it. At lower speeds, the excitation amplitude may be insufficient to trigger noticeable oscillation.

108. A — The power door lock actuator is a bidirectional motor (or a motor with internal gearing that allows both directions). If the motor or its gear mechanism can only rotate in one direction (lock) and has failed in the other direction (unlock), the lock function works but the unlock function does not. The manual lock mechanism bypasses the actuator entirely, operating the lock linkage through a direct mechanical connection that is independent of the motor.

109. C — A completely broken crossmember near the rear axle suspension mount compromises two critical functions: the frame's torsional rigidity (the crossmember connects the two frame rails and resists twisting) and the suspension mounting integrity (the suspension forces from that axle transfer through the crossmember to the frame). Without the crossmember, the remaining crossmembers bear additional load, the axle alignment may shift, and the frame can twist under dynamic loading.

110. A — The tractor delivers correct voltage at its auxiliary circuit, but the trailer's ABS ECU receives insufficient voltage to operate. The voltage loss occurs in the path between the tractor's connector and the trailer's ECU — corroded J560 pins, deteriorated trailer wiring, or a degraded ground path. Each high-resistance point drops voltage, and the cumulative loss along the trailer's aging wiring may reduce the voltage below the ECU's minimum operating threshold even though adequate voltage is available at the tractor's connector.

111. C — The vertical groove pattern (from top to bottom) is caused by large objects lodging between the load and the body sides during dumping. As the body tilts and the load slides downward, these trapped objects score the body wall vertically. Normal material sliding would produce horizontal or diagonal wear patterns from the material flowing across the surface. The vertical orientation of the grooves specifically indicates objects dragging downward between the body wall and the descending load.

112. B — The landing gear's worm gear mechanism is designed to be self-locking — the worm gear's helix angle is steep enough that the load (trailer weight) cannot drive the worm backward through the gear. When the worm gear teeth wear excessively, the helix angle effectively becomes shallower at the worn contact points, and the self-locking feature is compromised. The trailer's weight can now slowly back-drive the worn worm gear, retracting the legs under load.

113. C — The TRU ran continuously with no interruptions, and the temperature spike coincides with a delivery stop where the door was opened. Opening the trailer door introduces a large volume of warm ambient air that raises the cargo temperature rapidly. The TRU continued running and eventually pulled the temperature back to setpoint, but the thermal load from the door opening produced the recorded spike. Proper pre-cooling, rapid door operations, and strip curtains minimize warm-air intrusion during door openings.

114. B — All four air springs should have a similar profile at the same pressure and ride height. One spring that appears significantly wider than the others has a structural problem — the rubber bellows is stretching beyond its designed profile because the rubber has weakened, the internal reinforcement cords have deteriorated, or the rubber has degraded from ozone exposure. The spring may be at the correct height, but its ballooning profile indicates it is approaching rupture. It must be replaced preventively.

115. D — All driver's side lamps being equally dim while the passenger side is normal indicates a common resistance point affecting the entire driver's side. A high-resistance ground connection or a corroded wiring junction that serves as the common path for all driver's side lamps creates a voltage drop that reduces the voltage available to every lamp on that side. Replacing individual bulbs does not correct the problem because the voltage drop occurs upstream of the lamps in the shared wiring or ground path.

116. B — A winch ratchet that cannot hold tension is a cargo securement failure. If the strap tension is released during transport — from the ratchet releasing on a bump, during braking, or during cornering — the cargo can shift, fall from the trailer, or strike other vehicles. This is a safety hazard that requires immediate correction. The winch mechanism must be repaired or replaced before the trailer is loaded and operated.

117. C — Frost on the suction line between the expansion valve and the evaporator indicates liquid refrigerant is present in the suction line — it is evaporating after exiting the evaporator rather than fully vaporizing inside it. The expansion valve is metering too much refrigerant into the evaporator, flooding it with more liquid than the airflow can evaporate. The excess liquid passes through the evaporator and continues evaporating in the suction line, cooling the line below the dew point and forming frost.

118. A — The thermostat is partially open — enough to allow some coolant flow to the radiator (keeping the engine below normal operating temperature) but not stuck fully closed (which would cause overheating). The coolant temperature, while below the gauge's normal range, is still well above ambient and hot enough to provide effective cabin heating through the heater core. The gauge reads low because the engine isn't reaching its full operating temperature, but the heater produces adequate heat because the coolant is still hot.

119. D — The aftermarket electronic expansion valve floods the evaporator during highway driving because its controller or temperature sensor is not calibrated for the system's specific evaporator. At highway speed, the compressor turns faster and moves more refrigerant. The OEM thermostatic expansion valve was matched to the evaporator and modulated flow correctly at all compressor speeds. The aftermarket electronic valve opens too wide at higher flow rates, flooding the evaporator and dropping its temperature below freezing.

120. B — The long coolant hose run to the rear heater core creates more flow resistance than the short run to the front heater. At highway RPM, the water pump produces enough flow and pressure to push adequate hot coolant through the long rear hose and its restrictions. At idle, the pump's reduced output cannot maintain the same flow rate through the long, restrictive path. The reduced flow means less heat transfer at the rear core, producing only lukewarm air. A larger-diameter supply hose or an auxiliary coolant pump resolves the issue.

121. B — Low-side much lower than normal + high-side much higher than normal with a functioning condenser fan = a restriction in the liquid line between the condenser and the expansion valve. The restriction blocks refrigerant flow — upstream of the restriction, refrigerant backs up and pressure rises (high side elevated); downstream, the evaporator is starved of refrigerant and pressure drops (low side depressed). Common restriction sources include a kinked liquid line, a contaminated filter-drier, or a blocked screen at the expansion valve inlet.

122. D — The clicking every 3-4 seconds is the compressor clutch engaging and disengaging as the low-pressure switch cycles. A low refrigerant charge causes the suction pressure to drop below the switch's cut-out threshold shortly after the compressor starts. The switch opens, the compressor stops, pressure equalizes back above the cut-in threshold, the switch closes, and the compressor restarts. This rapid cycling produces the rhythmic clicking and intermittent cooling that the driver notices.

123. B — A vacuum test confirms the system is sealed under vacuum (negative pressure) conditions. However, some leaks only open under positive pressure — a Schrader valve core that seats against vacuum but lifts off its seat under pressure, or an O-ring that compresses and seals under vacuum but relaxes and leaks under positive pressure. The vacuum test is not a substitute for a pressure leak test. After charging, the system must be tested for leaks using an electronic detector, UV dye, or soap solution under operating pressure.

124. C — Full system pressure at the valve port with no cylinder movement indicates the cylinder cannot convert hydraulic pressure to mechanical motion. If the piston has separated from the rod, the piston just floats inside the barrel and fluid passes around it without producing linear force. If the piston seal is completely missing, fluid bypasses freely without pressurizing either side of the piston. The

directional valve is shifting correctly and delivering pressurized fluid, but the cylinder itself cannot use it.

125. A — A truly pressure-compensated flow control valve maintains constant flow regardless of load-induced pressure changes. If the boom slows under maximum load, the compensating element inside the valve has failed (a stuck compensator spool or a broken compensator spring), or the system pressure under maximum load is reaching the relief valve setting. At the relief setting, no additional pressure is available to create the differential needed for flow, and the flow drops below the valve's compensated range.

126. D — Isolating the cylinder from the directional valve stopped the drift. This eliminates the cylinder's piston seal as the leak source (if the piston seal were leaking, the drift would continue with the ports plugged). The drift was caused by fluid crossing through the valve spool's internal clearance from the cylinder's pressurized work port to the tank port. When the cylinder was isolated, the leak path through the valve was disconnected and the cylinder held its position.

127. B — Case drain flow on a hydraulic pump represents the pump's internal leakage — fluid that bypasses the pumping elements through worn clearances rather than being pumped to the discharge port. On a 20 gpm pump, 3 gpm of case drain means 3 gpm is being lost internally, leaving approximately 17 gpm of useful output. This represents 85% volumetric efficiency (17/20). The manufacturer's minimum efficiency specification determines whether the pump is acceptable for continued service.

128. D — Air in the hydraulic system makes the fluid compressible. When the operator positions the boom and releases the controls, the compressible fluid alternately compresses and expands under the load's weight. The load drops slightly as the air compresses, then bounces back as the air expands, creating an oscillation that continues until the energy is dissipated. An air-free, incompressible fluid would hold the boom rigidly in position. The air source must be identified and eliminated.

129. A — A Hi-Lo (high-low) system uses two pumps optimized for different operating phases. The high-volume, low-pressure pump provides rapid cylinder travel during the approach phase (moving the actuator quickly to the work position). When the load increases and system pressure rises above the low-pressure pump's rating, an unloader valve dumps the low-pressure pump's output to tank (protecting it from overpressure) and the high-pressure pump alone provides the force for the heavy work at reduced speed.

130. D — A relief valve that squeals at the set pressure has a contaminated seat or a worn poppet that cannot maintain a clean seal at the set point. The contamination or wear causes the poppet to oscillate

rapidly between the open and closed positions (chatter) as it attempts to regulate pressure at the threshold where it should smoothly crack open. The high-frequency chattering produces the audible squeal. Cleaning the valve seat or replacing the valve restores quiet, stable pressure regulation.

131. B — ATF and AW-46 hydraulic oil are different products with different specifications. ATF (typically ISO 10-15 viscosity) is significantly thinner than AW-46 (ISO 46 viscosity). The thinner ATF cannot maintain the lubricating film thickness that AW-46 provides between the pump's internal surfaces and the valve spools, causing accelerated wear. ATF's additive package may also be incompatible with the system's seal materials, potentially causing seal swelling, shrinkage, or deterioration. The system must be drained, flushed, and refilled with the correct AW-46 fluid.

132. C — The VCU manages the battery's state of charge within a specific operating window to protect battery health. The engine-start threshold is higher than the "empty" indicator — the VCU commands the engine to start when the SOC drops below a threshold (typically 30-40%) that the battery gauge may still show as "adequate." This prevents the battery from deep-cycling, which dramatically reduces lithium-ion battery lifespan. The engine runs until the generator recharges the battery above the threshold.

133. D — Winter range reduction in BEVs results from multiple compounding factors. Cold temperatures increase the battery's internal resistance (requiring more energy for the same output) and reduce its usable capacity. The cabin heater draws energy directly from the battery (unlike ICE vehicles where cabin heat is free waste heat). Cold tires have higher rolling resistance. Denser cold air increases aerodynamic drag. Each factor individually reduces range, and their cumulative effect produces the significant 30-40% range reduction commonly observed in severe cold.

134. A — The minimum insulation resistance is calculated as 500 kΩ/V × 600V = 300,000 kΩ = 300 MΩ (300 megohms). The measured 200 kΩ (0.2 MΩ) is approximately 1,500 times below the minimum requirement. This extremely low insulation resistance means the high-voltage system's insulation from the chassis has severely degraded, creating a shock hazard for anyone touching the vehicle's chassis or body while the high-voltage system is energized. The pack must be immediately removed from service.

135. B — The ground fault error occurs only at one specific charging station, not at others. The truck charges normally elsewhere, confirming the truck's onboard charger and its ground fault detection circuit are functional. The specific station has a fault in its wiring, EVSE, or ground connection that introduces a current leakage to ground. The truck's onboard charger correctly detects this external ground fault through its protection circuit and stops charging as a safety measure. The charging station must be inspected and repaired.