PRACTICE EXAM 12: RED SEAL 310T SIMULATION (135 QUESTIONS)

1. A technician is using a bench grinder to sharpen a cold chisel. The technician positions the chisel on the tool rest and begins grinding. Halfway through the operation, the chisel catches between the grinding wheel and the tool rest and is violently ejected from the technician's hands. What caused this incident?

A. The grinding wheel was rotating in the wrong direction for the type of chisel being sharpened

B. The cold chisel's hardened steel created excessive friction with the grinding wheel surface

C. The grinding wheel had not been trued and dressed before the operation, causing an uneven surface

D. The gap between the grinding wheel and the tool rest was too wide — the maximum allowable gap is 3 mm (1/8 inch); a wider gap allows the workpiece to be pulled into the space between the wheel and the rest, where the wheel's rotation ejects the piece violently; adjusting the tool rest to within 3 mm of the wheel face before every grinding operation prevents this entrapment

2. A technician is welding a repair bracket onto a truck frame using a MIG welder. The welding area is near the vehicle's fuel tank, which has been removed. However, the fuel supply and return lines are still connected to the frame-mounted fuel filter bracket 300 mm from the weld location. What safety step must be taken before welding?

A. Verify the fuel filter is empty by loosening the drain plug and checking for fuel flow

B. The fuel lines must be disconnected, capped, and moved away from the welding heat zone — residual diesel fuel in the lines and filter can ignite from the radiant heat, sparks, or spatter from the welding operation at 300 mm proximity; even capped lines should be relocated to a distance where they cannot be exposed to welding heat

C. Wrap the fuel lines and filter with a wet shop towel to absorb heat during the welding operation

D. Apply a fire-retardant spray to the fuel lines before beginning the welding operation to prevent ignition

3. A shop has a spill containment plan posted on the wall. During a routine transmission fluid change, a technician accidentally drops the drain pan and approximately 20 litres of ATF spills across the shop floor. What is the correct immediate response?

A. Stop the spill from spreading by containing it with absorbent material (floor-dry, absorbent pads, or booms), prevent the fluid from reaching floor drains, clean up the absorbed material, and dispose of it as used petroleum product according to the shop's waste management procedure — the spill creates a slip-and-fall hazard for all shop personnel and an environmental risk if it reaches the drain system

B. Mop the fluid with water and allow the diluted mixture to flow into the floor drain for disposal

C. Cover the spill with cardboard and continue working — the cardboard absorbs the fluid and can be disposed of in the general waste bin at the end of the shift

D. Leave the spill for the shop's cleaning service to handle at the end of the business day

4. A technician is servicing the high-pressure air conditioning system on a transit bus. The system operates at pressures exceeding 300 psi on the high side during warm weather. What qualification is required before the technician can service this system?

A. No special qualification is needed beyond the technician's standard 310T certification for working on truck and coach systems

B. A separate high-pressure vessel certification is required because A/C systems exceeding 200 psi fall under pressure vessel regulations

C. The technician must hold a valid refrigerant handling certification (ODS/HFC certificate) that covers the identification, recovery, recycling, and safe handling of the specific refrigerant used in the system

D. A provincial electrical license is required because the A/C compressor is electrically driven on transit buses

5. A technician discovers a crack in the shop floor near the vehicle lift's anchor bolts. The crack extends approximately 500 mm from the nearest anchor bolt in a diagonal line. What is the concern?

A. The crack will allow moisture to penetrate beneath the floor slab and corrode the lift's anchor bolts from underground

B. The crack is cosmetic and does not affect the lift's structural integrity as long as the anchor bolts are tight

C. The crack will trip technicians walking near the lift and should be filled with concrete patch material

D. The cracked concrete around the lift anchor may compromise the lift's foundation — vehicle lifts exert enormous forces on their anchor bolts during operation, and the concrete foundation must resist these forces without shifting or cracking; a crack extending from the anchor bolt suggests the concrete is failing under the lift's loads, and the lift should be taken out of service until the foundation is inspected and repaired by a qualified structural contractor

6. A technician is using a propane torch to heat a frozen fitting on a brake line. What specific risk does this heating method create for the brake system?

A. The propane flame can heat the brake line beyond 300°C and anneal (soften) the steel tubing, permanently weakening it

B. The heat from the torch can damage the brake fluid inside the line — if the brake line contains fluid, the localized heating boils the fluid and creates a vapor pocket; additionally, the torch heat can damage the line's internal coating, weaken the tubing wall, or ignite any grease or petroleum residue on the fitting surface

C. The propane combustion products can contaminate the brake fluid through the heated fitting threads

D. The torch can ignite the rubber brake hose connected downstream of the heated fitting

7. A new apprentice asks why the shop uses red-tagged lockout devices on equipment being serviced. What is the purpose of a lockout/tagout device in a truck repair shop?

A. A lockout device physically prevents a piece of equipment from being energized or activated while a technician is working on it — the device ensures that the energy source (electrical, pneumatic, hydraulic, or mechanical) cannot be restored by another person who may not know the equipment is being serviced; the tag identifies who applied the lock and why, providing personal accountability

B. The red tag identifies equipment that has been condemned and is awaiting disposal from the shop

C. The lockout device is a quality control marker that indicates the equipment has been inspected and approved for use

D. The red tag is a regulatory compliance marker required by Transport Canada for all commercial vehicle service equipment

8. A technician is inflating a tire that has been mounted on a single-piece rim. The tire bead seats with a loud pop at 30 psi. The technician continues inflating to the specified 110 psi. What safety precaution must be followed during this inflation?

A. The technician should stand to the side of the tire during inflation in case the rim flange separates under pressure

B. The technician should inflate the tire in 20 psi increments, pausing between each increment to listen for unusual sounds

C. The tire must be inflated inside a safety cage or with a clip-on chuck and an extension hose that allows the technician to stand at a safe distance — a tire/rim assembly can fail explosively during inflation from a defective rim, an improperly seated bead, or a damaged tire; the cage contains the explosive force, and the extension hose places the technician outside the trajectory zone

D. The tire should be submerged in water during inflation so that any leak is immediately visible as bubbles

9. A heavy-duty diesel engine has a condition where the engine produces full power but the exhaust is noticeably darker than normal under load. All sensors read correctly, boost pressure is at specification, and no fault codes are present. The engine has 500,000 km. What is the most likely cause of the darker-than-normal exhaust?

A. The fuel quality has degraded from contamination with a heavier petroleum fraction that does not atomize as completely

B. The EGR system is flowing slightly more exhaust gas than commanded, diluting the intake charge marginally

C. The DPF substrate has degraded and is no longer filtering the exhaust particulate matter as efficiently as when new

D. Gradual injector nozzle wear has enlarged the spray hole diameters over 500,000 km — the larger holes produce coarser fuel droplets that do not atomize as finely as the original specification, resulting in marginally less complete combustion that produces slightly darker exhaust without affecting the total power output or triggering sensor-detectable performance deviations

10. A technician is performing a cylinder contribution test on a six-cylinder diesel engine using the scan tool. The test reveals that cylinder 4 has a contribution value of zero — it is not contributing any power to the engine's output. The engine runs on the remaining five cylinders with a noticeable miss. What is the most efficient diagnostic sequence to determine why cylinder 4 is dead?

A. Remove the cylinder 4 injector and perform a bench test to verify its spray pattern and delivery volume

B. First verify the injector is receiving its electrical command from the ECM (check the injector circuit for power, ground, and the ECM's drive signal); if the circuit is functional, swap the cylinder 4 injector with an adjacent cylinder's injector — if the dead cylinder moves with the injector, the injector is at fault; if cylinder 4 remains dead, perform a compression or leakage test to check the cylinder's mechanical condition

C. Perform a compression test on all six cylinders to establish whether the dead cylinder has a mechanical failure

D. Remove the valve cover and inspect the cylinder 4 valve train for a broken rocker arm or a collapsed lifter

11. A heavy-duty diesel engine has a condition where the oil pressure is adequate at operating temperature (45 psi at 1,500 RPM) but the oil pressure at cold startup reads 90 psi — significantly higher than the 60-70 psi typical cold pressure. What does the abnormally high cold pressure indicate?

A. The oil is a higher viscosity than specified for the engine — the thicker oil creates more resistance to flow through the engine's oil passages at cold temperature, producing higher-than-normal pump output pressure; as the oil warms and thins, the pressure drops to the normal operating range; the wrong viscosity accelerates cold-start wear because the thick oil cannot reach tight clearances as quickly

B. The oil pump relief valve spring is too stiff and is holding the valve closed longer than designed during cold operation

C. The oil filter bypass valve is stuck closed, forcing all oil through the filter element and creating excessive pressure

D. The oil cooler thermostat is stuck closed, blocking the oil cooler circuit and increasing the system's total resistance

12. A diesel engine equipped with a DPF has completed a forced regeneration using the scan tool. Immediately after the regeneration, the technician checks the DPF backpressure and finds it has decreased from the pre-regeneration value but has not returned to the baseline (new DPF) value. What explains the remaining elevated backpressure?

A. The regeneration was incomplete and needs to be run again at a higher exhaust temperature to burn the remaining soot

B. The DPF substrate has been thermally damaged from excessive regeneration temperatures and has partially melted

C. The remaining elevated backpressure is from accumulated ash — soot was burned during regeneration, but ash (the non-combustible metallic residue from engine oil additives) remains in the DPF channels and cannot be removed by regeneration; the ash accumulation represents the permanent component of DPF loading that requires periodic off-vehicle cleaning

D. The DPF's differential pressure sensor needs recalibration after every regeneration event to account for the changed soot loading

13. A heavy-duty diesel engine has a condition where the engine produces a whistling noise during acceleration that is not present at idle or during deceleration. The noise pitch increases with engine speed. The turbocharger has been inspected and is functioning correctly. What is the most likely source?

A. The exhaust brake butterfly valve has a worn seal that produces a whistle when the exhaust flow velocity increases during acceleration

B. The intake air filter element has a torn section that vibrates and whistles as the airflow velocity increases during acceleration

C. The engine's crankshaft front seal has developed a leak that draws air inward during the intake stroke, producing the whistle

D. A small crack, a loose clamp, or a damaged gasket in the pressurized intake ducting between the turbocharger compressor outlet and the intake manifold — the boosted air escaping through the leak produces a whistle that increases in pitch and volume with engine speed because the boost pressure and airflow velocity increase during acceleration; at idle and deceleration, the boost is minimal and the leak is inaudible

14. A diesel engine's cooling system uses a degas bottle (pressurized expansion tank) as the highest point in the system. The technician notices that the coolant level in the degas bottle drops slowly over time, but no external leaks are visible and the oil is clean. What diagnostic test can definitively determine if the coolant is leaking internally?

A. A dye test using UV-fluorescent dye added to the coolant, then checking the exhaust with a UV light for fluorescent traces

B. A cooling system pressure test combined with a combustion gas test (block tester) — the pressure test confirms the system holds pressure externally, and the block tester detects combustion gas in the coolant, which confirms an internal breach between a combustion chamber and the cooling system

C. An infrared exhaust analysis looking for elevated CO_2 levels that would indicate coolant burning in the cylinders

D. A radiator cap pressure test to verify the cap is holding its rated pressure and not venting coolant past the cap seal

15. A heavy-duty diesel engine equipped with a HEUI fuel injection system has a condition where the engine's power output decreases as the engine oil temperature increases. At cold oil temperature, the engine produces full rated power. At normal operating oil temperature, the engine produces approximately 85% of rated power. What is the most likely cause?

A. The HEUI system uses high-pressure engine oil to actuate the injectors — as the oil temperature rises, the oil viscosity decreases and the high-pressure oil pump's volumetric efficiency drops because the thinner oil leaks past the pump's internal clearances more rapidly; the reduced pump efficiency at operating temperature produces lower injection control pressure (ICP), which reduces the injector's fuel delivery capability

B. The engine's combustion efficiency decreases at operating temperature because the hot cylinder walls reduce the compression ratio

C. The ECM intentionally derates the engine at operating temperature to protect the HEUI pump from thermal damage

D. The fuel temperature rises proportionally with the oil temperature, reducing the fuel's energy density at higher temperatures

16. A diesel engine has a condition where the engine starts normally but the idle speed is 100 RPM higher than the specified cold idle speed. The engine is cold (ambient temperature). The accelerator pedal is fully released. No fault codes are present. What is the most likely cause?

A. The idle speed set point in the ECM has been reprogrammed higher than the factory specification

B. The throttle position sensor is reading slightly above zero at the rest position, causing the ECM to add fuel for the perceived throttle input

C. The engine coolant temperature sensor is reading warmer than the actual temperature, causing the ECM to apply the warm-idle fuel map instead of the cold-idle map

D. The engine's cold idle speed is set by the ECM based on the coolant temperature sensor input — if the sensor reads warmer than the actual cold temperature, the ECM applies the warm-idle fuel quantity (which produces a higher RPM) instead of the cold-idle enrichment; the 100 RPM elevation matches the difference between the cold and warm idle calibrations

17. A diesel engine's intake manifold has a pressure reading of 3 psi at idle. The specification for this naturally aspirated engine at idle is −2 to −4 inches of mercury (vacuum). What does the positive pressure reading indicate?

A. The engine has a failed head gasket that is pressurizing the intake manifold with combustion gases from an adjacent cylinder

B. The engine's valve timing has shifted, causing the intake valve to close late and the compression stroke to push air back into the manifold

C. The engine has a turbocharger installed as an aftermarket modification that was not accounted for in the original specification — a turbocharged engine produces positive pressure (boost) in the intake manifold at all operating conditions including idle; the specification for vacuum at idle applies to a naturally aspirated engine; if this engine has been turbocharged, positive manifold pressure at idle is expected

D. The crankcase ventilation system is pressurizing the intake manifold through the CCV connection from excessive blow-by

18. A heavy-duty diesel engine has a diagnostic trouble code for "Fuel Pressure Regulator — Response Too Slow." The engine runs but has sluggish throttle response and occasional hesitation during rapid throttle changes. What does "response too slow" mean?

A. The fuel pressure regulator is not adjusting the rail pressure quickly enough to follow the ECM's commanded pressure changes — the ECM commands rapid pressure increases during acceleration and rapid decreases during deceleration, and the regulator's mechanical response is lagging behind the commands; worn valve components, contamination restricting valve movement, or a weak actuator cause the sluggish response

B. The fuel pressure sensor is slow to report pressure changes to the ECM, making the regulator appear slow

C. The fuel return line has a restriction that prevents the regulator from reducing pressure quickly during deceleration events

D. The ECM's fuel control algorithm has a software bug that sends pressure commands faster than the regulator was designed to follow

19. A diesel engine's turbocharger produces adequate boost pressure but the compressor inlet filter (the air filter) is loading at twice the normal rate — requiring replacement every 15,000 km instead of the normal 30,000 km. The operating environment has not changed. What should be investigated?

A. The turbocharger compressor for excessive oil leakage past the compressor seal that is coating the air filter from the clean side with oil

B. The air intake system for a leak between the filter and the turbocharger compressor inlet — a cracked duct, a loose clamp, or a missing gasket allows unfiltered air to be drawn in downstream of the filter, and the resulting turbulence creates a pressure differential that draws additional dust through the filter element from the clean side; additionally, the unfiltered air bypass introduces contaminants directly into the turbocharger and engine

C. The exhaust system for a leak upstream of the turbocharger that is reducing the turbine's exhaust energy

D. The charge air cooler for a restriction that is creating backpressure on the compressor and increasing the pressure differential across the air filter

20. A heavy-duty diesel engine equipped with an EGR system has a condition where the EGR valve is coked shut — completely blocked with carbon deposits. The driver has been operating the truck primarily in low-load city delivery service for the past 6 months. What operating condition promoted the excessive carbon buildup?

A. The city delivery service rarely produces exhaust temperatures high enough for the EGR gas to remain in a gaseous state — the cool, low-temperature exhaust gas condenses and deposits its carbon content (soot, unburned hydrocarbons) on the EGR valve, cooler, and intake manifold surfaces; sustained highway driving with higher exhaust temperatures keeps the EGR gas hot enough to pass through the system without depositing, and the higher temperatures can burn off light deposits before they harden

B. The EGR system is designed to operate only during highway cruising and the city driving has worn the valve mechanism

C. The fuel used for city delivery has a higher sulfur content that produces more soot than highway diesel fuel

D. The city driving's frequent stop-and-start cycling causes the EGR valve to open and close thousands of additional times, mechanically wearing the valve into the stuck position

21. A diesel engine has a condition where the engine oil turns jet black within hours of an oil change, even though the engine has been recently overhauled and has minimal blow-by. The oil used is the correct specification. What is the most likely cause of the rapid discoloration?

A. The oil filter is counterfeit and is not capturing the combustion soot that darkens the oil

B. The engine's crankcase was not thoroughly cleaned during the overhaul, and residual sludge and carbon deposits from the old oil are dissolving into the new oil — the new oil's detergent and dispersant additives are designed to clean and suspend contaminants, and they are actively dissolving the residual deposits and incorporating them into the new oil

C. The rapid discoloration is completely normal for a diesel engine — diesel combustion produces soot as a natural byproduct regardless of engine condition, and the oil's dispersant additives are specifically designed to capture and suspend this soot; black oil within hours confirms the additives are working

D. The engine oil cooler was not flushed during the overhaul and the old, contaminated oil remaining in the cooler has mixed with the new oil

22. A heavy-duty diesel engine's water pump drive belt squeals during cold startup but quiets within 30 seconds. The belt tension and alignment have been verified as correct. What is causing the temporary squeal?

A. The belt rubber contracts in cold temperature and becomes stiff — the reduced flexibility prevents the belt from conforming to the pulley groove profile for the first few seconds until the belt warms from friction and flexing; this is a characteristic behavior of serpentine and V-belts in cold weather and typically does not indicate a fault unless it persists beyond the initial warm-up or the belt shows signs of glazing

B. The water pump bearing seizes momentarily during cold startup until the lubricant warms and flows

C. The alternator's field current draw is highest during cold startup (to charge the cold batteries quickly) and the increased load causes the belt to slip momentarily

D. Condensation on the belt surface from overnight parking creates a temporary loss of friction that produces the squeal until the moisture evaporates

23. A diesel engine equipped with a DOC, DPF, and SCR aftertreatment system has a condition where the SCR inlet temperature is 50°C lower than expected for the current engine operating condition. The DOC outlet temperature and DPF outlet temperature are both at the expected values. What is causing the heat loss between the DPF and the SCR?

A. The SCR catalyst has absorbed the heat from the exhaust gas, masking the true inlet temperature from the sensor

B. The exhaust pipe between the DPF and the SCR has degraded insulation or a missing heat shield — the exhaust gas loses heat to the ambient air through the uninsulated pipe section; adequate insulation is critical because the SCR catalyst requires a minimum temperature to convert NOx efficiently, and excessive heat loss in the connecting pipe can drop the gas temperature below the catalyst's effective operating range

C. The DEF dosing injector is spraying excessive DEF that absorbs heat from the exhaust stream before it reaches the SCR inlet sensor

D. The SCR inlet temperature sensor has developed a calibration offset that reads 50°C lower than the actual temperature

24. A heavy-duty diesel engine has a condition where the engine produces a loud, metallic clattering noise from the top of the engine during the first 10 seconds after startup, then the noise disappears completely. The noise does not return during the remainder of the operating cycle. What is the most likely cause?

A. The turbocharger bearings are dry during initial startup and produce a clatter until oil pressure reaches the bearings

B. The crankshaft end play is excessive and the crankshaft shifts position during the first few revolutions before the thrust bearing loads

C. The timing gears have excessive backlash that produces a rattle until oil pressure provides hydraulic dampening to the gear mesh

D. The hydraulic valve lash adjusters (lifters) have drained down during the engine-off period — the adjusters are oil-filled devices that maintain zero valve lash; when the engine is off, the oil slowly leaks from the adjusters through their internal check valves; upon startup, the drained adjusters have excessive clearance and the valve train clatters until oil pressure refills the adjusters (typically 5-15 seconds)

25. A diesel engine's aftertreatment system has a condition where the DEF dosing injector is coking repeatedly — the injector tip builds carbon deposits that must be cleaned every 30,000 km. The normal cleaning interval is 150,000+ km. What operating condition accelerates the coking?

A. The DEF quality is out of specification and the non-standard urea concentration leaves more residue on the injector tip

B. The engine operates at sustained low loads that produce exhaust temperatures too low for the DEF to fully decompose

C. The dosing injector is experiencing sustained high exhaust temperatures that evaporate the DEF before it can spray properly — the extreme heat bakes the urea residue onto the injector tip, progressively building a carbon-like deposit that restricts the spray orifice; this occurs when the injector is exposed to exhaust temperatures above its designed operating range for extended periods

D. The DEF tank heater is overheating the DEF before it reaches the dosing injector, causing premature decomposition in the supply line

26. A diesel engine's oil analysis has shown a sudden spike in silicon (from 12 ppm to 55 ppm) and iron (from 25 ppm to 80 ppm) in the same sample. What is the significance of both silicon and iron increasing together?

A. Silicon indicates dirt ingestion (silicon is the primary component of soil), and the simultaneous iron increase confirms the ingested dirt is causing abrasive wear on the engine's iron components (cylinder liners, gears, and bearing surfaces) — the two metals appearing together confirm a cause-and-effect relationship: dirt entered the engine and is now abrading the internal surfaces

B. Silicon comes from silicone gasket sealant used during a recent repair, and the iron comes from the normal wear metals that were already trending upward

C. Both metals are from coolant contamination — the coolant additive package contains silicon-based inhibitors and the iron is from coolant-induced corrosion of the cooling system

D. The silicon is from the oil additive package breaking down, and the iron is from accelerated bearing wear caused by the depleted additives

27. A heavy-duty diesel engine has a condition where the engine produces a puff of white smoke during cold startup that clears within 2 minutes. The engine operates normally after warm-up with no smoke at any other operating condition. No fault codes are present. What is the most likely cause?

A. The fuel injectors are leaking a small amount of fuel into the cylinders during the engine-off period, and the accumulated fuel vaporizes as white smoke during the first startup combustion events

B. The cold engine's cylinders are below the autoignition temperature for the first several combustion events — the cold cylinder walls absorb heat from the compressed charge, preventing the fuel from fully igniting; the unburned fuel vapor exits the exhaust as white smoke until the cylinder temperatures rise enough for complete combustion; this is normal cold-start behavior for diesel engines, especially in cold ambient temperatures

C. Coolant is leaking into one cylinder from a head gasket seep that only opens when the engine is cold and the head bolts are at their minimum clamping force

D. The engine's glow plug or intake air heater system is not activating during startup, causing incomplete combustion

28. A diesel engine equipped with a fuel-water separator has a condition where the water-in-fuel warning activates immediately after every fuel fill. The warning clears after the truck has been driven for approximately 30 minutes. What is the most likely cause?

A. The fueling process introduces turbulence in the fuel tank that temporarily suspends the water layer at the bottom of the tank — the agitated mixture passes through the fuel-water separator and triggers the water sensor; after 30 minutes of driving, the water settles back to the bottom of the tank below the pickup tube level, and the sensor clears; the fuel tank should be drained of accumulated water and the fueling procedure should be evaluated to minimize turbulence

B. The fuel station's diesel has a water contamination problem that the truck's separator is detecting after every fill

C. The fuel tank vent system is allowing condensation to form during the fueling process when the cold fuel contacts the warm tank walls

D. The water-in-fuel sensor is defective and the turbulence from fueling creates a false signal from the fuel movement past the sensor

29. A heavy-duty diesel engine's oil analysis has been trending upward in copper content over the last three samples: 15 ppm, 22 ppm, 35 ppm. All other wear metals are stable. What engine component is the most likely source of the increasing copper?

A. The engine's piston pin bushings, which are typically copper or bronze alloy, wearing at an accelerating rate

B. The oil cooler's copper heat exchange tubes are eroding from coolant-side cavitation that is thinning the tube walls

C. Copper-alloy engine bearings (connecting rod or main bearings) are wearing through their overlay layer and exposing the copper intermediate layer — the progressive increase confirms the bearing overlay (lead-tin alloy) has worn through and the underlying copper layer is now the primary wear surface; this represents an advancing stage of bearing deterioration that will progress to failure if not addressed

D. The engine's copper oil gallery plugs are corroding from acidic oil that has exceeded its service life

30. A heavy-duty truck has a condition where the air system takes 5 minutes to build from 0 to 90 psi (within specification), but then takes an additional 3 minutes to build from 90 to the governor cut-out at 125 psi. What is the most likely cause of the slow build-up in the upper pressure range?

A. The compressor's internal valves are functioning normally but a leak in the system becomes significant only at pressures above 90 psi

B. A system leak exists that is pressure-dependent — the leak rate increases with pressure; below 90 psi, the leak is small and the compressor easily overcomes it; above 90 psi, the leak path opens wider (a marginal hose fitting, a valve diaphragm that flexes, or a check valve that does not seat fully) and the escaping air nearly matches the compressor's output, dramatically slowing the pressure rise

C. The governor is partially activating the unloader mechanism at 90 psi from a calibration drift, reducing the compressor's effective pumping capacity

D. The air dryer is restricting airflow at higher pressures because the desiccant bed compresses under the elevated pressure

31. A tractor-trailer combination has a condition where the trailer brakes lock up immediately when the trailer hand valve is applied even at minimal handle pressure. The tractor brakes respond proportionally to the foot valve as expected. What is the most likely cause?

A. The trailer's relay valve crack pressure is set too high, causing the valve to dump full pressure when it opens

B. The trailer ABS has failed and cannot modulate the brake pressure during the hand valve application

C. The trailer's brake chambers are a larger type than specified, producing excessive force at normal application pressure

D. The trailer's relay valve has failed in a way that delivers full supply pressure to the brake chambers regardless of the signal pressure — the relay valve should proportionally match its delivery pressure to the signal pressure from the hand valve; a failed relay valve that does not modulate its output delivers the full reservoir pressure to the chambers, causing immediate lockup at any signal level

32. A heavy-duty truck has a condition where the air compressor cycles normally (loads and unloads at the correct pressures) but the air dryer purge cycle is extremely short — the purge blast lasts less than 1 second instead of the normal 3-5 seconds. What is the consequence of an inadequate purge?

A. The desiccant bed is not adequately regenerated during the short purge — the purge cycle reverses airflow through the desiccant to strip accumulated moisture; a 1-second purge does not move enough dry air through the bed to remove the moisture absorbed during the loading cycle; the desiccant progressively saturates and begins passing moisture to the downstream reservoirs, contaminating the entire air system with water

B. The compressor builds excessive heat from the rapid cycling between loaded and unloaded states

C. The governor signal is too brief to fully unload the compressor, causing partial loading during the purge cycle

D. The short purge indicates the desiccant bed has collapsed internally, reducing the airflow resistance and shortening the purge time

33. A school bus equipped with hydraulic disc brakes has a condition where the brake pedal is firm and the bus stops adequately during the first stop after starting the engine, but subsequent stops within 5 minutes produce a progressively softer pedal and longer stopping distances. What is the most likely cause?

A. The brake fluid is boiling from residual heat in the calipers that transfers to the fluid during the first few stops

B. The vacuum booster is losing its vacuum reserve after the first application and cannot regenerate adequate vacuum between stops

C. The master cylinder has an internal bypass leak that worsens as the fluid heats from brake friction — the primary piston seal holds during the first cold application but softens and bypasses as the fluid temperature rises from the heat generated during the first stop; each subsequent stop adds more heat and the seal bypass worsens progressively

D. The ABS modulator is failing to release fully between applications, trapping fluid and reducing the available hydraulic volume for subsequent stops

34. A heavy-duty truck equipped with S-cam drum brakes has a condition where the right rear brake drum shows a polished, mirror-like surface in a 50 mm wide band around the center of the friction surface. The rest of the drum surface has a normal, slightly rough texture. What caused this localized polishing?

A. A foreign object became embedded in the brake shoe lining and dragged against the drum, polishing the surface

B. The brake shoe lining has a hard spot in the friction material — during brake application, this hard spot contacts the drum with concentrated force, generating heat and pressure that polish the drum surface in the narrow contact band; the hard spot may be from a manufacturing defect, contamination in the lining material, or a heat-hardened area from a previous overheating event

C. The brake drum was machined with a too-fine surface finish during the last brake service

D. The automatic slack adjuster has over-adjusted on one side, causing the leading shoe to drag in a narrow contact band

35. A transit bus has a condition where the driver must pump the brake pedal 2-3 times to get a firm pedal. Once firm, the brakes hold and the bus stops normally. What is the most likely cause?

A. The brake fluid level is low from a slow external leak, and the first pedal strokes push fluid to the calipers while air enters the master cylinder from the low reservoir level

B. The brake pads have excessive clearance from worn automatic adjusters that have not compensated for pad wear

C. The power brake booster has a leaking diaphragm that requires multiple applications to build adequate assist pressure

D. Excessive clearance exists between the brake pads and the rotors — the caliper pistons have not maintained their adjusted position (from failed automatic adjusters, pistons that have retracted too far, or worn pads); the first 2-3 pedal strokes push the pistons out to contact the rotors, and once contact is made, the pedal firms up and the brakes function normally

36. A heavy-duty truck's air brake system has a condition where the spring brakes apply normally when the parking brake valve is pulled, but the spring brakes release very slowly — taking approximately 20 seconds to fully release after the valve is pushed in. What is the most likely cause?

A. The spring brake relay valve's supply (inlet) port is restricted — the valve receives the signal to release the spring brakes and opens its inlet, but the restricted inlet limits the volume of air that can flow through the valve to the spring brake chambers; the chambers fill slowly because the restricted flow cannot deliver the required volume quickly; a contaminated valve inlet, a kinked supply line, or a failed internal valve component causes the restriction

B. The parking brake valve's internal return spring has weakened and the valve handle moves slowly from the applied to the released position

C. The spring brake chambers' hold-off diaphragms have stretched from age and require more air volume to compress the springs

D. The air dryer is restricting the airflow to the spring brake circuit because the desiccant bed has partially collapsed

37. A heavy-duty truck equipped with ABS has a condition where the ABS activates aggressively during stops on dry pavement — the driver feels the pedal pulsation and hears the modulator cycling on nearly every stop. The ABS warning lamp is not illuminated. The brake adjustment and tire condition are normal. What should be investigated?

A. The vehicle's load — an empty or lightly loaded truck has significantly less weight on the drive axle, making the wheels more susceptible to lockup; the ABS is functioning correctly by preventing the lightly-loaded wheels from locking during normal braking

B. The brake proportioning system, which may be delivering excessive pressure to one axle position

C. The wheel speed sensors for signal quality issues — an erratic sensor signal (from an incorrect air gap, a damaged reluctor ring tooth, or a deteriorating sensor element) may cause the ABS module to perceive a wheel speed variation that it interprets as impending lockup, triggering modulation during normal stops on dry pavement

D. The ABS module's software version, which may need updating to the latest calibration for the vehicle's configuration

38. A technician discovers that a truck's front brake chambers have been replaced with chambers from a different manufacturer. The replacement chambers are the correct Type designation (Type 24) but have a pushrod that is 12 mm longer than the original. What is the consequence of the longer pushrod?

A. The longer pushrod has no effect because the automatic slack adjuster compensates for the additional length during its self-adjustment cycle

B. The longer pushrod changes the slack adjuster's mechanical geometry, potentially causing an incorrect adjustment angle

C. The longer pushrod reduces the available stroke range before the pushrod exceeds the maximum stroke specification

D. The longer pushrod positions the slack adjuster at a different angle in its operating arc — this changes the mechanical advantage and the adjustment geometry; the ASA may not function correctly because it was calibrated for the original pushrod length; the pushrod stroke measurement may appear within specification but the actual shoe-to-drum clearance is different from what the stroke indicates; the original pushrod length should be restored

39. A tractor-trailer combination has a condition where the trailer service brakes release instantly when the foot valve is released, but the tractor's drive axle brakes take approximately 2 seconds to release after the foot valve is released. What is the most likely cause?

A. The tractor's ABS system is maintaining a brief application after the foot valve releases as an anti-rollback feature

B. The quick release valve on the tractor's drive axle circuit has a stuck or damaged exhaust port — the valve should exhaust the application air rapidly when the signal from the foot valve drops, but a contaminated or stuck exhaust seal holds the air momentarily before releasing; the trailer's relay valve has a functional exhaust and releases normally

C. The tractor's relay valve for the drive axle has a marginally high crack pressure that delays the release

D. The foot valve's primary piston is slow to return to its home position after the pedal is released

40. A heavy-duty truck equipped with electronic stability control (ESC) has a condition where the ESC activates during normal highway driving without any steering or lane-change input from the driver. The ESC warning lamp flashes intermittently during these activations. What is the most likely cause?

A. The steering angle sensor has a calibration error that reports a steering input when the driver is maintaining a straight-ahead course — the ESC module compares the steering input (from the angle sensor) to the vehicle's actual behavior (from the yaw rate and lateral acceleration sensors); if the steering sensor reports a turn while the vehicle is straight, the ESC perceives a stability deviation and intervenes

B. The yaw rate sensor is hypersensitive and is detecting road crown as a stability event

C. The lateral accelerometer has a zero offset that makes the ESC believe the vehicle is leaning to one side

D. The ESC module's software has a timing error that activates the stability intervention at random intervals

41. A heavy-duty truck's brake system has a condition where the air pressure drop during a full brake application (with the engine off) is 25 psi. The specification is a maximum of 20 psi per application. What does the excessive pressure drop per application indicate?

A. The air tanks are undersized for the number of brake chambers in the system

B. The relay valves are delivering more air than necessary to the brake chambers during each application

C. One or more brake chambers have a volume that exceeds the specification — oversized chambers, double-acting chambers installed where single-acting chambers should be, or additional chambers that were added during a modification consume more air per application than the system was designed to deliver from a single reservoir charge

D. The compressor is not maintaining the governor cut-out pressure, so the available air volume per application is reduced

42. A technician is performing a static brake test on a tractor-trailer combination. With the system fully charged and the engine off, the technician applies the brakes fully and holds the pedal down. The primary circuit drops 3 psi in the first minute. The secondary circuit drops 5 psi in the first minute. The maximum for a combination with brakes applied is 4 psi per minute. What is the assessment?

A. The primary circuit passes and the secondary circuit passes because the combined average of the two circuits is within specification

B. The primary circuit and secondary circuit must each individually meet the specification

C. The secondary circuit passes because the 5 psi drop is within the 6 psi maximum for the secondary circuit on a combination vehicle

D. The primary circuit passes (3 psi/min is within the 4 psi/min maximum), but the secondary circuit fails (5 psi/min exceeds the 4 psi/min maximum) — each circuit must individually meet the specification; the secondary circuit has a leak that must be located and repaired before the vehicle can pass the static brake test

43. A heavy-duty truck equipped with disc brakes on the steer axle has a condition where the right front brake produces a grinding noise during every brake application. The noise is metallic and constant during the application. What is the most likely cause?

A. The brake pad wear indicator (metal tab) on the right front is contacting the rotor during application

B. The right front brake pad has worn completely through its friction material — the steel backing plate of the worn pad is contacting the rotor directly during every application, producing the constant metallic grinding; the pad must be replaced immediately along with the rotor, which has been scored by the metal-to-metal contact

C. The right front caliper piston is corroded and the rough piston surface is grinding against the caliper bore seal

D. The right front rotor has developed a hard spot that produces a grinding feel during pad contact

44. A transit bus has a condition where the ABS warning lamp illuminates after driving for exactly 20 minutes every day. The lamp does not illuminate during the first 20 minutes of operation. The fault code indicates "Modulator Valve 3 — Coil Resistance Above Specification." What does this time-dependent fault indicate?

A. The modulator valve's electromagnetic coil has a thermal sensitivity fault — the coil's wire resistance increases with temperature as the coil heats during the first 20 minutes of driving (from current flowing through it during each ABS event and from radiant heat from the nearby brake); once the resistance exceeds the ABS module's maximum specification, the module sets the fault; the coil is marginal and the heat pushes it over the threshold

B. The ABS module has a 20-minute self-test cycle that only checks the modulator coil resistance after the warm-up period

C. The modulator valve's mounting has a heat-induced expansion that changes the coil's air gap after 20 minutes of operation

D. The ABS module's internal voltage regulator drifts after 20 minutes, causing it to misread the modulator coil resistance

45. A heavy-duty truck has a condition where the trailer brakes apply normally during foot valve operation, but the trailer hand valve produces much weaker trailer braking than expected. The hand valve handle moves through its full travel. What is the most likely cause?

A. The trailer hand valve is working correctly but the foot valve delivers a stronger signal to the trailer through the tractor protection valve's secondary circuit

B. The trailer's relay valve responds differently to the hand valve's signal frequency compared to the foot valve's signal

C. The trailer hand valve's internal piston seal is worn and the valve cannot build adequate output pressure at its delivery port — the piston bypasses internally, leaking signal pressure past the seal rather than delivering it to the trailer's relay valve; the foot valve sends its trailer signal through a separate circuit that bypasses the hand valve entirely, which is why the foot valve produces normal trailer braking

D. The hand valve's air supply line is partially restricted, limiting the volume of air available for the signal output

46. A school bus equipped with air brakes has a condition where the spring brakes apply during driving without the driver activating the parking brake valve. The driver reports that the spring brakes engage when the system pressure drops below approximately 65 psi during repeated hard stops. Is this normal operation?

A. This is abnormal — the spring brakes should not apply until the system pressure drops below approximately 25 psi

B. This is normal safety operation — the spring brakes are designed to apply automatically when the system pressure drops below approximately 60-65 psi, providing a final safeguard against total brake failure; the driver is using the brakes so frequently that the compressor cannot rebuild pressure between applications, and the pressure drops below the spring brake application threshold; the driver should use the engine brake to reduce the demand on the air system

C. This is abnormal — the tractor protection valve should close before the spring brakes apply

D. This is caused by a faulty spring brake relay valve that applies the spring brakes at too high a pressure

47. A heavy-duty truck has a condition where the engine cranks very slowly and will not start. Battery voltage at the terminals reads 12.6V (fully charged). During cranking, the voltage at the battery terminals drops to 10.8V, but the voltage at the starter motor drops to 7.5V. What do these two voltage readings reveal?

A. The batteries have high internal resistance and cannot maintain voltage under the starter's current draw

B. The starter motor has an internal short that is drawing excessive current and pulling down both voltages

C. The engine has a mechanical seizure that is overloading the starter motor and causing excessive current draw

D. The voltage difference between the battery terminals (10.8V) and the starter motor (7.5V) is 3.3V — this 3.3V is consumed by resistance in the cables, connections, and solenoid contacts between the battery and the starter; the maximum allowable total circuit voltage drop is typically 1.0V, so 3.3V represents severe resistance that is starving the starter of the voltage it needs to crank at normal speed

48. A truck's scan tool retrieves a fault code from the engine ECM: "Camshaft Position Sensor — Signal Not In Phase With Crankshaft Position Sensor." The engine runs but with reduced power. What does this "out of phase" condition indicate?

A. The sensors are electrically functional but their signals do not align in the expected timing relationship

B. The timing relationship between the camshaft and the crankshaft has changed — the ECM continuously compares the camshaft position sensor's signal to the crankshaft position sensor's signal to verify valve timing; if the signals are "not in phase," the actual cam-to-crank relationship has deviated from the expected relationship; this can be caused by a slipped timing gear, a stretched timing chain, a worn keyway, or incorrect assembly after a repair

C. The crankshaft position sensor is producing a signal at a frequency that is incompatible with the camshaft position sensor's frequency

D. The camshaft position sensor's wiring has been routed near an ignition source that is creating electromagnetic interference

49. A heavy-duty truck has a condition where the alternator produces 14.2V at the battery terminals with the engine running and all loads off. When the headlights are turned on, the voltage drops to 13.5V. When the HVAC blower is also turned on, the voltage drops to 12.8V. What does this progressive voltage drop with increasing load indicate?

A. The alternator's maximum current output is insufficient for the vehicle's total electrical demand — the voltage drops progressively as each additional load consumes more current than the alternator can produce; the alternator may have a failed diode (reducing output by approximately one-third), worn brushes (reducing field excitation), or a stator winding fault that limits its current capacity

B. The voltage regulator is intentionally reducing the voltage as loads increase to protect the batteries from overcharging

C. The battery cables have excessive resistance that produces greater voltage drop as the current increases with each additional load

D. The headlight and HVAC circuits have internal faults that are drawing more current than their rated specifications

50. A truck equipped with a multiplexed electrical system has a condition where the BCM commands the right rear marker light on, but the BCM's diagnostic data shows the circuit is drawing 0.0 amps. What does zero current draw on a commanded circuit indicate?

A. The BCM's output driver has failed in the conducting (shorted) state and is bypassing the current sensor

B. The marker light is an LED type that draws current below the BCM's detection threshold

C. An open circuit exists between the BCM's output and the lamp — either the lamp has burned out, a wire has broken, a connector has lost contact, or the ground path is open; the BCM is commanding voltage to the circuit, but zero current flows because the circuit is not complete; the BCM can identify which circuit is affected but cannot pinpoint the specific location of the open

D. The BCM has detected an overcurrent condition and has shut down the output as a protective measure

51. A heavy-duty truck has a condition where the dash-mounted voltmeter shows a steady 14.2V with the engine running, but the driver notices the batteries are consistently undercharged every morning. The parasitic draw is within specification. What should the technician investigate?

A. The battery temperature sensor, which may be commanding a reduced charge rate based on a falsely high temperature reading

B. The charging circuit between the alternator and the batteries for excessive voltage drop under load

C. The batteries themselves for internal sulfation that prevents them from accepting a full charge

D. The voltage sense wire — some charging systems use a dedicated sense wire from the battery to the voltage regulator to measure the actual battery voltage rather than the alternator output voltage; if this sense wire is open, corroded, or connected to the wrong point, the regulator measures the voltage at the alternator (14.2V, displayed on the dash) but does not know the actual voltage at the batteries; the batteries may receive less than 14.2V due to circuit resistance, and the regulator cannot compensate because it does not have accurate battery voltage feedback

52. A truck's CAN bus has been tested and the termination resistance reads 60 ohms — the correct value. However, the scan tool still cannot communicate with 3 of the 12 modules on the bus. The other 9 modules communicate normally. What is the most likely cause?

A. The 3 non-communicating modules have been replaced with incorrect part numbers that use a different CAN bus protocol

B. The CAN bus has a fault between the 9 communicating modules and the 3 non-communicating modules — a high-resistance splice, a damaged wire section, or a corroded connector in the bus backbone creates a partial bus failure; the 9 modules on the scan tool's side of the fault communicate normally because they are connected to an intact bus segment with both terminators; the 3 modules on the far side of the fault are isolated and cannot be reached

C. The 3 modules have identical firmware versions that have a communication bug preventing them from responding to the scan tool

D. The scan tool's CAN bus communication speed is set incorrectly for those 3 specific modules

53. A truck's electronic instrument cluster has a condition where the fuel gauge reads empty even though the tank is full. The technician measures the resistance at the fuel sender connector (at the tank) with the sender disconnected. The reading is 33 ohms. The specification for a full tank is 33 ohms and for an empty tank is 240 ohms. What is the most likely cause of the incorrect gauge reading?

A. The fuel sender is reading correctly (33 ohms for full), so the fault is in the wiring or the instrument cluster — the cluster is interpreting the 33-ohm signal as empty instead of full, which indicates either the wiring has a resistance that offsets the sender's value, the cluster's gauge calibration is reversed (reads low resistance as empty instead of full), or the cluster has an internal fault on the fuel gauge circuit

B. The fuel sender's float has saturated with fuel and sunk to the bottom of the tank, producing the empty reading

C. The fuel sender's rheostat has shorted at the full position, producing an incorrect resistance

D. The instrument cluster's fuel gauge stepper motor has failed in the empty position

54. A heavy-duty truck has a condition where the starter motor does not disengage after the engine starts — the starter continues to spin with the engine for 3-4 seconds before the driver releases the key. What is the likely cause of the delayed disengagement?

A. The starter drive (Bendix mechanism) is contaminated with grease that prevents it from releasing the flywheel ring gear

B. The ignition switch's start position contact has excessive spring tension and does not return to the run position quickly

C. The starter solenoid's plunger return spring has weakened and the plunger takes 3-4 seconds to fully retract after the ignition switch releases the start signal — the solenoid's heavy-duty contacts remain closed during this delay, keeping the starter motor engaged; the starter over-runs during this period, which can damage the starter drive mechanism

D. The starter motor's armature has excessive inertia from a replacement armature that is heavier than the original

55. A truck equipped with LED headlights has a condition where one LED headlight module produces a yellowish light instead of the expected white light. The other LED headlight produces the correct white color. Both assemblies are the same part number. What is the most likely cause?

A. The yellowish LED headlight has an internal power supply fault that is underdriving the LED elements, causing them to produce a warmer (yellower) color temperature than the correctly-driven white LEDs

B. One or more LED elements inside the affected assembly have failed — the remaining elements produce a shifted color spectrum because the blue LED elements (which combine with the yellow phosphor to produce white light) have died, leaving only the yellow phosphor-coated elements; the overall light output shifts from white toward yellow as the blue elements fail

C. The headlight lens on the yellowish side has UV-degraded, filtering out the blue wavelengths and allowing only the yellow wavelengths to pass through

D. The wiring to the yellowish headlight has excessive voltage drop that changes the LED operating point and shifts the color temperature

56. A truck's electronic throttle pedal has been replaced. After installation, the engine starts but will not respond to pedal input — it remains at idle. The scan tool shows the pedal position reading at 0% at all pedal positions. What must be done after installing a new throttle pedal?

A. The ECM must be reprogrammed with the new pedal's serial number before it will accept pedal input

B. The pedal connector must be seated with the ignition off — connecting the pedal with the ignition on causes the ECM to reject the signal

C. The new pedal must be physically adjusted with a set screw to align its zero position with the ECM's idle reference

D. The new throttle pedal must be calibrated (learned) by the ECM through a pedal calibration procedure — the ECM must learn the new pedal's voltage range from idle (0%) to full throttle (100%); without this procedure, the ECM cannot interpret the new pedal's signal correctly and defaults to 0% (idle); the calibration is performed through the scan tool or a key-on pedal sweep sequence

57. A heavy-duty truck has a condition where the engine runs normally but the check engine lamp illuminates every time the vehicle exceeds 100 km/h. The lamp extinguishes when the speed drops below 100 km/h. No fault codes are stored. What is the most likely cause?

A. The check engine lamp circuit has a wiring fault that is triggered by the vibration frequency corresponding to 100 km/h

B. The vehicle's speed limiter is activating at 100 km/h and the check engine lamp illumination is the designed warning for the driver that the speed limiter has engaged — the ECM limits fuel delivery to prevent the vehicle from exceeding the programmed maximum speed

C. The ECM detects an exhaust backpressure spike at 100 km/h from aerodynamic changes that it interprets as a DPF restriction

D. The tire size has been changed and the ECM calculates an incorrect speed that triggers a speed-based diagnostic threshold

58. A truck's scan tool retrieves a fault code from the ABS module: "Left Rear Modulator Valve — Short to Ground." The ABS lamp is illuminated. What does "short to ground" mean for the modulator valve circuit?

A. The modulator valve's mounting bracket has contacted the vehicle frame, creating an unintended ground path through the valve body

B. The modulator valve has an internal coil winding that has contacted the valve body, creating an unintended ground path

C. The modulator valve's electrical circuit (the coil winding or its wiring) has an unintended path to vehicle ground — a pinched wire, chafed insulation, or an internal coil fault allows current to flow from the power supply to ground without passing through the coil's designed resistance; this uncontrolled current path can damage the ABS module's output driver and prevents the module from controlling the valve

D. The modulator valve's exhaust port has been blocked by debris, causing a pneumatic ground-fault that the ABS module detects electrically

59. A truck has a condition where the horn sounds weak when the engine is running but sounds normal when the engine is off (key-on, engine off). What could cause the horn to sound weaker with the engine running?

A. The alternator's charging voltage is lower than the battery's resting voltage, reducing the voltage available to the horn circuit

B. The engine's vibration dampens the horn's diaphragm oscillation, reducing its acoustic output while the engine is running

C. The horn's ground connection has developed resistance that increases under the higher-current conditions of engine-running operation

D. The alternator's AC ripple is interfering with the horn's electromagnetic frequency — the horn operates by oscillating a diaphragm at a specific frequency using a self-interrupting electromagnetic circuit; the alternator's AC ripple (from a failing diode) superimposes on the DC supply, disrupting the horn's oscillation pattern and reducing its acoustic output

60. A heavy-duty truck's electronic gauge cluster shows all gauges at their minimum position (oil pressure at 0, coolant temp at cold, fuel at empty, tach at 0, speedo at 0) even though the engine is running normally. The scan tool communicates with all modules and shows correct engine data on the scan tool display. What is the most likely cause?

A. The instrument cluster has an internal fault — it receives the correct data from the CAN bus (confirmed by the scan tool reading correct values from the same data stream) but cannot process or display the data due to an internal electronics failure; the cluster's power supply, ground, internal processor, or gauge driver circuits must be diagnosed

B. The CAN bus has a speed mismatch between the ECM's broadcast rate and the cluster's receive rate

C. The cluster's CAN bus receive circuit has failed, preventing it from reading the data that the scan tool can still access

D. The ECM has entered a diagnostic mode that broadcasts zero values to the cluster while sending actual values to the scan tool

61. A truck has a condition where the right headlight is noticeably brighter than the left headlight. Both bulbs are the same type and wattage. The voltage at each headlight connector measures 13.8V at the left and 14.0V at the right. What does the 0.2V difference indicate?

A. The 0.2V difference is within normal variation and is not sufficient to produce a visible brightness difference between the headlights

B. The 0.2V difference is caused by the alternator's physical proximity to the right headlight circuit, boosting its voltage slightly

C. The left headlight circuit has slightly more resistance than the right — the 0.2V voltage drop reduces the left bulb's wattage and light output; while 0.2V seems small, the power delivered to the bulb varies with the square of the voltage ($P = V^2/R$), so even a small voltage difference produces a proportionally larger brightness difference

D. The right headlight has a thinner filament from a manufacturing variation that operates at higher temperature and appears brighter

62. A truck equipped with a telematics system has a condition where the telematics unit reports "Ignition On" status even when the truck is parked with the key removed. What is the most likely cause?

A. The telematics unit's internal timer has failed and it is broadcasting a stale "Ignition On" message from the last driving event

B. The telematics unit detects ignition status through a signal wire connected to a switched power source — if this wire is connected to a circuit that remains powered even with the key removed (such as a constant-power circuit instead of a switched-ignition circuit), the unit always detects voltage and reports "Ignition On"

C. The telematics unit's GPS module detects the vehicle's stationary position and interprets it as an engine-running, stopped condition

D. The vehicle's keyless ignition system has a phantom signal that the telematics unit's antenna is receiving as a valid ignition command

63. A truck has a condition where the backup camera display shows the image in mirror-reverse — left and right are swapped. The camera was recently replaced with an aftermarket unit. What is the most likely cause?

A. The aftermarket camera's lens is installed backward, reversing the image horizontally

B. The video cable between the camera and the display has been connected to the wrong input port

C. The display monitor has a software setting that mirrors the image for rear-view perspective and the aftermarket camera has already applied its own mirror correction internally

D. The aftermarket camera has a mirror-image setting that is configured differently from the original camera — backup cameras are designed to display a mirror-reversed image (so left and right on the screen match the driver's perspective when looking in the rearview mirror); if the aftermarket camera applies its own mirror correction and the display also applies mirror correction, the double-reversal produces a non-mirrored (reversed) image

64. A heavy-duty truck's electronic logging device (ELD) shows the driver in "Driving" status but the truck is parked and the engine is idling. The speedometer shows zero. What could cause this false "Driving" status?

A. The ELD uses a combination of speed and RPM to determine driving status — some ELDs transition to "Driving" when the engine RPM exceeds a threshold regardless of vehicle speed; at elevated idle (from PTO operation, A/C load, or an idle-up command), the engine RPM may exceed the ELD's driving threshold and trigger the incorrect status

B. The ELD's GPS module detects minor satellite drift and interprets the apparent position change as vehicle movement

C. The ELD's accelerometer detects engine vibration that exceeds the threshold for vehicle movement detection

D. The ELD's CAN bus connection is picking up phantom speed signals from electrical noise on the data link

65. A truck equipped with a J1939 CAN bus has a condition where one specific module intermittently transmits data with incorrect values — the oil pressure reading from the ECM occasionally spikes to an impossible value (999 psi) for one data frame before returning to the correct value. What does this single-frame data spike indicate?

A. The oil pressure sensor has a marginal electrical connection that produces a voltage spike during vibration events

B. The ECM's analog-to-digital converter has a fault on the oil pressure input channel

C. A CAN bus data transmission error — electrical noise, a marginal connector, or a deteriorating bus conductor can corrupt individual data frames during transmission; the corrupted frame displays as a nonsensical value because one or more bits in the message were flipped by the interference; the next frame transmits correctly and the value returns to normal

D. The oil pressure relief valve is chattering and producing actual pressure spikes that the sensor reports accurately

66. A heavy-duty truck has a condition where both low-beam headlights are dim, but both high-beam headlights operate at full brightness. All four bulbs are the correct specification. What is the most likely cause?

A. The headlight switch has excessive internal resistance on the low-beam contact that reduces voltage to both low-beam circuits

B. The low-beam relay has a high-resistance contact that limits current to both low-beam headlights

C. The dimmer switch has a worn contact on the low-beam position that creates a voltage drop for both low-beam circuits

D. A common resistance point in the low-beam circuit — the low-beam headlights share a common power source, relay, or switch contact that has developed resistance; this resistance creates a voltage drop that affects both low beams equally while the high beams use a separate, clean power path; the common resistance could be in the headlight switch, the low-beam relay, the wiring between the switch and the relay, or a shared connector

67. A truck has a condition where the starter motor operates normally (cranks at correct speed) but the engine will not start. The scan tool shows the engine RPM reading as zero during cranking. What does a zero RPM reading during cranking indicate?

A. The fuel system has no pressure and the ECM will not display RPM until fuel pressure is adequate for starting

B. The crankshaft position sensor or its circuit is not producing a signal — the ECM uses the crankshaft position sensor to determine engine RPM and crankshaft angular position for injection timing; if the sensor circuit is open, shorted, or the sensor is not reading the reluctor ring (from excessive air gap, a disconnected connector, or a damaged sensor), the ECM shows zero RPM and cannot command fuel injection; the engine cranks mechanically but cannot start without the sensor's timing reference

C. The camshaft position sensor has failed and the ECM cannot determine which stroke each cylinder is on

D. The ECM's tachometer output has failed but the internal RPM calculation is functioning correctly for fuel injection

68. A truck's electronic instrument cluster shows the oil pressure gauge reading at the maximum mark (full scale) at all times — idle, cruise, and full load. A mechanical test gauge reads 55 psi at 1,500 RPM and 18 psi at idle, both within specification. What is the most likely cause?

A. The oil pressure sender or its wiring has a fault that produces a signal the cluster interprets as maximum pressure — a sender with an internal short circuit, a signal wire shorted to the reference voltage, or a corroded connector that produces a fixed resistance all can create a signal that the cluster pegs at maximum regardless of actual pressure

B. The instrument cluster's oil pressure gauge stepper motor has failed in the maximum position

C. The ECM is broadcasting an incorrect oil pressure value on the CAN bus due to an internal analog-to-digital converter fault

D. The oil pressure relief valve is stuck closed, causing actual pressure to be at maximum at all times

69. A heavy-duty truck with a manual 18-speed transmission has a condition where the transmission shifts smoothly through all 18 gears except one — the split from 9th gear low-split to 9th gear high-split produces a grinding noise. All other splitter shifts are smooth. What is the most likely cause?

A. The transmission oil level is low and the 9th gear position does not receive adequate splash lubrication for the splitter synchronizer

B. The 9th gear's specific synchronizer cone has worn its friction surface below the effective threshold

C. The air valve for the splitter shift delivers inconsistent air pressure that only affects the 9th gear position

D. The 9th gear splitter synchronizer has worn specifically at the engagement point used for that gear — the synchronizer's friction cone or blocker ring for the 9th gear high-split has insufficient friction surface remaining to match speeds before the sliding sleeve advances; all other splitter positions use different synchronizer elements that remain functional

70. A truck equipped with an Allison automatic transmission has a condition where the converter stall speed is 300 RPM lower than the manufacturer's specification. What does a low stall speed indicate?

A. The torque converter is transferring too much torque at low speeds, preventing the engine from reaching the specified stall RPM

B. A low stall speed indicates the stator's one-way clutch has locked up — the stator should freewheel during the stall test when the fluid coupling is most inefficient; if the stator is locked, it restricts the fluid flow pattern inside the converter, reducing the slippage between the impeller and turbine; the reduced slippage makes the converter "tighter," and the engine cannot reach the specified stall RPM because the converter loads the engine more than it should during the stall condition

C. The engine is producing less power than its rated output, and the low stall speed reflects the engine's power deficiency

D. The transmission's main pressure is too high, clamping the forward clutch with excessive force during the stall test

71. A heavy-duty truck has a clutch that chatters during engagement from a standing start but engages smoothly during gear changes while driving. What does this start-from-stop-only chatter indicate?

A. The clutch disc's torsional damper springs are broken and produce chatter only during the higher torque application of starting from a stop

B. The pressure plate's release mechanism has worn fingers that create an uneven clamping force during full-pedal-release engagement

C. The flywheel friction surface has hot spots or heat damage that create uneven friction — starting from a stop requires the clutch to slip for the longest duration (speed matching from zero), and the uneven surface produces chatter during this extended slip; during in-gear shifts, the speed differential is smaller, the slip duration is shorter, and the chatter does not develop

D. The pilot bearing is binding and produces chatter as the input shaft tries to align with the crankshaft during the start-from-stop engagement

72. A truck's transfer case produces a rhythmic clunking noise that corresponds to driveshaft speed. The noise is present in both 2WD and 4WD. What does the noise being present in both modes indicate?

A. The noise source is a component that rotates at driveshaft speed in both 2WD and 4WD — the transfer case's input gear, output shaft, or a bearing that is common to both operating modes; components exclusive to the 4WD mode (such as the front output chain or the 4WD engagement mechanism) can be eliminated because they would only produce noise in 4WD

B. The front driveshaft has a U-joint fault that creates noise through the transfer case housing regardless of mode

C. The transfer case has a loose mounting bolt that allows the case to shift and produce the clunk in both modes

D. The rear driveshaft has an imbalance that transmits through the transfer case to produce the rhythmic clunk

73. A heavy-duty truck equipped with an automated manual transmission (AMT) has a condition where the transmission occasionally "hunts" between two gears during highway cruising — repeatedly shifting from 11th to 12th and back to 11th every 5-10 seconds. What is the most likely cause?

A. The AMT's shift algorithm has a programming error that creates an unstable shift point at the current vehicle speed and load

B. The torque converter (if equipped on this AMT model) is cycling between locked and unlocked, triggering gear changes

C. The vehicle's throttle position is fluctuating slightly from an unstable throttle position sensor or a hunting engine idle control algorithm

D. The vehicle is operating near the shift point boundary between 11th and 12th gear — the current speed, load, and grade produce a condition where the TCU's upshift criteria are met (shift to 12th) but the lugging condition in 12th gear immediately meets the downshift criteria (shift back to 11th); this hunting cycle repeats until the operating conditions change enough to stabilize in one gear; adjusting the shift calibration, increasing the vehicle speed, or changing throttle position resolves the hunting

74. A truck's clutch hydraulic system has been recently bled. The clutch pedal feels firm but the clutch does not disengage completely — the transmission grinds slightly when shifting into 1st gear from a stop. What is the most likely cause?

A. The clutch master cylinder's compensating port (the small hole that connects the reservoir to the hydraulic cylinder bore) is blocked — the blocked port prevents the hydraulic fluid from returning to the reservoir when the pedal is released, maintaining residual pressure in the line that holds the release bearing against the pressure plate; the clutch is always partially disengaged, and the remaining contact between the disc and flywheel is insufficient for clean gear engagement

B. The clutch disc's friction material has swollen from the brake fluid and is physically thicker, preventing full disengagement even when the release bearing is at full travel

C. The bleeder valve was not closed tightly enough and a small air bubble remains in the system

D. The slave cylinder has been installed with the wrong pushrod length, limiting the release bearing's travel

75. A heavy-duty truck has a rear axle that produces a howling noise during acceleration at highway speed. The noise is most prominent between 80 and 110 km/h. During deceleration, the noise disappears. What does this acceleration-only noise pattern indicate?

A. The wheel bearings on the drive axle are worn and produce a speed-dependent howl that is masked by road noise during deceleration

B. The drive axle's ring and pinion gear set has a wear pattern or incorrect adjustment on the drive (acceleration) side of the teeth that produces a howl

C. The ring and pinion gear set has a wear pattern or incorrect tooth contact on the drive (acceleration) side of the gear teeth — the gears produce noise only when loaded on the drive side during acceleration; during deceleration, the load shifts to the coast side of the teeth, and the noise disappears because the coast side contact pattern is different; the noise's speed range corresponds to the RPM where the gear mesh frequency excites a resonance in the axle housing

D. The driveshaft U-joints are worn and produce a howling noise from the high-frequency speed fluctuation during acceleration

76. A bus equipped with an automatic transmission has a condition where the transmission shifts from 1st to 2nd normally but the 2nd-to-3rd shift is accompanied by a noticeable engine flare (RPM rises) before the 3rd gear clutch engages. What does the engine flare during the 2-3 shift indicate?

A. The 3rd gear clutch pack is slipping during the engagement phase — the 2nd gear clutch releases normally (allowing the engine to speed up) but the 3rd gear clutch does not apply quickly enough or firmly enough to absorb the engine torque; the engine flare represents the period between 2nd gear release and 3rd gear engagement where no clutch is holding; the 3rd gear clutch pack is worn, has a leaking apply circuit, or has burned friction material

B. The torque converter is unlocking during the 2-3 shift, causing the apparent engine flare from the increased converter slip

C. The governor pressure is overshooting during the 2-3 shift, causing the TCM to delay the 3rd gear engagement

D. The accumulator piston for the 2-3 shift circuit has seized, eliminating the cushioned engagement

77. A heavy-duty truck's driveshaft has been checked for balance and runout — both are within specification. The U-joints are new and properly phased. The carrier bearing mount is intact. Despite all these checks, the truck has a vibration at highway speed. What additional driveshaft-related parameter should be checked?

A. The driveshaft's rotational direction, which may have been reversed during a previous repair

B. The driveshaft tube's straightness — the tube may have been bent during a previous removal or from road debris impact

C. The driveshaft's wall thickness, which may have corroded thin and changed the shaft's resonant frequency

D. The U-joint operating angles — even with a balanced, straight driveshaft with new U-joints, incorrect operating angles produce a speed-proportional vibration; the front and rear U-joint angles must be equal within approximately 1 degree, and neither angle should exceed the U-joint manufacturer's maximum specification; incorrect angles are the most commonly overlooked cause of driveshaft vibration after all other parameters have been verified

78. A heavy-duty truck equipped with a tandem drive axle has a condition where the inter-axle differential lock indicator light on the dashboard does not illuminate when the lock switch is activated, but the differential lock actually engages (verified by the driving behavior). What is the most likely cause?

A. The dashboard indicator bulb has burned out — the lock mechanism uses separate circuits for the engagement function and the indicator function; the engagement circuit (air solenoid or electric motor that physically moves the lock collar) is functional, but the indicator circuit (bulb, wiring, or switch that reports the lock status to the dashboard) has a fault

B. The lock indicator light and the lock engagement share the same circuit, and the light failure would also prevent engagement

C. The BCM controls both the lock engagement and the indicator, and a BCM fault would affect both simultaneously

D. The lock mechanism's position sensor is misadjusted and reports the lock as disengaged even when it is engaged

79. A truck's manual transmission has a condition where the transmission pops out of 5th gear under load (during acceleration). The detent mechanism has been checked and is within specification. What else should be investigated?

A. The engine mounts, which if broken could allow the engine-transmission assembly to shift under acceleration torque, pushing the shift rail out of the 5th gear detent

B. The 5th gear's engagement teeth for wear — if the sliding sleeve's engagement teeth or the 5th gear's dog teeth have worn or rounded on their engagement faces, the helical gear's thrust force can push the sleeve out of engagement under the load of acceleration; the thrust force overcomes the worn engagement because the rounded teeth cannot maintain full-depth engagement

C. The transmission's countershaft bearing for excessive end play that allows the countershaft gear to move axially under load

D. The shift linkage for excessive free play that absorbs the shift motion before the rail reaches the detent

80. A truck equipped with a driveshaft center carrier bearing has a condition where the bearing produces a growling noise that increases with vehicle speed. The noise does not change when the vehicle is coasting in neutral at the same speed. What does the unchanged noise in neutral indicate?

A. The noise is not driveshaft-related because it would change when the torque is removed in neutral

B. The noise is from the tires, which produce a speed-dependent growl regardless of drivetrain loading

C. The center carrier bearing growls at speed regardless of torque because the bearing rotates at driveshaft speed whenever the wheels are turning — the bearing is always loaded by the weight of the driveshaft and the support forces from the mount, regardless of whether torque is being transmitted; the noise in neutral confirms the bearing as the source because it produces the same noise whether the shaft is driving or being driven

D. The noise source is the rear axle differential, which produces speed-dependent noise that does not change with torque in neutral

81. A heavy-duty truck equipped with a 10-speed manual transmission has a condition where the driver reports that the shift from 5th to 6th gear requires significantly more effort than all other shifts. The shift does not grind — it is just physically harder to move the lever. What is the most likely cause?

A. The shift tower cover on the transmission has a raised area or burr from a previous repair that interferes with the shift rail for the 5th-to-6th gate

B. The shift linkage has a binding condition at a specific point in its travel that corresponds to the 5th-to-6th shift gate — a worn bushing, a bent shift rail, or a misaligned shift tower creates mechanical resistance at that specific position; all other shifts pass through different gates that are unaffected by the localized binding

C. The 6th gear synchronizer has excessive drag from a contaminated friction surface that resists speed matching

D. The transmission oil has contaminated the 5th-6th shift rail detent, creating a sticky surface that resists rail movement

82. A truck's automatic transmission has a condition where the transmission makes a buzzing noise when the shift lever is moved from Park to Neutral. The noise lasts approximately 1 second and then stops. The noise does not occur during any other gear selection. What is the most likely source of this noise?

A. The park pawl disengaging from the output shaft ring gear produces the brief buzzing as the pawl's tooth slides across the gear's tooth faces before clearing the engagement notch

B. The transmission pump momentarily cavitates during the Park-to-Neutral transition from a sudden change in fluid demand

C. The neutral safety switch contacts buzz briefly during the transition between the Park and Neutral positions

D. The shift cable actuator motor runs briefly to confirm the neutral position after the lever is moved from Park

83. A heavy-duty truck has a driveshaft that was recently replaced with a new unit. The new driveshaft is the correct part number and specifications. After installation, the truck develops a vibration at highway speed that was not present with the old driveshaft. The U-joint angles have been verified as correct. What should be checked?

A. The new driveshaft should be checked for proper balance — even a factory-new driveshaft can have a balance issue from manufacturing tolerance; the shaft should be verified on a balance machine or the vibration should be investigated by indexing the shaft on its companion flanges (rotating it 90° or 180° to see if the vibration character changes, which confirms a balance or runout issue at the connection point)

B. The companion flange bolts should be checked for the correct torque specification for the new driveshaft

C. The new driveshaft's slip yoke should be checked for excessive axial play in the transmission output

D. The new driveshaft's tube diameter should be verified against the original to ensure the correct resonant frequency

84. A heavy-duty truck equipped with a clutch brake has a condition where the transmission grinds when shifting into 1st gear or reverse from a complete stop, even with the clutch pedal fully depressed. The clutch fully disengages when tested (the truck does not creep with the clutch depressed in gear). What is the most likely cause?

A. The synchronizer for 1st gear is worn and cannot match the input shaft speed to zero for clean engagement

B. The input shaft pilot bearing has failed and the input shaft continues to spin from the friction of the worn bearing after the clutch is released

C. The clutch release bearing travel is insufficient to fully separate the pressure plate from the disc

D. The clutch brake is worn or missing — the clutch brake's function is to stop the transmission input shaft from spinning when the clutch pedal is depressed to the floor (the last 25 mm of pedal travel); when shifting from neutral to 1st or reverse at a stop, the input shaft must be stationary; without a functional clutch brake, the shaft continues to coast, and the speed difference between the stopped gears and the spinning shaft produces the grind

85. A truck equipped with an Allison automatic transmission has a condition where the transmission downshifts are harsher than the upshifts. The upshifts are smooth and well-timed. What is the most likely cause of the harsh downshifts specifically?

A. The engine brake is interfering with the downshift timing by adding deceleration force during the gear change

B. The transmission's accumulator for the downshift circuits has lost its piston seal or spring, eliminating the cushioning effect that smooths the downshift engagement — the accumulator absorbs the initial pressure spike during clutch application; without it, the clutch applies instantaneously and produces a harsh jolt; the upshift accumulators function normally, providing smooth upshifts

C. The torque converter lockup clutch releases too late during the downshift, adding engine braking force to the gear change

D. The downshift solenoids have a faster response time than the upshift solenoids from a different electrical specification

86. A heavy-duty truck has a condition where the steering effort increases noticeably when the engine is cold but returns to normal after the engine reaches operating temperature. The power steering fluid level is correct. What is the most likely cause?

A. The power steering pump's internal clearances tighten when cold, reducing the pump's output until thermal expansion restores the designed clearances

B. The steering gear's spool valve contracts when cold and binds in the valve bore, restricting fluid flow until thermal expansion loosens the fit

C. The power steering fluid is the incorrect viscosity specification for the application's operating temperature range

D. The power steering fluid's viscosity is too high at cold temperatures — the thick cold fluid resists flow through the pump, hoses, steering gear, and metering orifices; the pump cannot circulate the fluid efficiently, and the metering orifices in the steering gear cannot pass adequate flow for responsive assist; as the fluid warms from circulation and engine heat, the viscosity decreases to the operating range and the steering effort normalizes

87. A heavy-duty truck has a condition where the steer tires show a wear pattern with one shoulder worn smoothly and the opposite shoulder showing feathered edges. What alignment condition produces this combination wear pattern?

A. Excessive toe combined with zero camber creates feathering on both shoulders equally

B. A combination of incorrect toe and camber — the smooth shoulder wear is from the camber loading one side of the tire more heavily (the tilted wheel concentrates the load on one shoulder), and the feathered edges on the opposite shoulder are from the toe angle scrubbing the tread laterally; the two alignment faults combine to produce different wear characteristics on each side of the same tire

C. Excessive positive caster creates a dynamic camber change during driving that loads one shoulder and scrubs the other

D. A bent steer axle creates a toe change during driving that feathers the outside shoulder while the inside wears from the axle's misalignment

88. A heavy-duty truck equipped with air ride suspension has a condition where one air spring on the drive axle makes a loud popping noise when the vehicle drives over bumps. The air spring appears inflated and the ride height is correct. What is the most likely cause?

A. The air spring piston (the component the air spring sits on) has corrosion or damage on its surface that causes the spring's lower bead to shift and pop during compression and extension over bumps — the bead momentarily lifts off the piston surface, then reseats with a pop; the spring holds air because the bead re-seats, but the noise indicates imminent failure

B. The air line connection at the spring base is loose and pops as air pressure fluctuates during suspension travel

C. The height control valve is adding and venting air rapidly during each bump event, and the air discharge produces the popping noise

D. The shock absorber on that position has failed and the uncontrolled spring oscillation is producing the popping from rapid compression and extension

89. A heavy-duty truck has a condition where the steering system produces a rhythmic clicking noise from the steering column area when the steering wheel is turned. The clicking occurs once per steering wheel revolution. What is the most likely cause?

A. The steering column's universal joint has a worn cross that produces a click at one specific rotational position

B. The clockspring (spiral cable) inside the steering column has a worn section that clicks against the steering shaft once per revolution

C. The steering column U-joint (or flexible coupling) has a worn or damaged element — the U-joint connects the steering wheel shaft to the steering gear input shaft through one or more flexible joints; a worn cross, a damaged coupling element, or a loose clamp bolt produces a click at the point in each revolution where the worn component loads and unloads

D. The steering wheel itself has a loose hub-to-shaft connection that produces a click as the wheel rocks on the splines

90. A trailer equipped with a lift axle has a condition where the lift axle deploys (lowers) normally but will not retract (lift). The air supply to the lift mechanism is adequate. What is the most likely cause?

A. The lift axle retraction spring has broken, eliminating the retraction force that raises the axle

B. The lift axle's air cylinder is functioning correctly but the axle's mechanical stops have shifted, preventing full retraction

C. The height control valve for the lift axle has failed and is continuously commanding the axle to the deployed position

D. The lift axle control valve or air cylinder has a fault on the retract side — the deploy side of the circuit functions (air extends the cylinder or overcomes the retraction spring to lower the axle), but the retract side is blocked (a seized valve, a kinked line, or a failed cylinder seal); the air cannot reach or effectively actuate the retract mechanism

91. A heavy-duty truck has a condition where the front steer tires wear at a significantly faster rate than expected — they are reaching minimum tread depth in 40,000 km instead of the expected 80,000+ km. The alignment is within specification and the tire inflation is correct. What should be investigated?

A. The tire brand and model — different tire manufacturers produce steer tires with significantly different tread compounds and wear rates; a tire with a softer compound provides better traction but wears faster; the expected 80,000 km life may be based on a different tire model than what is installed

B. The driving patterns — frequent city driving with tight turns at low speed generates more tire scrub than highway driving; a truck that operates primarily in urban delivery service will wear steer tires faster than a highway truck

C. The brake system for drag on the steer axle that generates heat and accelerates tire wear from the elevated operating temperature

D. The driver's operating environment, brake condition, and the specific tire compound — aggressive driving (hard cornering, frequent turning), sustained brake drag that heats the tires, or a tire compound that is softer than the expected baseline all accelerate steer tire wear even with correct alignment and inflation

92. A heavy-duty truck's fifth wheel has a condition where the trailer bounces on the fifth wheel during highway driving — the trailer nose lifts and drops rhythmically. What is the most likely cause?

A. The fifth wheel's top plate has excessive wear that creates a loose fit between the plate and the trailer's upper coupler

B. The tractor's rear air ride suspension is lacking adequate damping from worn shock absorbers — the undamped suspension allows the rear of the tractor to oscillate, and the fifth wheel (mounted on the tractor frame behind the suspension) transmits this oscillation to the trailer's nose; the trailer follows the tractor's rhythmic motion, producing the bouncing sensation

C. The fifth wheel mounting bolts have loosened, allowing the fifth wheel assembly to pivot on the frame

D. The trailer's landing gear is not fully retracted and is intermittently contacting the ground during suspension travel

93. A truck's steer axle alignment shows total toe of 4 mm toe-in. The specification is 1.5 to 3 mm toe-in. What symptom will this excessive toe-in produce?

A. The truck will pull to one side during straight-line driving

B. The steering wheel will vibrate at highway speed from the opposing tire scrub forces

C. Both steer tires will show accelerated feathered wear on the outside edges of the tread — the excessive toe-in angles the front of each tire inward beyond the design specification, causing the outside edges of the tread to scrub against the road surface; the feathering develops on the outside edge as the tread blocks are dragged sideways during each revolution

D. The steering will feel heavy during parking maneuvers from the increased tire scrub angle

94. A trailer equipped with disc brakes has a condition where one rotor has developed blue discoloration across its entire friction surface. The other rotors show no discoloration. What does the blue color indicate, and what should be done?

A. The blue rotor has been contaminated with a chemical that has discolored the surface but does not affect its braking performance

B. The blue color is a normal heat tint from the pad break-in process and will fade during continued service

C. The blue rotor has experienced a single extreme heat event from the pad break-in process

D. The blue rotor has been subjected to temperatures exceeding 300°C that have altered the cast iron's metallurgy — the heat may have been caused by a dragging caliper, a seized slide pin, or excessive braking; the rotor must be checked for hardness variation and thickness variation because the heat may have created hard spots and warpage; if the rotor's properties have been altered, it must be replaced because the changed metallurgy can cause brake pulsation and reduced friction performance

95. A truck equipped with hub-piloted aluminum wheels has a condition where one wheel has developed a circumferential crack around the center bore. The crack follows the edge of the center bore and extends approximately 90 degrees around the circumference. What caused this crack?

A. The wheel was manufactured from a batch of aluminum with a casting defect that has propagated over time

B. The center bore crack was caused by the wheel operating with excessive hub runout — the hub pilot pads were corroded, damaged, or had debris that prevented the wheel from seating concentrically on the hub; the off-center wheel was loaded eccentrically at the center bore with each revolution, creating a cyclic stress that initiated and propagated the fatigue crack around the bore

C. The wheel was over-torqued during installation, creating a compression stress at the center bore that exceeded the aluminum's fatigue limit

D. The wheel was subjected to an impact event (pothole or curb strike) that cracked the center bore from the concentrated impact force

96. A heavy-duty truck's frame inspection reveals that the left frame rail has a slight bow outward (lateral bend) approximately 2 metres behind the cab. The bow is approximately 15 mm from the straight edge. What could cause this localized lateral bow?

A. The bow was caused by a side impact to the frame at that location — a collision with a fixed object, a sideswipe from another vehicle, or contact with a loading dock at the specific point where the bow is located; the frame absorbed the lateral force and deformed outward; the localized nature of the bow (2-metre section) indicates a point impact rather than a distributed load

B. The frame rail has a manufacturing defect that has gradually revealed itself over the vehicle's service life

C. The frame's crossmember at that location has loosened, allowing the rail to bow outward under the torsional loads of normal driving

D. The suspension load on the left side has been chronically higher than the right, gradually bending the rail outward from the asymmetric loading

97. A heavy-duty truck equipped with leaf spring suspension has a condition where one front spring makes a squeaking noise over bumps that is temporarily silenced by lubrication. What is the root cause of the recurring squeak?

A. The spring leaves are contacting each other without inter-leaf friction pads — the metal-to-metal contact between the leaves produces a squeak during suspension deflection; lubrication temporarily silences the noise by reducing the friction between the leaves, but the lubricant is expelled quickly during normal driving and the noise returns

B. The spring mounting bushings have dried out and the rubber-to-metal contact produces the squeak during deflection

C. The spring's U-bolt clips have loosened and the spring pack shifts slightly during each bump, producing the squeak at the U-bolt contact points

D. The spring's main leaf eye bushing is dry and produces a squeak as the spring pivots in the hanger during each bump event

98. A truck has a condition where the right rear dual tires consistently run hotter than the left rear dual tires on the same axle. The tire pressures are equal and the tires are the same specification. The brake adjustment is correct on both sides. What should be investigated?

A. The right rear brake for a slight drag that is not severe enough to produce a noticeable performance symptom but generates enough friction heat to elevate the tire temperature

B. The differential for a torque bias that sends more power to the right side, generating more tire heat from the increased traction load

C. The right rear wheel bearings for a tight adjustment that generates friction heat transferred to the hub and tires — a tight bearing preload creates continuous rolling friction that elevates the bearing temperature; this heat conducts through the hub to the wheel and tires; the left side's correctly adjusted bearings run cooler because they generate less friction

D. The exhaust system routing, which may run closer to the right rear tires and radiate heat onto them during driving

99. A trailer equipped with an air ride suspension has a condition where the ride height is correct but the trailer rolls excessively during cornering — the trailer leans significantly more than similar trailers during the same turns. What should be investigated?

A. The trailer's cargo center of gravity, which may be higher than normal from the cargo arrangement

B. The air spring pressures, which if lower than specification would allow excessive roll despite maintaining the correct ride height through the height control valves

C. The height control valve response time, which if too fast would actually reduce roll by compensating during cornering

D. The shock absorbers and sway bar (if equipped) — the roll rate during cornering is controlled by the shock absorbers' resistance to lateral body motion and the sway bar's resistance to differential suspension travel between the left and right sides; worn shock absorbers and a damaged or disconnected sway bar allow the trailer to lean excessively during cornering

100. A truck has a condition where the steer tires show a wear pattern that is normal on the left tire but shows a wear pattern on the right tire where every other tread rib is worn significantly more than its adjacent rib. What is the most likely cause?

A. The right tire has an internal structural defect that causes alternating ribs to contact the road at different pressures

B. The right side king pin bushing is worn, allowing the wheel to shift between two positions during driving — the shift changes the effective camber and toe on the right side with each road input, loading alternate ribs more heavily than their neighbors

C. The right steer tire was manufactured with alternating rib heights as a directional tread feature that was installed on the wrong side

D. A cupped or scalloped wear pattern on the right tire that appears as alternating rib wear — this pattern develops from a worn right-side shock absorber that allows the tire to bounce, creating intermittent heavy contact on alternating ribs; the left shock absorber is functional and maintains even tire contact, producing the normal wear pattern on the left tire

101. A trailer has a condition where one axle position on the tandem shows significantly more brake dust on the wheel than the other axle positions. The brake adjustment and lining thickness are the same on all positions. What does the excessive brake dust on one position indicate?

A. The brake drum on that position is undersized from excessive machining, and the shoes contact the drum at a different angle that generates more dust

B. The brake lining on the dusty position is a different compound — whether from a previous service that installed a non-matching replacement lining or from a manufacturing variation, the different compound produces more dust than the standard lining at the other positions; alternatively, the lining is contaminated with oil that changes its friction characteristics and dust production

C. The height control valve on that corner is set to a slightly different ride height, changing the load distribution and brake effort

D. The ABS modulator on that position is cycling more frequently than the others, generating additional pad friction and dust

102. A truck equipped with air ride suspension has a condition where one corner of the vehicle sits approximately 20 mm lower than the other three corners. The air spring appears inflated. The height control valve's linkage has been adjusted and the ride height was set to specification 5,000 km ago. What should be checked?

A. The air spring's internal volume, which may have decreased from a partially collapsed bellows

B. The height control valve linkage for wear or looseness that has changed the valve's reference position since the adjustment — a worn bushing, a loose bolt, or a bent linkage arm in the valve's sensing mechanism shifts the valve's "level" reference point, causing it to maintain a height that is 20 mm lower than the original setting; the valve functions correctly but operates around an incorrect reference

C. The frame for a localized deflection at the air spring mounting point that has lowered the spring's attachment position

D. The air supply line to that spring for a restriction that limits the air volume available to maintain full height

103. A heavy-duty truck's power steering produces a shuddering (oscillating) sensation through the steering wheel during low-speed turns in a parking lot. The shudder is not present during highway steering. What is the most likely cause?

A. The power steering pump has a worn internal component that produces a pulsating output at the low flow rates of slow-speed steering — the pulsation is amplified by the steering gear's hydraulic circuit and transmitted to the steering wheel as a shudder; at highway speed, the higher flow rates smooth the pulsation and the shudder is not perceptible

B. The front tires have a flat spot that produces a shudder only at parking-lot turning speed

C. The steering gear's sector shaft bearing has play that produces a shudder during the high-load, low-speed turns

D. The king pin bushings are worn and allow the steering knuckles to chatter during the high-effort, low-speed turning

104. A heavy-duty truck's cab has a condition where the windshield develops condensation (fog) on the outside surface during cool, humid mornings when the A/C is running in recirculation mode. What is causing the external fogging?

A. The A/C system is overcooling the windshield glass from the inside, dropping the exterior glass surface temperature below the ambient air's dew point

B. The windshield glass has a manufacturing defect that attracts moisture on its exterior surface

C. The HVAC system's defrost ducts are leaking cooled air onto the exterior windshield surface through a gap in the cowl

D. The windshield's interior surface temperature (cooled by the A/C in recirculation mode) drops the exterior glass surface below the ambient dew point — the cold glass chills the humid ambient air on its exterior surface below the dew point, and moisture condenses as fog on the outside; switching to fresh air mode or defrost mode introduces warmer air to the windshield interior, raising the glass temperature above the dew point and clearing the exterior fog

105. A transit bus has a condition where the driver's side window regulator motor operates but the window does not move. The motor's sound is heard when the switch is activated. What is the most likely cause?

A. The window regulator's internal gear or cable mechanism has failed — the motor is turning but the mechanical connection between the motor and the window glass has broken (a stripped gear, a broken cable, or a detached mounting clip); the motor runs freely because there is no load, and the window remains stationary because no force reaches the glass

B. The window glass has bonded to the rubber channel from age and adhesion, and the motor cannot generate enough force to break it free

C. The window regulator motor is spinning in the wrong direction and is tightening the mechanism against a stop instead of moving the glass

D. The window switch has a faulty contact that powers the motor but does not release the window's holding brake

106. A heavy-duty truck's cab has a condition where the driver reports a vibration felt through the steering wheel that appears only when the cab's HVAC blower is on high speed. The vibration is not present when the blower is off or on lower speeds. What is the most likely cause?

A. The HVAC blower motor is out of balance from a damaged or contaminated fan wheel — the imbalanced fan produces a vibration that is transmitted through the HVAC housing, the dash structure, and the steering column to the steering wheel; the vibration appears only on high speed because the centrifugal force from the imbalance increases with the square of the rotational speed, making it imperceptible at lower speeds but noticeable at high speed

B. The blower motor's mounting bracket has loosened and the motor rocks at high speed, transmitting vibration through the dash

C. The HVAC ducts resonate at the airflow frequency produced by the high-speed blower setting

D. The blower motor's electrical draw on high speed creates a voltage fluctuation that affects the steering wheel's heated element

107. A truck's cab tilt pump motor runs when the tilt switch is activated, but the cab does not tilt. The pump sounds like it is running normally. What is the most likely cause?

A. The cab tilt safety latch has not been released before attempting the tilt operation

B. The cab tilt hydraulic pump is running but producing no hydraulic pressure — the pump may have a failed internal check valve, a ruptured suction line, or the hydraulic fluid reservoir may be empty; the motor runs the pump, but the pump cannot draw or pressurize fluid to extend the tilt cylinder

C. The cab tilt cylinder has seized from corrosion and the pump cannot develop enough pressure to overcome the seized piston

D. The cab tilt hydraulic circuit has a bypass valve stuck in the open position, routing all pump output directly back to the reservoir instead of to the tilt cylinder

108. A heavy-duty truck has a condition where the cab's interior trim panels produce annoying rattling noises over rough roads. The rattles come from multiple locations — the dash, the door panels, and the headliner. What is the most probable underlying cause?

A. The individual trim panel fasteners and clips have loosened from years of vibration exposure

B. The cab mounting bushings have deteriorated, allowing the cab to transmit more road vibration through the frame to the interior structure

C. The cab's structural welds have cracked from fatigue, allowing the cab panels to flex independently

D. The cab mounting isolators (bushings or rubber mounts) have hardened or deteriorated — when new, the isolators absorb and dampen the vibration transmitted from the frame to the cab; hardened or deteriorated isolators transmit more vibration directly to the cab structure, which excites every panel, clip, and trim piece throughout the cab; replacing the cab mounts restores the original isolation and reduces all the rattles simultaneously

109. A dry van trailer has a condition where the floor shows depressions (sunken areas) at regular intervals that correspond to the floor crossmember locations. The floor surface between the crossmembers is level. What caused these depressions?

A. The floor material has swelled from moisture absorption between the crossmembers while shrinking at the crossmembers from the hardware compression

B. The crossmembers have rusted and expanded, pushing the floor material upward between the crossmembers while the floor sits lower at the corroded crossmember locations

C. The depressions at the crossmember locations are caused by forklift traffic — forklifts entering the trailer concentrate their wheel loads on the floor, and the floor material deflects less at the crossmember locations (where it is supported) but the repeated concentrated loading at the crossmember contact points has gradually compressed or crushed the floor material at these support points

D. The trailer frame has sagged between the crossmembers, and the floor follows the frame's deflection

110. A trailer's air ride suspension has a condition where the system maintains correct ride height when loaded but the trailer slowly rises above the correct ride height when empty. What is the most likely cause?

A. The height control valve's sensing linkage has been adjusted for the loaded condition and the geometric relationship between the linkage and the valve changes when the trailer is unloaded — the valve's reference position shifts at the unloaded ride height, causing it to add air beyond the correct empty ride height

B. The air springs have a non-linear spring rate that causes them to extend beyond the designed height when the load is removed

C. The height control valve has a leaking seal on its exhaust port that prevents it from venting air when the ride height exceeds the set point

D. The trailer's air supply pressure is too high for the air springs' rated capacity at the unloaded weight

111. A trailer equipped with drum brakes has a condition where one brake drum shows circumferential scoring (groove around the entire drum surface) at the center of the lining contact area. What caused this scoring?

A. The brake shoe rivets have worn through the lining at the center of the shoe, and the exposed rivet heads are scoring the drum during each wheel revolution

B. A foreign object (stone, bolt, or debris) has become lodged between the shoe and drum and is scoring the drum as the wheel rotates

C. The S-cam has worn flat and is concentrating the shoe contact at one narrow band instead of distributing it across the full lining width

D. The brake lining has worn through to the rivets or the shoe table at one localized point — the exposed metal contacts the drum and scores a groove around the entire circumference as the drum rotates; the scoring is at the center of the contact area because the lining wears fastest at the point of maximum contact pressure

112. A reefer trailer's temperature monitoring system shows that the cargo temperature has fluctuated between −16°C and −22°C during a 6-hour trip. The setpoint is −18°C. Is this fluctuation acceptable?

A. The fluctuation is unacceptable — the cargo temperature should maintain the setpoint within ±1°C at all times during transport

B. A ±4°C fluctuation around the setpoint during transport is within the normal operating range for a reefer trailer — the TRU cycles between cooling and defrost modes, and the cargo temperature oscillates around the setpoint during each cycle; the fluctuation depends on the TRU's capacity, the cargo's thermal mass, the ambient temperature, and the door-opening frequency

C. The fluctuation indicates the TRU's thermostat has a calibration error that needs correction

D. The fluctuation is caused by a failing TRU compressor that cannot maintain consistent cooling output

113. A trailer's structural inspection reveals a crack at the gooseneck (the forward section where the trailer necks down to clear the tractor's rear axle). The crack is at the junction between the gooseneck's upper plate and the main I-beam's top flange. What is the structural significance of this location?

A. The gooseneck-to-main-frame junction carries the highest stress concentration in the trailer's structure — all of the trailer's cargo weight and dynamic loads are transferred from the main frame to the gooseneck and then to the king pin; the junction between these two sections is a geometric stress riser where the frame's cross-section changes abruptly; cracks at this location compromise the trailer's most critical structural transition and must be repaired immediately according to the manufacturer's approved procedure

B. The gooseneck crack is a cosmetic issue because the king pin assembly carries the load independently of the gooseneck plates

C. The crack at the gooseneck is less critical than a crack at the tandem suspension mount because the gooseneck only supports the nose weight, not the full cargo weight

D. The gooseneck crack is a maintenance item that should be monitored at each annual inspection but does not require immediate repair unless it extends more than 100 mm

114. A trailer's lighting system has a condition where all lights function correctly when tested at the shop with the engine running, but the driver reports that the lights flicker during highway driving. What is the most likely cause?

A. The alternator's voltage fluctuates at highway RPM, causing all trailer lights to respond to the voltage variation

B. The engine's vibration at highway speed is transmitted through the tractor frame to the fifth wheel, through the upper coupler to the trailer frame, and is loosening a marginal electrical connection in the trailer's lighting system

C. The J560 connector has a pin or pins that make adequate contact when stationary but lose contact intermittently during the vibration of highway driving — the connector's pins may be worn, corroded, or pushed back in the connector body, and the road vibration is enough to break contact momentarily

D. The trailer's ABS module is cycling power to the lighting circuits during highway operation as part of a self-diagnostic routine

115. A flatbed trailer has a condition where the deck boards are cupping (curling upward at the edges). The boards were installed flat 2 years ago. What caused the cupping, and what is the consequence?

A. The boards have dried unevenly — the top surface dries faster than the bottom surface from sun exposure and airflow, causing the top to shrink relative to the bottom and creating the upward curl; cupped boards create trip hazards, uneven cargo support, and can damage cargo packaging from the raised edges

B. The boards have absorbed moisture from below (from trapped condensation between the boards and the crossmembers) and swelled on the bottom surface

C. The boards were installed without proper cross-grain orientation and the natural grain has curled the boards over time

D. The crossmembers have corroded and dropped slightly, allowing the boards to flex upward between the fastening points

116. A trailer equipped with electric brakes (common on lighter trailers) has a condition where the brakes on the right side are significantly weaker than the left side. The brake controller in the tractor produces the correct output voltage. What should be investigated?

A. The right-side brake drums for an out-of-round condition that reduces the brake shoe contact area

B. The right-side brake magnet and wiring — the electric brake magnet on the right side may have excessive resistance from a corroded connector, a partially broken wire, or a worn magnet that draws less current than the left side; reduced current produces a weaker magnetic field that generates less friction force against the drum, resulting in weaker braking on the right side

C. The brake controller's polarity, which may be reversed for the right-side output

D. The right-side brake shoes for a different lining compound than the left side

117. A truck's A/C system has a condition where the compressor makes a loud rattling noise when the clutch first engages, then the noise quiets after 2-3 seconds. The noise returns every time the compressor cycles on. What is the most likely cause?

A. The compressor has an internal liquid slugging condition — liquid refrigerant that has accumulated in the compressor housing during the off cycle is compressed (slugged) during the first few revolutions after engagement; the liquid cannot be compressed like a gas and the impact of the piston against the liquid produces the rattling; the noise stops once the liquid has been pumped through and the compressor is handling vapor only

B. The compressor clutch air gap is too wide, causing a delayed engagement that produces the rattle

C. The compressor mounting bolts have loosened and the compressor shifts position briefly during each engagement

D. The compressor's internal valve plate has cracked and flutters during the initial engagement before stabilizing

118. A truck's HVAC system has a condition where the heater core produces adequate heat but the floor duct outlets deliver warm air while the dashboard and defrost outlets deliver cold air when both are selected simultaneously. What is the most likely cause?

A. The HVAC housing has an internal partition (baffle) that separates the heated air pathway to the floor from the pathway to the upper ducts

B. The dash and defrost outlets are located further from the heater core and the air cools as it travels through the longer ductwork

C. The blend door is partially open — the warm air from the heater core takes the shorter path to the floor ducts, while the air destined for the upper ducts passes through the A/C evaporator section of the housing (which retains residual cold from previous A/C operation) before reaching the dashboard and defrost outlets; the blend door position is routing some air through the cold evaporator section

D. The blower motor distributes air unevenly within the HVAC housing, delivering more heated air to the lower ducts and less to the upper ducts

119. A truck's A/C system has manifold gauge readings showing: high side 280 psi, low side 45 psi. Normal readings for the current 35°C ambient temperature should be: high side 250 psi, low side 30 psi. Both readings are higher than normal. What is the most likely system condition?

A. The compressor is over-pressurizing the system from a failed unloading mechanism

B. The expansion valve is stuck partially open, allowing excessive refrigerant to flood the evaporator

C. The condenser fan has failed, preventing adequate heat rejection from the condenser at the high ambient temperature

D. The system is overcharged — excess refrigerant raises both the high-side and low-side pressures above normal; the high side is elevated because the condenser contains more liquid refrigerant than it can cool effectively, and the low side is elevated because the excess refrigerant floods the evaporator with more liquid than the airflow can evaporate

120. A truck's cab heater produces heat normally but the heater hose that supplies hot coolant to the heater core is so hot that it burns the technician's hand when touched briefly. The engine coolant temperature is normal. Is the hot heater hose a concern?

A. The heater hose temperature is dangerously high and indicates a cooling system overpressure condition

B. The hot heater hose is normal — the heater supply hose carries engine coolant at the engine's operating temperature (typically 80-95°C), which is hot enough to cause burns on brief skin contact; the coolant temperature is within the designed operating range, and the hose temperature simply reflects the coolant temperature it is carrying

C. The heater control valve has failed open and is allowing excessive coolant flow that should be restricted

D. The thermostat is stuck closed and the engine is running hotter than the dashboard gauge indicates, overpressurizing the heater hose

121. A truck's A/C system has been recharged after a compressor replacement. The system cools adequately but the new compressor is significantly noisier than the original. The noise is a constant whine that varies with compressor speed. What should the technician check?

A. The system refrigerant charge weight — an overcharged system forces the compressor to work harder and produces a whine from the elevated internal pressures and the effort of compressing liquid refrigerant; verify the charge weight against the specification and recover any excess

B. The compressor oil type and quantity, which may not match the specification for the replacement compressor

C. The compressor belt tension, which if too tight would load the compressor bearings and produce a whine

D. The compressor mounting bracket, which if misaligned would load the compressor body at an angle and produce the whine

122. A bus's rear passenger A/C unit produces a clicking noise from the evaporator area that corresponds to the compressor clutch cycling. The clicking occurs once each time the compressor engages and once each time it disengages. What is the most likely cause?

A. The rear evaporator's expansion valve is opening and closing with each compressor cycle, producing a click

B. The rear evaporator's mounting brackets have loosened, and the sudden pressure change in the evaporator coil when the compressor engages and disengages causes the evaporator to shift slightly and click against the mounting structure

C. The pressure change in the evaporator coil during each compressor engage/disengage event flexes the evaporator housing or a connected component — the sudden pressure increase when the compressor engages and the sudden decrease when it disengages create a thermal/mechanical shock that produces a click; this is typically caused by a loose mounting bracket, a loose evaporator core in its housing, or an expansion valve that snaps open and closed with each pressure change

D. The compressor clutch solenoid produces an audible click that is transmitted through the refrigerant lines to the evaporator

123. A truck's HVAC system has a condition where the fresh-air intake draws in diesel exhaust fumes from the truck's own exhaust during specific driving conditions — typically during low-speed reversing maneuvers. What design or operational factor causes this?

A. The HVAC fresh-air intake is located at the base of the windshield, and during reversing, the truck's own exhaust is carried forward by the reverse movement and drawn into the intake — the wind direction created by the vehicle's rearward motion pushes the exhaust gases from behind the truck forward along the vehicle's body to the cowl area where the fresh-air intake is located

B. The exhaust system has a leak forward of the turbocharger that releases gases near the fresh-air intake

C. The HVAC system's recirculation door opens automatically during reverse gear, drawing outside air instead of recirculating the cab air

D. The truck's exhaust pipe extension has broken off, shortening the exhaust outlet and directing gases under the vehicle instead of behind it

124. A hydraulic system on a utility truck has a condition where all functions operate correctly when the engine is at operating RPM (1,200+) but the boom lift function moves very slowly at engine idle (600 RPM). All other functions operate at acceptable speed at idle. What is the most likely cause?

A. The boom lift circuit requires more flow than the other circuits, and at idle the gear pump produces barely enough flow for the lighter functions but not enough for the boom lift's larger cylinder volume

B. The boom lift cylinder has developed internal bypass that is more pronounced at the lower pressures generated at idle RPM

C. The boom lift directional valve has a partial restriction that limits flow to the boom circuit at the lower pump output of idle speed

D. The boom lift counterbalance valve has a high crack pressure that requires elevated system pressure to open — at idle, the pump produces adequate flow but the pressure is lower than at operating RPM; the reduced pressure cannot fully open the counterbalance valve, restricting the flow reaching the lift cylinder

125. A hydraulic crane has a condition where the boom swings smoothly in one direction but produces a jerky, oscillating motion when swinging in the opposite direction. What is the most likely cause?

A. The swing motor has worn bearings that produce vibration when loaded in one rotational direction

B. The swing circuit's counterbalance valve or over-center valve has a calibration problem on one direction — the valve that controls the deceleration and load-holding for the return swing direction is set too high or is sticking, causing it to chatter (alternately open and close) during the swing; the other direction's valve is calibrated correctly and produces smooth operation

C. The swing motor's internal displacement changes with rotational direction due to a worn swash plate

D. The swing bearing (slew ring) has a worn section that the swing motor encounters only during rotation in the jerky direction

126. A hydraulic system's reservoir has a sight glass that shows milky-colored hydraulic fluid. The system was operating normally until a recent rain event. What has contaminated the fluid, and what is the consequence?

A. The rain introduced water into the reservoir through a damaged or missing breather cap — water mixing with hydraulic oil creates a milky emulsion; the water reduces the oil's lubricating properties, causes internal corrosion on precision-machined surfaces (pumps, valves, cylinders), promotes seal deterioration, and changes the fluid's viscosity characteristics; the contaminated fluid must be drained, the system flushed, the breather cap replaced, and the system refilled with clean fluid

B. The milky color is from air entrainment caused by the rain cooling the reservoir and creating a vacuum that drew air through the return line

C. The hydraulic fluid has reached its maximum service life and the milky appearance indicates additive precipitation

D. The rain water has entered the system through the cylinder rod seals and mixed with the hydraulic oil during retraction

127. A hydraulic system uses an accumulator in the brake circuit to provide emergency braking capability if the hydraulic pump fails. The technician discovers that the accumulator's nitrogen pre-charge pressure is 50% below the specification. What is the consequence of the low pre-charge?

A. The accumulator cannot store adequate energy for the emergency brake function — the nitrogen pre-charge determines how much hydraulic energy the accumulator stores at system pressure; a 50%

reduction in pre-charge means the accumulator stores significantly less energy, and it may not have enough stored volume and pressure to provide the number of emergency brake applications specified for the system

B. The low pre-charge has no effect on the accumulator's emergency brake function because the system pump replenishes the accumulator during normal operation

C. The accumulator's low pre-charge will cause the brake system to activate unexpectedly during normal operation

D. The low pre-charge will cause the accumulator's bladder to rupture from being compressed beyond its design range

128. A hydraulic system has a condition where the pump's pressure gauge shows steady pressure during all functions, but the gauge needle oscillates rapidly (vibrates) when no functions are commanded and the system is in standby. What causes the oscillation during standby?

A. The pump is producing pressure pulsations that are normally absorbed by the system's fluid volume during active functions — in standby, the small volume of trapped fluid between the pump and the closed directional valve cannot absorb the pulsations, and the gauge needle oscillates with each pump displacement cycle; the oscillation frequency corresponds to the pump's piston or gear mesh frequency

B. The gauge's internal mechanism has a resonant frequency that coincides with the engine idle speed

C. The pressure relief valve is chattering at the standby pressure setting

D. The directional valve's neutral position has a leaking spool that creates alternating pressure pulses

129. A hydraulic crane has a condition where the boom telescope retracts normally when unloaded but cannot retract when the boom is loaded with the crane's rated capacity. The system pressure reaches the relief valve setting. What is the most likely cause?

A. The telescope retract circuit's relief valve is set too low for the force required to retract the telescope under the rated load

B. The retract circuit does not have adequate force — the rod-side area of the telescope cylinder is smaller than the cap-side area (because the rod occupies part of the bore), so the retract force is less than the extend force at the same system pressure; the load creates friction and gravity forces that the reduced retract force cannot overcome at the current system pressure

C. The telescope cylinder's piston seal is bypassing under the higher pressure required for loaded retraction

D. The boom's internal friction increases under load from the weight deflecting the telescoping sections against their guides, and the retract circuit cannot generate adequate force to overcome the combined load and friction forces at the relief valve's pressure setting

130. A hydraulic system on a dump truck has a condition where the body raises to full height normally but the operator hears a loud "thud" from the hydraulic circuit when the dump body reaches full extension. What causes the thud?

A. The dump body's mechanical stop at full extension transmits an impact force through the cylinder to the hydraulic circuit

B. The cylinder piston contacts the cylinder cap at full extension without adequate deceleration — the cylinder's internal cushion has failed or was not designed for the application, and the piston impacts the cap at the full travel speed, producing a hydraulic shock wave and mechanical impact (thud) that transmits through the hydraulic lines and the dump body structure

C. The directional control valve does not shift to neutral quickly enough when the cylinder reaches full stroke, causing a momentary pressure spike

D. The relief valve opens at the end of stroke as the pump continues to deliver fluid against the fully extended cylinder

131. A hydraulic system has a condition where the pump cavitates intermittently — the cavitation noise appears and disappears randomly. The suction line and strainer have been inspected and are clear. The reservoir level is adequate. What else could cause intermittent cavitation?

A. The reservoir breather cap is partially blocked — the breather allows atmospheric air to enter the reservoir as the pump draws fluid; a partially blocked breather restricts the air entry, creating a partial vacuum inside the reservoir during periods of high pump demand; the vacuum reduces the pressure at the pump inlet below the fluid's vapor pressure, causing cavitation; when the pump demand decreases, the restricted breather can equalize the pressure and the cavitation stops

B. The pump's drive coupling has intermittent slippage that momentarily reduces the pump speed below the self-priming threshold

C. The hydraulic fluid has entrained air from a previous service that has not fully separated in the reservoir

D. The pump's internal relief valve is cycling at a frequency that creates intermittent suction-side pressure fluctuations

132. A battery electric transit bus has a condition where the driving range decreases by approximately 5% every month even though the battery state of health (SOH) remains stable at 92%. The bus operates on the same route with the same passenger load. What is the most likely cause of the progressive range reduction?

A. The bus's auxiliary systems (HVAC, lighting, door mechanisms) are drawing progressively more energy from a developing electrical fault

B. The tire pressures on the drive axle have been gradually decreasing — underinflated tires increase rolling resistance proportionally; a 10% reduction in tire pressure can increase rolling resistance by 5-8%, which directly reduces the bus's electrical driving range by the same percentage; the progressive monthly decrease matches the gradual air loss pattern of tires that are not being checked regularly

C. The regenerative braking system's efficiency is degrading from wear on the traction motor's brushes (if applicable)

D. The traction motor's permanent magnets are gradually demagnetizing from the cumulative thermal cycling of daily operation

133. A hybrid electric truck has a condition where the engine-driven generator produces a whining noise that was not present when the truck was new. The generator produces the correct voltage and current output. What is the most likely cause of the new noise?

A. The generator's internal bearings have worn from the continuous high-speed rotation and high-current loading of hybrid operation

B. The generator's internal bearings have worn, increasing the internal clearances — the worn bearings allow the rotor to vibrate within the enlarged clearance, and the vibration produces a whine that increases with rotational speed; the generator continues to function (producing correct output) because the clearance has not yet progressed to the point of mechanical failure, but the noise indicates progressive degradation that will eventually require bearing replacement or generator rebuild

C. The generator's cooling fan blades have accumulated carbon deposits from the engine exhaust that create an aerodynamic imbalance

D. The generator's drive belt has glazed and is slipping on the pulley, producing a belt-related whine rather than a bearing-related noise

134. A battery electric truck's BMS reports a cell voltage imbalance — one cell in the 96-cell pack reads 3.2V while all others read 3.7V (the nominal voltage). What is the consequence of this single-cell imbalance?

A. The single low cell limits the entire pack's performance — the BMS protects the weakest cell by limiting the pack's discharge current and total energy output to prevent the low cell from dropping below its minimum safe voltage; the pack's usable capacity is reduced to the capacity of the weakest cell, and the single low cell effectively determines the pack's overall performance

B. The single cell imbalance has no effect on the pack's performance because the other 95 cells compensate for the weak cell

C. The BMS isolates the weak cell from the circuit and the pack operates on the remaining 95 cells at a slightly reduced voltage

D. The weak cell will be charged to 3.7V during the next regenerative braking event and the imbalance will self-correct

135. A plug-in hybrid electric bus has a condition where the high-voltage battery charges normally from the charging station but the regenerative braking system does not charge the battery during driving — the battery SOC decreases steadily during operation despite the bus making frequent stops. What is the most likely cause?

A. The regenerative braking system's inverter is not receiving the torque command from the VCU during braking events

B. The friction brakes are doing all the braking and the regenerative system is not being commanded to activate

C. The regenerative braking system has a fault — the inverter, the motor's generator function, or the communication between the VCU and the motor controller has a fault that prevents the traction motor from switching to generator mode during braking; the bus brakes using the friction brakes only, and no energy is recovered; the charging station charges the battery normally because the charging circuit is a separate system from the regenerative circuit

D. The battery has reached its maximum charge cycle count and the BMS has disabled regenerative charging to protect the cells from further cycling degradation

Practice Exam 12: Answer Key and Explanations

1. D — The maximum allowable gap between the grinding wheel and the tool rest is 3 mm (1/8 inch). A wider gap allows the workpiece to be pulled into the space between the wheel and the rest by the wheel's rotational force. Once caught, the wheel's rotation ejects the piece violently, creating a projectile hazard. The tool rest must be adjusted to within 3 mm of the wheel face before every grinding operation.

2. B — Fuel lines and filters containing residual diesel fuel within 300 mm of a welding operation are a fire hazard. Radiant heat, sparks, and weld spatter can ignite residual fuel in the lines or on the fitting surfaces. The lines must be disconnected, capped to contain any residual fuel, and relocated outside the welding heat zone before any welding or cutting begins.

3. A — The immediate priority is containing the spill to prevent it from spreading, particularly toward floor drains where it could enter the municipal sewer system. Absorbent material (floor-dry, pads, or booms) surrounds and absorbs the fluid, the absorbed material is collected, and it is disposed of as used petroleum product. The spill also creates an immediate slip-and-fall hazard for all shop personnel that must be addressed.

4. C — Canadian regulations require technicians who service mobile A/C systems to hold a valid ODS/HFC refrigerant handling certificate. This certification covers refrigerant identification, safe recovery and recycling procedures, and the environmental regulations governing refrigerant handling. The certificate requirement applies regardless of the technician's other certifications and regardless of the system's operating pressure.

5. D — Vehicle lifts exert enormous forces on their anchor bolts during operation — the full weight of the vehicle plus dynamic forces during raising and lowering. A crack extending from an anchor bolt indicates the concrete foundation is failing under these forces and may not securely resist the lift's loads. The lift must be taken out of service until the foundation is inspected and repaired by a qualified structural contractor.

6. B — Heating a brake line with a propane torch creates multiple hazards. If the line contains brake fluid, the localized heating boils the fluid and creates a vapor pocket that reduces braking effectiveness. The heat can weaken the tubing wall, damage internal coatings, and burn through the line. Additionally, grease or petroleum residue on the fitting surface can ignite from the flame. Alternative heating methods (induction heater) or penetrating oil should be used.

7. A — A lockout device physically prevents a piece of equipment (electrical panel, pneumatic valve, hydraulic circuit) from being energized or activated while a technician is working on it. The device ensures that another person cannot unknowingly restore power to equipment being serviced, preventing injury or death from unexpected machine activation. The attached tag identifies who applied the lock and provides accountability.

8. C — A tire/rim assembly under inflation pressure can fail explosively from a defective rim, an improperly seated bead, or a damaged tire. The explosive failure projects tire and rim fragments at lethal

velocity. A safety cage contains this explosive force, and a clip-on chuck with an extension hose allows the technician to stand at a safe distance during inflation. These precautions are mandatory for every tire inflation operation.

9. D — Over 500,000 km, the fuel injector nozzle spray holes gradually enlarge from the erosive force of high-pressure fuel passing through them. The enlarged holes produce coarser fuel droplets that do not atomize as finely as the original specification, resulting in marginally less complete combustion. The slightly darker exhaust reflects this reduced atomization quality without affecting total power output or triggering sensor-detectable deviations.

10. B — The most efficient diagnostic sequence is to first verify the injector receives its electrical command (confirming the ECM is commanding the injector), then swap the suspected injector with an adjacent cylinder's injector. If the dead cylinder follows the injector, the injector is confirmed as faulty. If cylinder 4 remains dead with a known-good injector, the problem is mechanical (compression, valve train), and a compression or leakage test is the next step.

11. A — Cold oil has significantly higher viscosity than warm oil. If the installed oil is a higher viscosity grade than specified, the resistance to flow through the engine's passages at cold temperature creates abnormally high pump output pressure. As the oil warms and thins to operating viscosity, the pressure drops to the normal range. The wrong viscosity also delays cold-start lubrication because the thick oil cannot reach tight bearing clearances as quickly.

12. C — Regeneration burns soot (the combustible carbon particulate from incomplete combustion), but ash — the non-combustible metallic residue from engine oil additives (zinc, phosphorus, calcium, magnesium) — cannot be burned at any temperature achievable in the DPF. The ash remains permanently in the DPF channels after every regeneration, progressively reducing the available channel volume. Periodic off-vehicle cleaning with compressed air and vacuum is the only way to remove accumulated ash.

13. D — A whistling noise during acceleration that increases in pitch with engine speed is characteristic of pressurized air escaping through a small leak in the intake ducting between the turbocharger compressor outlet and the intake manifold. The boosted air (at 15-30+ psi during acceleration) escapes through a crack, loose clamp, or damaged gasket. At idle and deceleration, the boost is minimal and the leak produces no audible noise.

14. B — A cooling system pressure test confirms the system holds pressure externally (no external leaks). A combustion gas test (block tester) detects the presence of combustion products (CO_2, CO) in

the coolant — these gases can only enter the cooling system through a breach between a combustion chamber and a coolant passage. The combination of these two tests definitively confirms an internal leak from a head gasket, cracked head, or cracked liner.

15. A — The HEUI system uses high-pressure engine oil to actuate the injectors. As oil temperature rises, viscosity decreases, and the thinner oil leaks past the high-pressure oil pump's worn internal clearances more rapidly. The reduced pumping efficiency produces lower injection control pressure at operating temperature, which reduces the injectors' fuel delivery capability. At cold temperature, the thicker oil seals the worn clearances and the pump maintains full ICP.

16. D — The ECM sets the cold idle speed based on the coolant temperature sensor input. If the sensor reads warmer than the actual cold temperature (from a calibration drift, a resistance shift, or a wiring fault that adds resistance), the ECM applies the warm-idle fuel map instead of the cold-idle enrichment. The warm-idle fuel quantity produces a higher RPM than the cold-idle specification because the ECM believes the engine is already warm.

17. C — A naturally aspirated diesel engine produces vacuum (negative pressure) in the intake manifold at idle. A positive pressure reading of 3 psi indicates the intake manifold is being pressurized — this is normal behavior for a turbocharged engine. If the engine has been turbocharged (either as original equipment or as an aftermarket modification), positive manifold pressure at idle is expected because the turbocharger adds pressure to the intake even at idle.

18. A — The fuel pressure regulator receives commands from the ECM to increase or decrease rail pressure rapidly during acceleration and deceleration. A regulator that responds too slowly cannot keep up with these commands — the pressure lags behind during increases and decreases. Worn valve components, contamination restricting valve movement, or a weak actuator all slow the regulator's mechanical response, producing the sluggish throttle response and hesitation.

19. B — A leak in the intake ducting between the air filter and the turbocharger compressor inlet allows unfiltered air to bypass the filter. The resulting turbulence at the leak point creates a pressure differential that draws additional dust through the filter from the clean side, loading it prematurely. More critically, the unfiltered air entering downstream of the filter introduces abrasive contaminants directly into the turbocharger and engine.

20. D — Low-load city delivery operation produces exhaust temperatures that are too low to keep the EGR gas hot enough to pass through the system without depositing its carbon content. The cool exhaust gas condenses and deposits soot, unburned hydrocarbons, and carbon on the EGR valve, cooler, and

intake manifold surfaces. Highway driving produces higher exhaust temperatures that keep the gas in vapor form and can burn off light deposits before they harden.

21. C — Rapid oil discoloration in a diesel engine is completely normal. Diesel combustion produces soot as a natural byproduct regardless of engine condition. The oil's dispersant additives are specifically designed to capture this soot and hold it in suspension, preventing it from depositing on engine surfaces. Black oil confirms the dispersants are working. Even a freshly overhauled engine with minimal blow-by produces soot that the oil's additives capture.

22. A — Belt rubber contracts and stiffens in cold temperatures, reducing its flexibility and its ability to conform to the pulley groove profile. During the first few seconds of operation, the stiff belt cannot grip the pulley as effectively, producing a squeal from the slippage. As the belt warms from friction and flexing, it regains flexibility, conforms to the groove, and the squeal stops. This is characteristic cold-weather belt behavior that does not indicate a fault unless it persists.

23. B — The DOC and DPF outlet temperatures are at expected values, but the SCR inlet temperature has dropped 50°C between the DPF outlet and the SCR inlet. This heat loss occurs in the exhaust pipe connecting the two components. Degraded insulation, a missing heat shield, or inadequate pipe insulation allows the exhaust gas to radiate heat to the ambient air. The SCR catalyst requires a minimum temperature for effective NOx conversion, and excessive heat loss can drop the gas below this threshold.

24. B — Hydraulic valve lash adjusters are oil-filled devices that maintain zero valve lash by hydraulically extending to fill the clearance. When the engine is off, the oil slowly leaks from the adjusters through their internal check valves. At startup, the drained adjusters have excessive clearance and the valve train clatters until the engine's oil pressure refills them — typically 5-15 seconds. The noise is normal post-shutdown behavior and does not indicate a fault if it clears quickly.

25. C — The DEF dosing injector is exposed to exhaust temperatures during operation. When the exhaust temperature sustained at the injection point exceeds the injector's designed operating range, the extreme heat evaporates the DEF before it can spray properly and bakes the urea residue onto the injector tip. The progressive carbon-like deposit restricts the spray orifice and degrades the spray pattern, reducing NOx conversion efficiency.

26. A — Silicon and iron appearing together in an oil analysis sample confirm a cause-and-effect relationship. Silicon is the primary component of soil and dust — its presence confirms dirt has entered the engine. The simultaneous iron increase confirms the ingested dirt is acting as an abrasive on the

engine's iron components (cylinder liners, gears, bearings). The air intake system must be inspected for the breach that allowed the dirt ingestion.

27. B — White smoke during cold startup that clears within 2 minutes is unburned fuel vapor. When the engine is cold, the cylinder walls absorb heat from the compressed charge, preventing the fuel from reaching its autoignition temperature. The unburned fuel exits the exhaust as white smoke. As the engine warms, the cylinder temperatures rise above the autoignition threshold and complete combustion resumes. This is normal cold-start behavior for diesel engines.

28. A — The fueling process introduces turbulence that disturbs the water layer accumulated at the bottom of the fuel tank. The agitated water suspends in the fuel and passes through the fuel-water separator, triggering the water sensor. After 30 minutes of driving, the water settles back to the bottom of the tank below the pickup tube level. The tank should be drained of accumulated water and the fueling procedure evaluated to minimize turbulence.

29. C — A progressive increase in copper content (15 → 22 → 35 ppm) with all other metals stable indicates a single source that is wearing at an accelerating rate. Copper is the primary material in engine bearing intermediate layers. The bearing overlay (lead-tin) has worn through, exposing the copper layer underneath. The accelerating trend confirms the overlay is gone and the copper is now the primary wear surface — a condition that progresses toward bearing failure.

30. B — Normal build-up to 90 psi confirms the compressor has adequate capacity. The dramatically slowed build-up above 90 psi indicates a pressure-dependent leak that increases in severity with rising pressure. Below 90 psi, the leak is small enough that the compressor easily overcomes it. Above 90 psi, the leak path widens (from a flexing diaphragm, a marginal fitting, or a check valve that lifts off its seat) and the escaping air nearly matches the compressor's output.

31. D — The trailer's relay valve has failed in a way that delivers full supply pressure regardless of the signal pressure. A functioning relay valve proportionally matches its delivery pressure to the signal input — a small hand valve input produces a small brake application. The failed valve dumps full reservoir pressure to the chambers at any signal level, producing immediate wheel lockup. The foot valve signals through a different relay valve circuit that functions correctly.

32. A — The air dryer purge cycle must reverse enough dry air through the desiccant bed to strip the moisture accumulated during the loading cycle. A 1-second purge moves insufficient air volume through the bed. The desiccant is not adequately regenerated, progressively saturates, and begins passing

moisture to the downstream system. The moisture contaminates valves, corrodes chambers, and can freeze in cold weather, causing brake failures.

33. C — The first cold stop is firm because the master cylinder seal holds against the cold fluid. Subsequent stops produce a softer pedal because the brake friction heat transfers through the calipers to the fluid, warming the seal. The heated seal softens and begins to bypass internally, allowing fluid to leak past the piston. Each subsequent stop adds more heat, the bypass worsens, and the pedal sinks further. The master cylinder must be rebuilt or replaced.

34. B — A narrow polished band on the drum surface at the center of the lining contact area indicates concentrated contact at one point rather than distributed contact across the full lining width. A hard spot in the lining material — from a manufacturing defect, contamination, or heat hardening — contacts the drum with concentrated force during each application, generating enough heat and pressure to polish the drum surface in that narrow zone.

35. D — Pumping the brake pedal 2-3 times to get a firm pedal indicates excessive clearance between the pads and the rotors. The first pedal strokes push the caliper pistons outward to close the gap between the pads and the rotors. Once the pads contact the rotors, the pedal firms up and the brakes function normally. The automatic adjusters have not maintained their position, or the pads have worn beyond the adjusters' compensation range.

36. A — The spring brake relay valve's inlet delivers hold-off air to the spring brake chambers to release the brakes. A restricted inlet (from contamination, a kinked supply line, or a failed internal valve component) limits the air volume flowing through the valve. The chambers fill slowly because the restricted flow cannot deliver the required volume quickly enough, producing the 20-second release time instead of the normal 1-2 seconds.

37. D — The ABS warning lamp is off, confirming the system is functional and detecting no internal faults. Aggressive ABS activation during normal dry-pavement stops with correct brake adjustment and good tire condition suggests the ABS module is receiving abnormal wheel speed data. Erratic sensor signals from incorrect air gaps, damaged reluctor ring teeth, or deteriorating sensor elements cause the module to perceive impending lockup and intervene during normal stops.

38. C — Brake chamber pushrod length is a critical dimension that determines the slack adjuster's operating geometry. A pushrod 12 mm longer than specified positions the slack adjuster at a different angle in its arc. This altered geometry changes the mechanical advantage, the adjustment function, and

the relationship between the stroke measurement and the actual shoe-to-drum clearance. The original pushrod length must be restored.

39. B — The tractor's drive axle brakes release 2 seconds after the foot valve is released, while the trailer releases instantly. The quick release valve on the tractor's drive axle circuit has a stuck or contaminated exhaust seal that holds the application air momentarily before releasing. The trailer's relay valve exhaust functions correctly. The tractor's quick release valve must be inspected, cleaned, or replaced.

40. A — The ESC compares the driver's steering input (from the steering angle sensor) to the vehicle's actual behavior (from the yaw rate and lateral acceleration sensors). If the steering angle sensor reports a steering input that does not exist (from a calibration error or a zero-offset), the ESC perceives a discrepancy between intent and reality. The system intervenes to correct the phantom stability deviation, activating during normal straight-line driving.

41. C — The maximum allowable pressure drop per application is 20 psi. A 25 psi drop exceeds this specification and indicates the system consumes more air per application than designed. Oversized chambers, double-acting chambers where single-acting should be, or additional chambers from a system modification all increase the air volume consumed per application beyond the system's designed capacity.

42. D — Each circuit must individually meet the maximum allowable leak rate. The primary circuit passes at 3 psi/minute (within the 4 psi/minute combination maximum). The secondary circuit fails at 5 psi/minute (exceeds the 4 psi/minute maximum). The secondary circuit has a leak that must be located and repaired. The circuits are tested independently because a failure in one circuit must not be averaged with the other's performance.

43. A — Brake pad wear indicators are designed features — small metal tabs attached to the pad that contact the rotor when the friction material wears to its minimum thickness. The tab-to-rotor contact produces a metallic scraping or grinding noise during every brake application, alerting the driver that the pads need replacement. The noise is constant during each application because the tab maintains continuous contact with the rotor under application pressure.

44. A — The modulator valve's coil resistance increases with temperature. The coil warms from current flow during ABS events and from radiant heat from the nearby brake drum. After 20 minutes, the accumulated heat pushes the coil's resistance above the ABS module's maximum specification. The

module detects the out-of-spec resistance and illuminates the warning lamp. The coil is marginal when cold (passes the self-test) but fails when hot.

45. C — The hand valve's internal piston seal has worn, creating an internal bypass that leaks signal pressure. The worn seal cannot build adequate output pressure at the delivery port — the pressure leaks past the seal rather than being delivered to the trailer's relay valve. The foot valve sends its trailer signal through a completely separate circuit (the tractor protection valve and service gladhand), bypassing the hand valve entirely.

46. B — Spring brakes are designed to apply automatically when system pressure drops below approximately 60-65 psi. This is a safety feature that provides emergency braking when the air system cannot maintain adequate service brake pressure. The driver's repeated hard stops are consuming air faster than the compressor can replace it, and the pressure drops below the spring brake threshold. The engine brake should be used to reduce air brake demand.

47. D — Battery terminal voltage during cranking (10.8V) minus starter motor voltage during cranking (7.5V) = 3.3V consumed by the cable and connection resistance. The maximum allowable total voltage drop is typically 1.0V. A 3.3V drop means the cables, terminals, or solenoid contacts are consuming three times the allowable voltage, starving the starter of the electrical energy it needs to crank at normal speed.

48. B — The ECM continuously compares the camshaft position signal to the crankshaft position signal to verify valve timing. An "out of phase" code means the actual timing relationship has deviated from the expected alignment. A slipped timing gear, a stretched timing chain, a worn keyway, or incorrect assembly after a repair all change the cam-to-crank timing relationship, and the ECM detects the deviation through the misaligned sensor signals.

49. A — The progressive voltage drop with each additional electrical load confirms the alternator cannot supply enough current for the total demand. A healthy alternator maintains its regulated output voltage regardless of load changes. The voltage drops because the alternator's maximum current capacity has been reduced — from a failed rectifier diode, worn brushes, or a stator fault — and each additional load pulls more current than the alternator can deliver.

50. C — The BCM commands the circuit on (voltage applied) but measures zero current flow. Zero current with voltage applied means no complete circuit exists — the circuit is open at some point between the BCM's output and the lamp's ground. The lamp may be burned out, a wire broken, a

connector disconnected, or the ground path open. The BCM identifies the affected circuit but cannot determine the specific location of the open.

51. D — The dashboard voltmeter shows 14.2V, confirming the alternator's output at the measurement point. But the batteries are consistently undercharged. A voltage sense wire provides the regulator with accurate battery voltage feedback. If this wire is open, corroded, or connected incorrectly, the regulator measures voltage at the alternator (14.2V) rather than at the battery, and cannot compensate for the voltage drop in the charging circuit between the alternator and the batteries.

52. B — The termination resistance reads correctly (60 ohms), confirming both terminators are in the circuit. But 3 modules cannot communicate while 9 can. A high-resistance splice, damaged wire, or corroded connector in the bus backbone between the two groups creates a partial bus failure. The 9 modules on the scan tool's side communicate normally. The 3 modules on the far side of the fault are effectively isolated.

53. A — The fuel sender reads 33 ohms (the full-tank specification), confirming the sender is reporting correctly. The fault is between the sender and the display. The cluster is interpreting the 33-ohm full-tank signal as empty — either the wiring has added resistance that offsets the sender's value, the cluster's gauge calibration is reversed, or the cluster has an internal fault on the fuel gauge circuit.

54. C — The starter solenoid's plunger return spring pushes the plunger back to disengage the solenoid contacts after the ignition switch releases the start signal. A weakened return spring cannot retract the plunger quickly, and the heavy-duty contacts remain closed for 3-4 seconds after the key returns to the run position. The starter over-runs during this delay, which can damage the starter drive (Bendix) mechanism and the flywheel ring gear.

55. B — White LED headlights produce their white color by combining blue LED light with a yellow phosphor coating. When the blue LED elements fail, only the yellow phosphor-coated elements remain. The overall light output shifts from white toward yellow because the blue component of the combined spectrum is missing. The color shift confirms internal LED element failure, not a circuit or voltage problem.

56. D — A new electronic throttle pedal must be calibrated (learned) by the ECM through a pedal calibration procedure. The ECM needs to learn the new pedal's voltage range from idle (0%) to full throttle (100%). Without this procedure, the ECM cannot correctly interpret the new pedal's signal and defaults to 0% (idle). The calibration is performed through the scan tool or a specific key-on pedal sweep sequence.

57. A — The check engine lamp illuminating only above 100 km/h and extinguishing below 100 km/h is the designed behavior of the vehicle's speed limiter. The ECM limits fuel delivery to prevent the vehicle from exceeding the programmed maximum speed, and the check engine lamp illuminates as the warning to the driver. No fault codes are stored because the lamp is performing its intended function.

58. C — "Short to ground" means the modulator valve's electrical circuit has an unintended path to vehicle ground. A pinched wire with chafed insulation, or an internal coil fault where the winding contacts the valve body, allows current to flow directly to ground without passing through the coil's designed resistance. The uncontrolled current can damage the ABS module's output driver and prevents proper valve control.

59. D — The horn sounds weaker with the engine running than with the engine off. The alternator's AC ripple (from a failing rectifier diode) superimposes on the DC supply. The horn operates by oscillating a diaphragm at a specific frequency using a self-interrupting electromagnetic circuit. The AC ripple disrupts the horn's oscillation pattern, reducing its acoustic output. With the engine off, the battery provides clean DC and the horn operates normally.

60. A — The scan tool communicates with all modules and displays correct engine data, confirming the CAN bus is functional and the ECM is broadcasting accurate information. The instrument cluster receives this data but shows all gauges at minimum. The cluster has an internal fault — the power supply, ground, internal processor, or gauge driver circuits have failed. The cluster cannot process or display the data despite receiving it correctly.

61. B — The 0.2V difference between left (13.8V) and right (14.0V) headlight circuits indicates the left side has slightly more resistance. The power delivered to a bulb varies with the square of the voltage ($P = V^2/R$), so even a small voltage difference produces a proportionally larger brightness difference. The left circuit's resistance point must be located and corrected.

62. B — The telematics unit detects ignition status through a signal wire connected to a switched power source. If this wire is connected to a circuit that remains powered with the key removed (a constant-power circuit), the unit always detects voltage and reports "Ignition On." The wire must be reconnected to a true switched-ignition circuit that de-energizes when the key is removed.

63. D — Backup cameras display a mirror-reversed image so that left and right on the screen match the driver's perspective. If the aftermarket camera has already applied its own mirror correction internally, and the display monitor also applies mirror correction, the double-reversal produces a non-mirrored

image — left and right appear swapped. The camera's mirror setting must be adjusted to work correctly with the display's existing mirror function.

64. A — Some ELDs use engine RPM as one of their driving-status criteria. At elevated idle RPM (from PTO operation, A/C compressor load, or an idle-up command), the engine RPM may exceed the ELD's driving threshold. The ELD interprets the sustained above-threshold RPM as driving activity, even though the vehicle speed is zero. The ELD's driving-status parameters must be configured for PTO-equipped vehicles.

65. B — A single-frame spike to an impossible value (999 psi) that immediately returns to normal is characteristic of a CAN bus data transmission error. Electrical noise, a marginal connector, or a deteriorating bus conductor can corrupt individual data frames. One or more bits in the message are flipped by the interference, producing a nonsensical value. The next frame transmits correctly and the reading normalizes.

66. A — Both low beams are dim equally, indicating a common element in the low-beam power path has resistance. The high beams are bright, confirming they use a separate, clean power path. The headlight switch has excessive resistance on its low-beam contact that reduces voltage to both low-beam circuits. The shared resistance could also be in the low-beam relay, a common wiring point, or a shared connector.

67. B — The scan tool shows zero RPM during cranking despite the starter operating (confirmed by the normal cranking sound and speed). The ECM cannot detect engine rotation. The crankshaft position sensor or its circuit is not producing a signal. Without this signal, the ECM cannot determine injection timing and will not command fuel injection. The engine cranks mechanically but cannot start because no fuel is delivered.

68. A — The oil pressure sender or its wiring is producing a fixed signal that the cluster interprets as maximum pressure. A sender with an internal short circuit, a signal wire shorted to the reference voltage, or a corroded connector producing a fixed resistance value sends the cluster a constant maximum-pressure signal regardless of actual oil pressure. The mechanical test gauge confirms normal pressure, isolating the fault to the electronic reporting circuit.

69. D — All other splitter shifts are smooth, isolating the fault to the 9th gear high-split synchronizer specifically. The synchronizer's friction cone or blocker ring for that specific gear position has worn below its effective threshold. The worn friction surface cannot match the gear speeds quickly enough

before the sliding sleeve advances, producing the grind. All other splitter positions use different synchronizer elements that remain functional.

70. B — A low stall speed means the converter is "tighter" than designed — it loads the engine more at the stall condition than it should. A locked stator one-way clutch forces the stator to remain stationary when it should freewheel during the stall test. The locked stator restricts the fluid circulation pattern, reducing the slippage between the impeller and turbine. The engine cannot reach the specified stall RPM against the tighter coupling.

71. C — Starting from a stop requires the longest clutch slip duration because the disc must match speeds from zero vehicle speed to the engine's engagement RPM. A flywheel with hot spots or heat-damaged areas creates uneven friction during this extended slip, producing the chatter. During in-gear shifts, the speed differential is small, the slip duration is brief, and the uneven surface does not have enough time to produce noticeable chatter.

72. A — The clunking is present in both 2WD and 4WD, eliminating any component that is exclusive to one operating mode. Components that rotate at driveshaft speed in both modes include the input gear, the output shaft, and common bearings. The 4WD chain, front output shaft, and 4WD engagement mechanism only operate in 4WD and would produce noise only in that mode.

73. D — The vehicle operates near the shift point boundary where the upshift criteria and the downshift criteria are both marginally met. The TCU upshifts to 12th, the engine lugs slightly, the TCU detects the lugging and downshifts to 11th, the engine speed rises, and the upshift criteria are met again. The cycle repeats until the operating conditions change enough to stabilize in one gear.

74. B — The clutch disengages completely (confirmed by no creep in gear) but the transmission still grinds into 1st and reverse from neutral. The clutch brake stops the input shaft when the pedal is pressed to the floor. A blocked compensating port in the master cylinder maintains residual pressure in the line, which holds the release bearing against the pressure plate and partially disengages the clutch at all times. The clutch brake is never engaged because the pedal travel is consumed by the residual pressure condition.

75. C — The ring and pinion noise is present only during acceleration (drive side of teeth loaded) and absent during deceleration (coast side). The drive-side tooth contact pattern has a wear condition or incorrect adjustment that produces noise when loaded. The speed range (80-110 km/h) corresponds to the gear mesh frequency that excites a resonance in the axle housing, amplifying the noise. Outside this range, the mesh frequency does not excite the resonance.

76. A — The engine flare during the 2-3 shift represents the period when the 2nd gear clutch has released but the 3rd gear clutch has not yet applied. The 3rd gear clutch pack is slipping, worn, or has a leaking apply circuit that delays or weakens its engagement. The engine speed rises unchecked during the gap because no clutch is absorbing the engine torque.

77. D — A balanced, straight driveshaft with new, correctly phased U-joints can still vibrate if the operating angles are incorrect. The front and rear U-joint angles must be equal within 1 degree, and neither should exceed the manufacturer's maximum specification. Unequal angles prevent the speed fluctuations from canceling between the two joints, producing a vibration at twice per revolution.

78. A — The differential lock physically engages (confirmed by driving behavior), but the dashboard indicator does not illuminate. The lock mechanism uses separate circuits for the engagement function (the air solenoid or electric motor) and the indicator function (the bulb, wiring, and position switch). The engagement circuit is functional while the indicator circuit has a fault — a burned bulb, an open wire, or a faulty position switch.

79. B — The 5th gear engagement teeth have worn or rounded on their engagement faces. The helical gear design produces an axial thrust force proportional to the transmitted torque. Under acceleration, this thrust force pushes the sliding sleeve out of engagement. The worn tooth faces cannot maintain full-depth engagement against this thrust, and the sleeve slides out of the gear. The detent mechanism is functional but cannot compensate for worn engagement teeth.

80. C — The center carrier bearing rotates at driveshaft speed whenever the wheels are turning, regardless of whether torque is being transmitted. The bearing is always loaded by the driveshaft's weight and the mount's support forces. In neutral, the shaft is still driven by the wheels through the axle, so the bearing continues to rotate and produce the same growling noise. The unchanged noise in neutral confirms the bearing as the source.

81. B — The shift from 5th to 6th requires the shift lever to move through a specific gate in the shift tower. A worn bushing, a bent shift rail, or a misaligned shift tower at that specific gate position creates localized mechanical resistance. All other shifts pass through different gates that are unaffected by the localized binding. The shift does not grind because the gears engage once the lever overcomes the resistance.

82. A — The brief buzzing sound when moving from Park to Neutral is the park pawl disengaging from the output shaft's ring gear. The pawl's tooth slides across the gear teeth as it withdraws from the

engagement notch, producing the buzzing. The noise is brief because the pawl clears the gear quickly, and it occurs only in this specific transition because the pawl is only engaged in Park.

83. A — Even a factory-new driveshaft can have a balance issue within manufacturing tolerances. The new shaft should be checked on a balance machine. Additionally, indexing the shaft on its companion flanges (rotating it 90° or 180°) determines whether the vibration changes character — which would confirm a balance or runout issue at the connection point. The companion flanges' runout should also be verified.

84. D — The clutch brake stops the transmission input shaft when the clutch pedal is pressed fully to the floor. Without a functional clutch brake, the input shaft continues to coast from its inertia after the clutch releases it. The speed difference between the stopped gears (1st and reverse have no synchronizers on many heavy-duty transmissions) and the coasting input shaft produces the grind during engagement from a stop.

85. B — The harsh downshifts with smooth upshifts indicate the downshift cushioning system has failed while the upshift cushioning remains functional. The accumulator for the downshift circuits absorbs the initial pressure spike during clutch application. Without the accumulator's cushioning, the downshift clutch applies instantaneously with full force, producing the harsh jolt. The upshift accumulators function normally.

86. D — The power steering fluid's viscosity is temperature-dependent. At cold temperatures, the thick fluid resists flow through the pump, hoses, steering gear, and metering orifices. The pump cannot circulate the viscous fluid efficiently, and the restricted metering orifices inside the steering gear cannot pass adequate flow for responsive assist. As the fluid warms from circulation and engine heat, the viscosity drops to the operating range and the steering effort normalizes.

87. B — A combination of incorrect toe and camber produces two different wear characteristics on the same tire. The camber tilts the wheel, loading one shoulder more heavily (smooth wear from concentrated pressure). The toe angle scrubs the tread laterally, feathering the opposite shoulder. The two faults combine to produce the asymmetric half-and-half wear pattern on each steer tire.

88. A — An air spring that pops during bump travel has a bead seating problem. The piston's corroded or damaged surface prevents the spring's lower bead from maintaining a consistent seal. During compression and extension, the bead lifts momentarily from the irregular surface and reseats with a pop. The spring holds air because the bead reseats, but the noise indicates the seal is compromised and the spring is approaching failure.

89. C — A click once per steering wheel revolution from the steering column indicates a defect at one specific rotational position. The steering column U-joint or flexible coupling connects the steering wheel shaft to the steering gear through one or more joints. A worn cross element, a damaged coupling, or a loose clamp bolt produces a mechanical click as the worn component loads and unloads at one point in each revolution.

90. B — The lift axle deploys normally (air extends the cylinder to lower the axle) but will not retract. The deploy side of the air circuit functions, but the retract side has a fault. A seized control valve on the retract circuit, a kinked retract air line, or a failed cylinder seal on the retract side prevents the air from reaching or effectively actuating the retraction mechanism.

91. D — Steer tire wear rates depend on multiple factors beyond alignment and inflation. The driver's operating environment (city versus highway), brake condition (any drag generates heat that accelerates tire wear), and the specific tire compound all influence wear rates. A comprehensive assessment of all three factors identifies the contributor to the accelerated wear.

92. A — The tractor's rear air ride suspension lacks adequate damping from worn shock absorbers. The undamped suspension oscillates, and the fifth wheel (mounted on the tractor frame behind the suspension) transmits this oscillation to the trailer's nose. The trailer follows the tractor's rhythmic bouncing, producing the nose-lift-and-drop sensation at highway speed.

93. C — Excessive toe-in (4 mm versus the 1.5-3 mm specification) angles the front of each tire inward more than designed. The outside edges of the tread scrub against the road surface during each revolution. The feathering develops on the outside edges because the scrubbing force acts outward as the over-toed tires are forced to track straight despite their inward angle.

94. D — A single rotor with blue discoloration across its entire friction surface has been subjected to temperatures exceeding 300°C. The heat alters the cast iron's metallurgy — changing its hardness, stress properties, and thermal stability. The rotor must be checked for hardness variation and thickness variation. If the properties have been altered, the rotor must be replaced because the changed metallurgy causes pulsation and reduced friction.

95. A — A circumferential crack around the center bore indicates cyclic fatigue from eccentric loading. The hub pilot pads position the wheel concentrically on the hub. If the pads are corroded, damaged, or have debris, the wheel mounts off-center. Each revolution loads the center bore eccentrically, creating a cyclic bending stress that initiates and propagates the fatigue crack around the bore.

96. A — A localized lateral bow in a specific 2-metre section of the frame rail indicates a point impact — a collision with a fixed object, a sideswipe, or contact with a loading dock at that specific location. The frame absorbed the lateral force and deformed outward. The localized nature of the bow confirms a concentrated impact rather than a distributed load or manufacturing defect.

97. A — The leaf spring's individual leaves contact each other directly during suspension deflection. Without inter-leaf friction pads (which some spring designs include), the metal-to-metal contact between the leaves produces a squeak during each bump event. Lubrication temporarily silences the noise by reducing the friction, but the lubricant is expelled quickly during normal driving. The squeak returns as soon as the dry metal surfaces resume contact.

98. C — Both sides have identical tires, pressures, and brake adjustment. The right rear runs hotter consistently. A tight wheel bearing preload creates continuous rolling friction that generates heat conducted through the hub to the tires. The correctly adjusted left-side bearings generate less friction and run cooler. The right-side bearing preload must be checked and compared to the specification.

99. D — Excessive roll during cornering with correct ride height indicates inadequate resistance to lateral body motion. The shock absorbers resist vertical suspension movement, and the sway bar (if equipped) resists differential travel between left and right. Worn shock absorbers and a damaged or disconnected sway bar allow excessive lateral lean during cornering. Replacing the shocks and repairing the sway bar restores the designed roll resistance.

100. A — Normal wear on the left tire but alternating rib wear on the right tire indicates the right side has a dynamic condition that loads alternate ribs differently. A worn right-side shock absorber allows the tire to bounce, creating intermittent heavy contact. The bouncing pattern loads alternate ribs more heavily during each oscillation cycle, producing the distinctive alternating wear pattern.

101. B — Excessive brake dust on one position with identical adjustment and lining thickness across all positions indicates a different lining compound on the dusty position. A non-matching replacement lining from a previous service or a manufacturing variation produces more dust from its different formulation. The different compound may also have different friction characteristics that affect braking balance.

102. B — The ride height was set correctly 5,000 km ago but one corner is now 20 mm low. The height control valve's sensing linkage has developed wear or looseness (a worn bushing, a loose bolt, or a bent arm) that has shifted the valve's "level" reference point since the adjustment. The valve functions

correctly but maintains height around an incorrect reference position. The linkage must be inspected and readjusted.

103. A — A shuddering sensation during low-speed parking lot turns indicates a pulsating hydraulic output from the power steering pump. At low speed, the pump operates at low flow rates where worn internal components produce pressure pulsations. The pulsations are amplified by the steering gear's hydraulic circuit and transmitted to the steering wheel. At highway speed, the higher flow rates smooth the pulsations and the shudder is imperceptible.

104. D — The A/C in recirculation mode cools the cab air, which cools the windshield's interior glass surface. The cold interior glass drops the exterior surface temperature below the ambient air's dew point. The humid ambient air on the exterior condenses as fog on the cold glass. Switching to fresh air mode or defrost introduces warmer air to the windshield interior, raising the glass temperature above the dew point and clearing the exterior fog.

105. A — The window regulator motor runs (audible) but the window does not move. The mechanical connection between the motor and the glass has failed — a stripped internal gear, a broken cable, or a detached mounting clip. The motor spins freely because it has no load, and the window stays stationary because no force reaches the glass from the disconnected mechanism.

106. C — The HVAC blower motor has an imbalanced fan wheel from damage, contamination, or a broken blade. The centrifugal force from the imbalance increases with the square of the rotational speed. At low and medium speeds, the imbalance force is too small to produce a perceptible vibration. At high speed, the quadrupled centrifugal force transmits through the HVAC housing, dash structure, and steering column to the steering wheel.

107. B — The cab tilt pump motor runs and sounds normal, but the cab does not tilt. The pump is running but cannot produce hydraulic pressure — from a failed internal check valve, a ruptured suction line, an empty reservoir, or a bypass valve stuck open. The motor operates the pump's mechanical components, but the pump cannot draw, pressurize, or deliver fluid to the tilt cylinder.

108. D — Multiple rattling locations throughout the cab (dash, door panels, headliner) appearing simultaneously indicates a common underlying cause rather than multiple individual failures. Hardened or deteriorated cab mounting isolators transmit more road vibration to the cab structure, exciting every panel, clip, and trim piece. Replacing the cab mounts restores the original vibration isolation and reduces all the rattles simultaneously.

109. C — The depressions at the crossmember locations are caused by forklift traffic. Forklifts entering the trailer concentrate their wheel loads on the floor at specific points. The floor material at the crossmember contact points receives the highest concentrated stress (the crossmember provides a hard support point), and the repeated loading has compressed or crushed the floor material at these support locations.

110. A — The height control valve was adjusted for the loaded condition. The geometric relationship between the sensing linkage and the valve changes when the load is removed and the suspension extends. The valve's reference position shifts at the unloaded ride height, causing it to interpret the correct empty height as "too low" and add air until the trailer exceeds the correct empty ride height.

111. D — Circumferential scoring at the center of the lining contact area indicates a hard, metallic object in continuous contact with the drum at that point. The brake lining has worn through to the rivets or the steel shoe table at one localized point, and the exposed metal scores the drum around its entire circumference as the wheel rotates. The scoring is at the center because the lining wears fastest at the point of maximum contact pressure.

112. B — A ±4°C fluctuation around the −18°C setpoint during transport is within the normal operating range. The TRU cycles between cooling and defrost modes, and the cargo temperature oscillates around the setpoint during each cycle. The fluctuation magnitude depends on the TRU's capacity, the cargo's thermal mass, the ambient temperature, and the door-opening frequency.

113. A — The gooseneck-to-main-frame junction carries the highest structural stress in the trailer. All cargo weight and dynamic forces transfer from the main frame through this junction to the king pin. The abrupt cross-section change at the junction creates a geometric stress riser. A crack at this location compromises the trailer's most critical structural transition and requires immediate repair per the manufacturer's procedure.

114. C — The J560 connector has pins that make adequate contact when stationary but lose contact during the vibration of highway driving. Worn, corroded, or pushed-back pins maintain contact in the shop environment (static testing) but the road vibration is sufficient to break contact momentarily, causing all trailer lights to flicker as the connection oscillates.

115. A — The deck boards have dried unevenly — the top surface dries faster from sun exposure and airflow, causing the top to shrink relative to the bottom. The differential shrinkage creates the upward curl (cupping). Cupped boards create trip hazards for personnel, damage cargo packaging from the raised edges, and interfere with forklift operations on the deck surface.

116. B — The right-side electric brake magnet or its wiring has excessive resistance from corrosion, a partially broken wire, or magnet wear. The reduced current through the magnet produces a weaker electromagnetic field that generates less friction force against the drum. The left side receives full current and produces normal braking force, creating the imbalance.

117. A — Liquid refrigerant accumulates in the compressor during the off cycle. When the compressor engages, the first few piston strokes attempt to compress the incompressible liquid (liquid slugging). The piston impacts against the liquid column produce the rattling noise. After 2-3 seconds, the liquid has been pumped through and the compressor handles only compressible vapor, eliminating the noise until the next off-cycle liquid accumulation.

118. C — The blend door is partially open, allowing some air to pass through the A/C evaporator section before reaching the upper ducts. The floor duct path bypasses the evaporator and delivers fully heated air. The air destined for the dashboard and defrost vents passes through the residual cold of the evaporator, losing heat before reaching the upper outlets. Verifying and correcting the blend door position resolves the temperature difference.

119. D — Both high-side and low-side pressures elevated above normal with the condenser fan operating indicates excess refrigerant in the system. The extra refrigerant fills the condenser with more liquid than it can cool effectively (raising high-side pressure) and floods the evaporator with more liquid than the airflow can evaporate (raising low-side pressure). Recovering the excess charge to the specified weight normalizes both pressures.

120. B — The heater supply hose carries engine coolant at the engine's operating temperature — typically 80-95°C. This temperature is hot enough to cause burns on brief skin contact. The hose temperature simply reflects the coolant temperature it is carrying. The engine temperature is normal (confirmed by the gauge), and the hot hose is a normal, expected condition of a functioning heater circuit.

121. A — An overcharged A/C system forces the compressor to work harder, compressing more refrigerant per cycle than designed. The elevated internal pressures and the effort of compressing liquid refrigerant (which collects in the compressor from the excess charge) produce the constant whine. The charge weight must be verified against the specification with a calibrated scale, and any excess recovered.

122. B — The pressure change during each compressor engage/disengage event creates a thermal and mechanical shock in the evaporator. The sudden pressure increase during engagement and the sudden

decrease during disengagement flex the evaporator housing, its mounting brackets, or connected components. A loose bracket or a loose evaporator core in its housing shifts slightly with each pressure change, producing the click.

123. C — During low-speed reversing, the truck's rearward movement creates a relative airflow that pushes the exhaust gases from behind the truck forward along the vehicle's body. The gases travel along the vehicle's underside and sides to the cowl area at the base of the windshield, where the HVAC fresh-air intake draws them into the cab. Switching to recirculation mode during reversing prevents the exhaust from entering the cab.

124. B — All other functions operate at acceptable speed at idle, confirming the pump produces adequate flow at idle RPM for the lighter circuits. The boom lift circuit requires the most flow because its cylinder has the largest volume. At idle, the pump output is barely sufficient for the lighter functions and insufficient for the boom lift's demand. At operating RPM, the pump delivers adequate flow for all functions including the boom lift.

125. A — The swing circuit's counterbalance or over-center valve controls deceleration and load-holding for each swing direction. If the valve for the jerky direction is miscalibrated, sticking, or contaminated, it chatters — alternately opening and closing — during the swing. The chattering produces the oscillating, jerky motion. The other direction's valve is calibrated correctly and operates smoothly.

126. D — The milky color confirms water contamination. Rain water entered through a damaged or missing breather cap. Water in hydraulic oil creates an emulsion that reduces lubrication, causes corrosion on precision surfaces, deteriorates seals, and changes viscosity. The contaminated fluid must be drained, the system flushed, the breather cap replaced, and the system refilled with clean fluid.

127. C — The accumulator's nitrogen pre-charge determines how much hydraulic energy it stores at system pressure. A 50% reduction means the accumulator stores far less energy than specified. During an emergency brake situation (pump failure), the depleted accumulator may not have enough stored pressure and volume to provide the specified number of emergency brake applications, compromising the safety system.

128. A — During active functions, the large fluid volume in the system absorbs the pump's pressure pulsations. In standby, the small trapped volume between the pump outlet and the closed directional valve cannot absorb the pulsations. Each pump displacement cycle produces a pressure pulse that the

gauge needle follows, creating the visible oscillation. The oscillation frequency corresponds to the pump's displacement cycle rate.

129. D — The telescope retract circuit uses the rod-side area of the cylinder, which is smaller than the cap-side area (the rod displaces part of the bore). At the same system pressure, the retract force is proportionally less than the extend force. Under the rated load, the boom sections deflect against their internal guides, creating friction. The combined load weight and friction forces exceed the available retract force at the relief valve's pressure setting.

130. B — The thud at full extension is the piston impacting the cylinder cap without adequate deceleration. The cylinder's internal cushion (if equipped) has failed, or the cylinder was not designed with a cushion for this application. The piston arrives at the cap at full travel speed and the impact produces a hydraulic shock wave and mechanical thud that transmits through the system.

131. C — The suction line and strainer are clear, and the reservoir level is adequate. A partially blocked breather cap restricts atmospheric air entry into the reservoir as the pump draws fluid. During high pump demand, the restricted breather cannot equalize the pressure, creating a partial vacuum that drops the pump inlet pressure below the fluid's vapor pressure. When demand decreases, the breather catches up and the cavitation stops.

132. D — The SOH is stable (no battery degradation), the route and load are consistent, yet range decreases 5% per month. Gradually decreasing tire pressures increase rolling resistance proportionally — a 10% pressure drop increases rolling resistance by 5-8%, directly reducing electrical driving range by the same percentage. The progressive monthly decrease matches the pattern of tires that are not being checked and inflated regularly.

133. B — The generator's bearings have worn from the continuous high-speed rotation and high-current loading of hybrid operation. The increased clearance allows the rotor to vibrate within the worn bearing surfaces. The generator continues to produce correct output because the electrical clearances are unaffected, but the mechanical noise confirms progressive bearing degradation that will eventually require service.

134. A — The single low cell (3.2V versus 3.7V for all others) limits the entire pack's performance. The BMS must protect the weakest cell from dropping below its minimum safe voltage during discharge. It limits the pack's total current output and usable capacity to the weakest cell's capacity. The single low cell effectively becomes the bottleneck that determines the pack's overall discharge limits.

135. C — The battery charges normally from the charging station (confirming the battery and charging circuit are functional). The regenerative braking does not charge the battery during driving. The regenerative system uses a completely separate circuit from the plug-in charging system — the inverter converts the motor's generator output to DC for the battery during braking. A fault in the inverter, the motor's generator function, or the VCU-to-motor-controller communication prevents the motor from switching to generator mode.