

PRACTICE EXAM 4: RED SEAL 310T SIMULATION (135 QUESTIONS)

1. A technician accidentally splashes battery acid (sulfuric acid) into their eyes while servicing a heavy-duty truck battery bank. What is the correct immediate first-aid response?

A. Flush the eyes continuously with clean water at an emergency eyewash station for a minimum of 15 to 20 minutes while holding the eyelids open, and seek immediate medical attention

B. Apply a neutralizing baking soda solution directly to the eyes to counteract the acid before flushing with water

C. Close the eyes tightly and apply a cold compress for 10 minutes to reduce the acid's chemical reaction rate

D. Wipe the acid from the eyes with a clean dry cloth and then apply prescribed eye drops from the first-aid kit

2. A technician is about to cut through an exhaust pipe on a truck using an oxy-acetylene torch. Before lighting the torch, the technician notices that the acetylene cylinder is stored next to the oxygen cylinder in the work area without any separation. What safety violation is present?

A. The cylinders should be laid on their sides during use to prevent accidental tipping and falling

B. The cylinders are too far from the work area and should be moved closer for efficient hose management

C. Oxygen and fuel gas cylinders must be stored at least 6 metres (20 feet) apart or separated by a fire-resistant barrier to prevent a catastrophic fire or explosion if one cylinder leaks near the other

D. The cylinders should be unchained from their cart during active use to allow rapid repositioning if needed

3. A shop has recently hired a new apprentice who has never worked in a truck repair facility. Before the apprentice begins any work, what is the employer's legal obligation under the Occupational Health and Safety Act?

A. Provide the apprentice with a copy of the company employee handbook and direct them to read it independently

B. Provide workplace-specific health and safety orientation and training including hazard identification, emergency procedures, WHMIS, PPE requirements, and the location of safety equipment before the apprentice is exposed to any workplace hazards

C. Assign the apprentice to work alongside an experienced technician with no additional safety training required

D. Allow the apprentice to observe shop operations for one week before providing any formal safety training

4. A technician needs to test the voltage at a live 600-volt terminal inside a hybrid bus junction box. What category of multimeter is required for this measurement?

A. Any standard automotive multimeter rated for 12/24-volt vehicle electrical systems

B. A CAT I rated meter designed for electronic bench testing and low-energy signal measurements

C. A CAT II rated meter designed for household receptacle and plug-connected equipment testing

D. A CAT III or CAT IV rated meter designed for distribution-level circuits and capable of safely measuring voltages at the 600-volt level with adequate input protection and arc-flash resistance

5. A technician observes a coworker lifting a heavy brake drum by bending at the waist with straight legs and a rounded back. The coworker appears to be struggling with the weight. What is the primary ergonomic risk of this lifting technique?

A. Severe risk of lumbar spine injury — the rounded back and straight-leg posture places the load on the intervertebral discs and spinal ligaments rather than the leg muscles, dramatically increasing the risk of disc herniation, muscle strain, and chronic back injury

B. Risk of shoulder dislocation from the arms supporting the full weight of the drum without leg assistance

C. Risk of carpal tunnel syndrome from the grip force required to hold the drum with the hands in a flexed position

D. Risk of knee ligament injury from the straight-leg position transferring the load directly through the knee joints

6. During a routine shop inspection, a technician discovers that the emergency exit door at the rear of the shop is blocked by a stack of tires and a parts washer that have been pushed against it. What action must be taken?

A. Note the blockage in the maintenance log and schedule the items to be moved during the next shop cleanup day

B. Verify that the front entrance is unobstructed and designate it as the sole emergency exit until the rear door is cleared

C. Clear the obstruction immediately — emergency exits must remain unobstructed at all times as required by fire code and occupational health and safety regulations, and blocking an exit puts all shop personnel at risk

D. Place a sign on the blocked door redirecting personnel to the front exit in case of emergency evacuation

7. A technician is using a hydraulic press to remove a bearing from a shaft. What PPE is required for this operation?

A. Leather gloves and steel-toed boots only, since the press operates at slow speed with minimal splash risk

B. Safety glasses with side shields and a face shield to protect against the possibility of the bearing or retaining components fragmenting under the high pressing force, plus hearing protection if the operation generates impact noise

C. A full-body protective suit rated for hydraulic fluid splash in case the press cylinder develops a leak

D. Respiratory protection to guard against the metal dust generated when the bearing separates from the shaft

8. A technician is draining used engine oil from a heavy-duty diesel engine into a waste collection container. What environmental handling requirement applies to used engine oil in Canada?

A. Used engine oil can be disposed of in the facility's general waste dumpster if the volume is less than 20 litres

B. Used engine oil can be poured down the shop floor drain as long as the drain connects to a municipal sewer system with oil separation capability

C. Used engine oil can be mixed with used coolant in the same waste container since both are petroleum-based liquids

D. Used engine oil must be collected in a dedicated, clearly labelled waste oil tank and picked up by a licensed waste oil recycler — it is classified as recyclable hazardous waste and must not be mixed with other waste streams or disposed of in drains or on the ground

9. A heavy-duty diesel engine equipped with electronic unit injectors has one cylinder that consistently misfires. The technician performs an injector cut-out test using the scan tool and finds that disabling cylinder number four produces no change in engine RPM or sound. What does this confirm?

A. The fuel supply pump is not delivering adequate pressure to the number four injector rail passage

B. Cylinder number four is already not contributing to engine output — the injector is not firing, has failed mechanically, or the cylinder has a compression problem that prevents combustion

C. The scan tool's cut-out function is not compatible with the unit injector system on this engine platform

D. The number four injector has excessive internal leakage that is flooding the cylinder and hydraulically locking the piston

10. A technician is performing an overhead valve adjustment on a heavy-duty diesel engine and sets the exhaust valve lash to 0.025 inches. The manufacturer's specification for exhaust valve lash is 0.020 inches. What symptom will this excessive lash produce?

A. The exhaust valve will open too early in the cycle, overlapping with the intake valve and causing excessive backflow

B. The exhaust valve will not fully close, allowing combustion gas to leak past the valve seat continuously

C. The exhaust valve will remain open for a longer duration than designed, increasing exhaust gas scavenging beyond the optimal level

D. The exhaust valve will open later and close earlier than designed, reducing the effective exhaust flow duration, and the valve train will produce a noticeable clicking noise from the excess clearance being taken up at each cam lobe lift

11. An inline six-cylinder diesel engine has two cylinders with significantly lower compression readings than the other four. The two weak cylinders are adjacent to each other. What is the most likely cause?

A. A head gasket failure between the two adjacent cylinders, allowing compression to leak from each cylinder into the other through the blown gasket area, resulting in reduced readings on both

B. Both cylinders have simultaneously developed worn piston rings from operating on contaminated fuel

C. The fuel injectors on both cylinders have failed in an open position, bleeding compression pressure through the open nozzle

D. The camshaft lobes for both cylinders have worn flat simultaneously, preventing the valves from closing fully

12. A fleet of trucks operating in Northern Ontario experiences repeated fuel filter plugging during January and February. The fuel filters show a waxy residue on the filter media. The trucks operate normally during the rest of the year. What is the cause?

- A. The fuel supplier is delivering a summer-grade diesel fuel with reduced detergent additives during winter months
- B. Microbial growth in the fuel tanks accelerates during cold weather and produces the waxy byproduct found on the filters
- C. Paraffin wax in the diesel fuel is crystallizing at low ambient temperatures, forming a gel-like substance that plugs the fuel filter media and restricts fuel flow to the injection system
- D. The fuel tank vent is freezing shut, creating a vacuum that draws moisture into the fuel and forming ice crystals that appear waxy on the filter

13. A technician is diagnosing a heavy-duty diesel engine that produces a puff of blue smoke at startup after sitting overnight but then runs cleanly. What is the most likely cause?

- A. Worn turbocharger oil seals that allow oil to drain into the intake or exhaust housing while the engine is off, which then burns when the engine is started
- B. A leaking fuel injector that drips fuel into the cylinder overnight, creating a rich mixture that produces blue smoke at startup
- C. Worn cylinder liners that have cooled and contracted overnight, temporarily creating a larger-than-normal clearance that allows blow-by until the engine warms and the liners expand
- D. Condensation in the exhaust system that vaporizes at startup and appears as blue smoke until the exhaust warms up

14. A heavy-duty diesel engine has been diagnosed with a failed EGR cooler. Coolant is leaking into the exhaust passage. What symptom would the driver have noticed before the diagnosis?

- A. A gradual increase in engine oil temperature due to the coolant mixing with the oil through the EGR passage
- B. A strong fuel odor in the cab from unburned fuel passing through the cracked cooler into the ventilation system
- C. An increase in exhaust soot loading that triggered more frequent DPF regeneration events

D. Unexplained coolant loss with no visible external leak, possible white steam or vapor from the exhaust, and potentially a sweet coolant odor near the tailpipe as the leaking coolant is vaporized by the hot exhaust gases

15. An engine oil analysis report shows a significant increase in fuel dilution — the oil viscosity has dropped below its minimum specification. What is the primary concern with fuel-diluted engine oil?

A. The fuel in the oil will cause the oil filter to bypass prematurely due to the reduced viscosity flowing through the filter media too quickly

B. The fuel vapors in the oil will create a fire hazard at the crankcase breather outlet during hot operating conditions

C. The reduced viscosity means the oil film between bearings and journals is too thin to prevent metal-to-metal contact under load, dramatically increasing the risk of bearing failure, accelerated wear, and potential engine seizure

D. The fuel in the oil will cause the oil pump to cavitate because the reduced viscosity allows the pump to move the oil too quickly through the circuit

16. A technician replaces the thermostat on a heavy-duty diesel engine. After reassembly, the engine overheats within 10 minutes of starting. The technician reverses the thermostat installation by flipping it 180 degrees, and the overheating problem is resolved. What was the original installation error?

A. The thermostat was installed upside down — the sensing element (wax pellet) must face the engine side (toward the hot coolant) to sense the correct temperature and open at the designed threshold; installed backward, the sensing element faces the cooler radiator coolant and never reaches its opening temperature

B. The thermostat gasket was installed on the wrong side of the thermostat housing flange

C. The thermostat's bypass port was facing the wrong direction, routing coolant to the heater core instead of the radiator

D. The thermostat's jiggle pin was blocked by the housing, preventing air from bleeding past the valve during warm-up

17. A diesel engine's SCR system has a diagnostic trouble code indicating "DEF Quality — Concentration Out of Range." The driver reports that the DEF was recently refilled from a bulk tank at the fleet yard. What is the most likely cause?

A. The DEF tank heater has malfunctioned and is boiling the DEF, changing its concentration through evaporation

B. The SCR catalyst has degraded and is sending a false signal to the NOx sensors that the ECM interprets as a DEF quality issue

C. The DEF dosing injector is over-injecting, flooding the decomposition tube and creating a concentration reading that differs from the tank concentration

D. The DEF in the bulk tank has been contaminated or has degraded — either the urea concentration is not the required 32.5%, the DEF was stored improperly (exposed to heat or sunlight for extended periods), or the bulk tank was contaminated with a foreign substance

18. A technician observes that a heavy-duty diesel engine's crankcase ventilation (breather) tube is expelling an abnormally high volume of vapor and pressure. What condition does excessive crankcase pressure indicate?

A. The engine's oil level is overfull, causing the oil to foam and generate excessive vapor in the crankcase

B. Combustion gases are leaking past the piston rings into the crankcase at a rate that exceeds the ventilation system's capacity — indicating worn rings, worn liners, or both — and this excessive blow-by is the primary indicator that the engine is approaching the need for an overhaul

C. The crankcase ventilation filter is plugged, creating backpressure that forces vapor out of the breather tube

D. The turbocharger compressor seal has failed, pressurizing the crankcase through the intake manifold and breather circuit

19. A heavy-duty diesel engine equipped with a DPF has a diagnostic trouble code indicating "DPF Differential Pressure — Higher Than Expected." The engine is in an active derate. What is the most common cause of elevated DPF backpressure?

A. Excessive soot accumulation in the DPF from an extended period of low-load operation that prevented regeneration, or ash accumulation that has reached the service cleaning threshold — both conditions restrict exhaust flow through the filter and increase the pressure differential measured by the backpressure sensor

B. A cracked DPF substrate that is allowing exhaust to bypass the filter media, reducing the measured differential pressure

C. A failed exhaust gas temperature sensor upstream of the DPF that is reporting incorrect temperatures to the ECM

D. An oversized turbocharger that is generating more exhaust flow than the DPF was designed to handle at all operating conditions

20. A diesel engine's oil pressure gauge reads normal at cold startup but gradually drops to near zero as the engine reaches full operating temperature. The oil level is correct. What is occurring?

A. The oil pump relief valve spring is weakening from heat, allowing the valve to open at progressively lower pressures as temperature rises

B. The oil cooler is becoming restricted as it heats up, diverting oil away from the main gallery and reducing pressure

C. As the engine warms up, the oil becomes thinner (viscosity decreases), and the already-worn bearing clearances allow the thinner oil to leak past faster than the pump can supply it — the combination of reduced viscosity and worn bearings drops the pressure to near zero at operating temperature

D. The oil filter bypass valve is opening at operating temperature because the hot oil activates the bypass valve's thermal element

21. A technician is diagnosing a turbocharger with a broken compressor wheel blade. What are the two most likely consequences of operating the engine with this condition?

A. Reduced engine power from decreased air intake restriction and increased fuel consumption from a richer mixture

B. A slight increase in turbo lag but no significant effect on engine power or reliability during normal driving

C. Increased exhaust backpressure that triggers frequent DPF regeneration events but does not affect boost pressure

D. Reduced boost pressure causing power loss and black smoke, plus the risk of the broken blade fragment entering the engine's intake system and causing catastrophic internal damage to the cylinders, pistons, and valves

22. A technician discovers that an engine's air compressor discharge line is coated in a thick layer of carbon buildup. The carbon has partially restricted the line. What is the root cause of this carbon accumulation?

A. The air dryer desiccant has broken down and is depositing silica particles that bake into a carbon-like coating

B. The air compressor is passing excessive oil past its piston rings into the discharge air — this oil coats the hot discharge line, bakes onto the surface at discharge temperatures, and progressively carbonizes into a hard, restricting deposit

C. The engine's exhaust gas recirculation system is leaking exhaust soot into the air intake, where it enters the compressor and deposits in the discharge line

D. The air compressor's intake is drawing unfiltered air containing road dust that combines with moisture to form the carbonaceous deposit

23. During a routine DPF service, the technician removes the DPF and sends it for off-vehicle cleaning. The cleaning process removes ash but the facility reports that the DPF substrate has internal cracks visible through the outlet channels. What caused the substrate cracking?

A. Thermal shock from an uncontrolled regeneration event — a large accumulation of soot burned in a short period, generating temperatures that exceeded the substrate's thermal tolerance and caused cracking from the rapid, uneven heating

B. Excessive exhaust backpressure from the ash accumulation that physically pressurized the substrate beyond its structural limit

C. The cleaning process itself caused the cracking through excessive air pressure applied during the pneumatic cleaning

D. Normal wear from 500,000 km of exhaust gas erosion gradually thinning the substrate walls until they cracked

24. A technician is troubleshooting an engine that surges at idle — the RPM oscillates between 600 and 900 RPM in a rhythmic pattern. The engine runs smoothly at all other speeds. What is the most likely cause?

A. A restricted fuel return line that is causing fuel pressure fluctuations at the low fuel demand of idle operation

B. Worn engine mounts that allow the engine to rock at its natural frequency, which coincidentally matches the idle RPM

C. An air leak in the intake system downstream of the throttle — the ECM detects the unmetered air, adjusts fuel delivery, the RPM rises, the air leak's effect diminishes at the higher RPM, the ECM reduces fuel, the RPM drops, and the cycle repeats

D. A failing crankshaft position sensor that intermittently drops signal at the low rotational speed of idle, causing the ECM to momentarily lose injection timing reference

25. A heavy-duty diesel engine's aftertreatment system includes a DOC, DPF, and SCR in sequence. A technician replaces the DOC catalyst due to degradation. After installation, the DPF regeneration frequency increases significantly. What is the relationship between DOC performance and DPF regeneration?

A. The DOC is unrelated to DPF regeneration — the increased frequency must be caused by a coincidental change in the vehicle's duty cycle

B. The new DOC is more efficient than the old one and is generating more heat that triggers unnecessary regeneration events

C. The new DOC has a higher flow restriction than the old one, creating backpressure that the ECM interprets as DPF loading

D. If the replacement DOC is not performing to specification — producing insufficient NO₂ for passive regeneration and insufficient heat for active regeneration — the DPF cannot regenerate as effectively, causing soot to accumulate faster and triggering more frequent regeneration attempts

26. A fleet manager reports that one truck consistently has higher DEF consumption than identical trucks on the same routes. The SCR system has no fault codes. What should the technician investigate?

- A. The DEF concentration, which may be weaker than 32.5% and requiring the system to inject more volume to achieve the same NO_x conversion
- B. The engine's base NO_x output — higher engine-out NO_x from an EGR system fault, advanced injection timing, or a turbocharger issue requires the SCR system to inject more DEF to achieve the same tailpipe NO_x target, increasing consumption
- C. The DEF tank heater, which may be running continuously and boiling off DEF, reducing the usable volume in the tank
- D. The trailer being pulled by this truck, which may have higher aerodynamic drag that increases engine load and indirectly affects DEF consumption

27. A diesel engine has a diagnostic trouble code for "Exhaust Gas Temperature Sensor 2 — Circuit Open." Sensor 2 is located at the DOC outlet / DPF inlet. What is the consequence of operating with this fault?

- A. The engine will not start because the ECM requires all exhaust temperature signals before allowing injection
- B. The engine will derate to idle-only mode immediately because the DOC outlet temperature is needed for emission compliance verification
- C. The ECM cannot verify the DOC outlet temperature, which means it cannot confirm that the DOC is generating adequate heat for active DPF regeneration — the ECM will disable active regeneration as a protective measure, leading to progressive DPF soot accumulation and eventual derate
- D. The exhaust gas temperature at the DPF inlet will be unregulated, potentially causing the DPF to overheat and crack during passive regeneration

28. A technician is performing a cylinder contribution test on a six-cylinder diesel engine using the scan tool. The test shows that cylinders 1 through 5 contribute equally, but cylinder 6 contributes approximately 30% less than the average. What should be investigated on cylinder 6?

- A. The main bearing directly below cylinder 6, which may be worn and reducing the mechanical energy transfer from that piston
- B. The camshaft journal directly supporting the cylinder 6 lobes, which if worn would reduce lift on both valves for that cylinder
- C. The crankshaft counterweight nearest to cylinder 6, which if damaged would create an imbalance that reduces power output from that cylinder
- D. The fuel injector performance (spray pattern, fuel delivery rate, and opening pressure), the compression (ring and valve condition), and the valve lash setting for cylinder 6 — any of these factors could individually or collectively reduce that cylinder's contribution to engine output

29. A technician replaces the coolant temperature sensor on a heavy-duty diesel engine. After replacement, the cooling fan runs continuously at full speed regardless of engine temperature. What is the most likely cause?

- A. The replacement sensor has the wrong resistance range for the application, causing the ECM to read an incorrect temperature that triggers continuous fan engagement as a protective response to a perceived overheating condition
- B. The fan clutch solenoid was accidentally disconnected during the sensor replacement and needs to be reconnected
- C. The new sensor needs a 30-minute break-in period before it provides accurate readings to the ECM
- D. The ECM needs to be reflashed with updated software to recognize the new sensor's calibration parameters

30. A technician is inspecting the air compressor on a heavy-duty truck and finds that the compressor head is cracked and leaking oil externally. What additional concern should the technician have beyond the external leak?

- A. The cracked head may be allowing air to leak from the discharge side back to the inlet, reducing pumping efficiency
- B. The cracked head may be allowing exhaust gases from the engine to enter the air system through the compressor's intake connection

C. The cracked head may be allowing engine oil to enter the compression chamber and be pumped into the air system, contaminating the air dryer desiccant and all downstream brake system components

D. The cracked head is a cosmetic issue only since the compressor's pumping elements are located in the lower block section

31. A heavy-duty truck's air system has a condition where the air dryer purge valve cycles continuously — the valve opens and closes every few seconds rather than only during the governor's cut-out signal. What is the most likely cause?

A. The governor is cycling rapidly due to a significant system air leak, and each time the governor unloads the compressor, it triggers the air dryer purge — the rapid cycling is a symptom of the air leak, not a dryer fault

B. The air dryer's internal timer is malfunctioning and triggering purge cycles independently of the governor signal

C. The purge valve diaphragm has failed, causing the valve to flutter open and closed under system pressure

D. The air dryer heater element is stuck on and is heating the desiccant to a temperature that triggers a thermal purge cycle

32. A tandem-axle tractor has been involved in a minor collision that bent the rear axle housing slightly. The brakes on that axle appear to function but the vehicle pulls to the left during braking. What is the most likely explanation?

A. The bent axle housing has changed the shoe-to-drum alignment, causing one side to contact the drum sooner or with more force than the other

B. The collision damaged the ABS modulator valve on the right side, causing it to release pressure during every brake application

C. The air lines to the right-side brake chambers were pinched in the collision, restricting airflow to those chambers

D. The bent axle housing has shifted the brake drum position relative to the shoes, creating unequal contact patterns and uneven braking force between the left and right wheels on that axle

33. A transit bus equipped with hydraulic disc brakes has a condition where the brake fluid in the master cylinder reservoir is consistently low. No external leaks are visible. The brake pads were replaced 3,000 km ago. What is the most likely cause?

A. The master cylinder bore is worn and is allowing fluid to bypass the primary piston seal during applications

B. The caliper piston bores have corroded since the pad replacement, creating internal porosity that absorbs fluid

C. The brake pad wear sensors are generating a false low-fluid signal even though the actual fluid level is adequate

D. The master cylinder reservoir cap vent is stuck closed, creating a vacuum that pulls the fluid level down in the reservoir

34. A technician notices that one S-cam brake drum on a drive axle is significantly hotter than the other drums after a road test. The pushrod stroke on that wheel is within specification. What is the most likely cause?

A. A weak or broken brake shoe return spring that is not fully retracting the shoes from the drum when the brakes are released, causing the shoes to drag against the drum during driving and generating excessive heat

B. The ABS modulator on that wheel is applying residual pressure during driving

C. The brake lining material on that wheel is a different compound than the other wheels, generating more friction heat during the same brake application

D. The tire on that wheel is underinflated, causing the sidewall flex to generate heat that transfers to the drum through the hub

35. A school bus has a federal requirement for a crossing arm that extends in front of the bus when the stop arm is deployed. The crossing arm is pneumatically actuated. The crossing arm fails to extend when the stop arm is deployed. The air system is functioning normally. What should the technician check?

- A. The crossing arm's mechanical linkage, which may be bent or seized from corrosion preventing the arm from extending
- B. The wiring to the stop arm switch, which may not be sending the correct signal to the crossing arm solenoid
- C. The air control valve and air line specific to the crossing arm circuit, and the solenoid that controls air flow to the crossing arm actuator — a failed solenoid, a restricted air line, or a faulty control valve prevents air from reaching the actuator
- D. The bus's main air system governor, which may be set too low to provide adequate pressure for the crossing arm actuator

36. A driver reports that the brakes on a loaded dump truck feel weak during the first application after a long downhill descent where the engine brake was used extensively. Subsequent brake applications feel normal. What is the most likely cause?

- A. The engine brake heated the exhaust system components near the brake chambers, softening the chamber diaphragms temporarily
- B. The brake drums cooled during the descent (because the service brakes were not used while the engine brake was active), and the first application must heat the drum surface slightly before the lining achieves its optimal friction coefficient — this is known as cold-drum effect or green fade
- C. The air system pressure dropped below normal during the descent because the engine brake consumed air from the brake circuit
- D. The engine brake deactivated the ABS system during the descent, and the first service brake application reactivated it with a momentary delay

37. A heavy-duty truck has a condition where the spring brakes apply suddenly while driving at highway speed. The air system pressure readings on both gauges show pressure dropping rapidly. The low-pressure warning buzzer activated approximately 20 seconds before the spring brakes applied. What happened?

- A. The parking brake valve malfunctioned and exhausted the spring brake hold-off air independently of the service circuit pressure

B. The tractor protection valve closed automatically because the trailer developed a massive air leak that was draining both systems

C. The air compressor failed catastrophically (seized), and no other system fault existed to cause the pressure drop

D. A major air system leak has caused the system pressure to drop below the spring brake release threshold (approximately 20-40 psi) — as pressure dropped, the low-pressure warning activated at 60 psi, and the spring brakes applied automatically when pressure dropped further, which is the fail-safe emergency function operating as designed

38. A technician measures the air system build-up time on a heavy-duty truck. With the engine at governed RPM, the system takes 5 minutes to build from 85 psi to 100 psi. What does this excessive build-up time indicate?

A. Either the air compressor has reduced pumping capacity (from worn valves, rings, or a restricted intake) or a significant air leak in the system is consuming air nearly as fast as the compressor produces it — the standard requires building from 85 to 100 psi in 45 seconds or less at governed RPM

B. The governor is set too low and is cutting in at 85 psi instead of the standard 100 psi, extending the build-up range

C. The air dryer desiccant cartridge is oversaturated and is creating excessive restriction that slows the air flow from the compressor to the reservoir

D. The build-up time is within the acceptable range for a heavy-duty tractor-trailer combination under loaded conditions

39. A trailer has all four brakes dragging after being coupled to the tractor. The trailer was parked with the spring brakes applied. After coupling, the tractor supplies air to the trailer and the spring brakes release, but the service brakes are partially applied. What is the most likely cause?

A. The trailer relay valve has a stuck exhaust piston that is not venting residual pressure from the previous brake application

B. The trailer ABS system is applying a baseline brake force to all wheels as part of its startup self-test sequence

C. The trailer's service brake circuit has a restricted or kinked air line that is trapping residual application pressure in the brake chambers, preventing full release of the service brakes after the initial coupling check

D. The tractor's foot valve has a leaking secondary circuit seal that is sending a constant low-pressure signal to the trailer service circuit through the gladhand

40. A technician is performing a brake adjustment check on a transit bus with air disc brakes. How is the pad-to-rotor clearance verified on most air disc brake designs?

A. By measuring the gap between the pad and rotor through an inspection window using a feeler gauge at multiple points around the rotor

B. By measuring the brake chamber pushrod stroke with the brakes applied and comparing it to the manufacturer's specification — the pushrod stroke on an air disc brake reflects the pad-to-rotor clearance through the caliper's internal adjustment mechanism

C. By removing the wheel and measuring the pad thickness directly with a caliper, then comparing to the minimum thickness specification

D. By connecting a scan tool to the ABS module, which monitors pad wear through an integrated electronic wear sensor

41. What is the primary reason that brake chamber diaphragms fail in heavy-duty air brake systems?

A. Exposure to extreme cold temperatures during Canadian winter operation causes the rubber to become brittle and crack

B. Contamination from oil-laden compressed air that softens and degrades the rubber diaphragm material

C. Excessive brake application force from an over-pressurized air system that stretches the diaphragm beyond its elastic limit

D. Age-related deterioration accelerated by oil contamination from the air system, moisture exposure, heat cycling from brake operation, and mechanical fatigue from thousands of application and release cycles

42. A tractor-trailer combination has a condition where the trailer brakes apply when the driver makes a moderate service brake application, but the tractor brakes on the drive axle appear to be doing very little work. What is the most likely cause?

A. The tractor's rear brake chambers or slack adjusters on the drive axle are severely out of adjustment — the pushrod stroke is excessive, requiring most of the air volume to be consumed taking up the free play before the shoes contact the drum, resulting in weak rear brake application while the trailer brakes (which are properly adjusted) apply normally

B. The trailer relay valve is set to a higher pressure ratio than the tractor's rear relay valve, causing the trailer to receive more force

C. The tractor's primary circuit has a restriction that slows air delivery to the drive axle but allows full flow to the trailer

D. The brake proportioning valve has shifted its bias toward the trailer circuit at the expense of the tractor's drive axle circuit

43. During a brake inspection, a technician finds that both front brake drums on a truck show a network of fine surface cracks on the friction surface. The cracks form a pattern resembling a spider web or heat checks. What is the assessment?

A. The cracks are cosmetic surface imperfections from the manufacturing casting process and are acceptable for continued use

B. The cracks are from a single instance of hard braking that will not progress further during normal operation

C. Heat checking indicates that the drums have been subjected to repeated thermal stress cycles (heating and cooling during normal braking), and while minor heat checking is common and acceptable if shallow, the drums must be inspected to determine if the cracks have progressed deep enough to warrant replacement

D. The drums must be replaced immediately because any visible cracking on a brake drum is an automatic out-of-service condition

44. A technician is testing the tractor protection valve on a heavy-duty tractor. With the trailer supply valve (red button) pushed in and the system at full pressure, the technician slowly drains the primary

circuit through a test port while monitoring the trailer supply line pressure. At what approximate tractor system pressure should the tractor protection valve close and exhaust the trailer supply?

- A. 80 to 85 psi, which is the same threshold as the pressure protection valve for accessories
- B. 40 to 45 psi — the tractor protection valve closes at this pressure to protect the tractor's remaining air supply from being drained by the trailer circuit and simultaneously applies the trailer spring brakes
- C. 60 psi, which is the same threshold as the low-pressure warning device activation
- D. 20 to 25 psi, which is the minimum pressure needed to hold the spring brakes released on the tractor

45. A heavy-duty truck has a complaint of excessive brake pedal effort — the driver must push much harder than normal to achieve adequate braking. The air system pressure is normal at 120 psi. What component should be investigated?

- A. The brake chambers, which may be undersized for the vehicle's loaded weight and unable to generate adequate force
- B. The ABS system, which may be limiting the air pressure delivered to the chambers during every application
- C. The air dryer, which may be restricting the flow of air from the reservoir to the foot valve during rapid pressure demand
- D. The foot valve (treadle valve) — a binding linkage, a worn internal piston, or a partially blocked inlet port can restrict the air flow from the reservoir to the output circuits, requiring the driver to push harder to achieve the same application pressure at the chambers

46. A technician is replacing all brake shoes on a drive axle during a scheduled brake service. After installation, what verification must be performed before returning the vehicle to service?

- A. The pushrod stroke must be measured on each wheel with the brakes fully applied to verify the automatic slack adjusters are maintaining stroke within specification, the drums must be checked for proper fit and free rotation with brakes released, and a low-speed road test must confirm balanced braking with no pull

B. Only a visual inspection of the shoe installation is needed since the automatic slack adjusters will set the correct adjustment during the first few brake applications

C. The ABS system must be recalibrated using the scan tool to accommodate the new lining thickness on the drive axle

D. The air system must be fully drained and rebuilt from zero pressure to verify all components function during a fresh build-up cycle

47. A technician is measuring voltage at the starter motor terminal during cranking. The reading is 8.5 volts. Battery voltage at the battery posts during cranking is 10.8 volts. What does the 2.3-volt difference indicate?

A. The battery is weak and cannot maintain adequate voltage under the cranking load

B. The starter motor is drawing less current than normal, causing excess voltage to remain in the cables

C. The reading is within normal specification for the voltage difference between battery and starter during cranking

D. There is 2.3 volts of voltage drop in the cables, connections, and solenoid between the battery and the starter motor — this excessive drop is stealing voltage from the motor, reducing cranking speed, and must be isolated by testing each segment individually

48. A truck has two 12-volt batteries in parallel. Battery 1 tests at 12.6 volts open-circuit and passes a load test. Battery 2 tests at 11.8 volts open-circuit and fails the load test. What is the consequence of leaving the failed battery in the parallel bank while replacing only the failed one?

A. The new replacement battery will be damaged immediately by the voltage difference between the two batteries

B. If only the failed battery is replaced, the new battery and the existing good battery should be tested together to verify compatibility — ideally, both batteries should be the same age, type, and CCA rating to prevent the stronger battery from carrying a disproportionate load and failing prematurely

C. The existing good battery should be moved to the failed battery's position and the new battery installed in the original good battery's position

D. The parallel connection will automatically balance the voltage between the new and existing battery within 30 minutes of engine operation

49. A technician needs to test a wire for resistance between two connectors that are located 6 metres apart on a truck frame. The wire is part of a multi-conductor harness and cannot be visually traced for its entire length. What is the correct procedure?

A. Disconnect both ends of the wire from their respective connectors, set the multimeter to ohms, connect one lead to each end of the wire, and read the resistance — a good wire reads near 0 ohms while an open wire reads infinite (OL)

B. Set the meter to DC volts and measure the voltage drop across the wire while the circuit is energized under normal load

C. Set the meter to AC volts and apply an AC signal from a tone generator to one end while measuring at the other

D. Set the meter to DC amps and measure the current flow through the wire while both ends are connected to their normal circuits

50. A truck's trailer ABS power supply through the J560 connector Pin 7 (auxiliary) reads 0 volts at the connector with the ignition on. The tractor's own ABS system functions normally. What should the technician check?

A. The trailer ABS ECU, which may have an internal short that is pulling the auxiliary circuit voltage to zero

B. The tractor's ABS module, which controls the auxiliary power output to the J560 connector and may have disabled the output

C. The fuse, relay, and wiring in the tractor's auxiliary circuit that powers Pin 7 of the J560 connector — a blown fuse, a failed relay, or an open wire in the tractor's side of this dedicated circuit prevents voltage from reaching the connector

D. The J560 connector ground pin, which if open would prevent voltage from appearing on any other pin

51. A heavy-duty truck's charging system is producing 14.2 volts at the battery terminals, which is within normal specification. However, the batteries are consistently undercharged and the truck has difficulty starting after overnight parking. What should the technician investigate?

- A. The battery cable sizes, which may be too small for the vehicle's charging current requirements
- B. The alternator belt tension, which if slightly loose could allow belt slippage at high alternator load
- C. The voltage regulator calibration, which may be set to the lower end of the acceptable range
- D. The parasitic draw (key-off current drain), which may be excessive — a module or circuit that remains active after shutdown drains the batteries faster than the next day's driving can recharge them

52. A technician is troubleshooting a circuit where the headlights work on low beam but switching to high beam causes both headlights to go out completely — neither low nor high beam illuminates. Returning the switch to low beam restores normal operation. What is the most likely cause?

- A. The high-beam filaments in both bulbs have failed simultaneously, which is unlikely but possible if both were replaced at the same time
- B. The dimmer switch or multifunction switch has an internal fault — in the high-beam position, the switch is opening both the low-beam and high-beam circuits instead of only switching from low to high, causing a complete loss of all headlight power in the high-beam position
- C. The high-beam relay has welded contacts that are backfeeding voltage into the low-beam circuit and causing both circuits to cancel
- D. The high-beam indicator lamp on the dashboard has a short that is drawing all the current away from the headlight circuit when energized

53. A heavy-duty truck equipped with LED headlights has one LED headlight assembly that flickers intermittently during driving. The other headlight operates without issue. What is the most likely cause?

- A. A loose or corroded connector, a damaged wire, or a poor ground connection at the flickering headlight that creates an intermittent high-resistance point disrupted by road vibration

B. The LED headlight assembly is incompatible with the vehicle's voltage regulation system and requires a voltage-stabilizing module

C. The alternator's AC ripple is interfering with the LED's internal driver circuit on the affected side only

D. The LED headlight assembly has an internal thermal management fault that causes it to dim and brighten as its heat sink temperature fluctuates

54. A truck's scan tool retrieves fault codes from the engine ECM, but the technician notices that the fault code descriptions are displayed as numerical codes only — no text descriptions appear. What is the most likely reason?

A. The ECM has a firmware corruption that has deleted the fault code description database from its internal memory

B. The CAN bus communication speed is too low to transmit the text descriptions along with the numerical codes

C. The scan tool's software does not contain the fault code library for the specific engine make, model, or software version being diagnosed — the tool can read the raw code numbers but cannot translate them without the correct database

D. The fault codes are from a module other than the engine ECM and have been forwarded to the ECM for storage without their original descriptions

55. A truck's electric horn sounds weak and low-pitched instead of its normal loud, clear tone. The horn fuse and relay are functioning correctly. What is the most likely cause?

A. The horn's internal diaphragm adjustment has drifted from its factory setting and needs to be readjusted

B. A voltage drop in the horn's power or ground circuit is reducing the voltage available to the horn, causing it to vibrate at a lower frequency and produce a weaker, lower-pitched sound than normal

C. The horn bracket has loosened, allowing the horn to vibrate against the frame and absorb the sound energy

D. The relay contacts have developed a high resistance that reduces current to the horn during the initial activation

56. A technician measures the resistance between CAN H and CAN L at the 9-pin diagnostic connector and reads 40 ohms with the ignition off. What does this indicate?

A. The bus is properly terminated with two 120-ohm resistors in parallel, and the 40-ohm reading is within the acceptable tolerance range

B. One of the modules on the bus has a faulty internal termination circuit that is loading the bus with additional resistance

C. The bus has three terminating resistors instead of two — an extra 120-ohm termination has been introduced, possibly from an aftermarket device or a replacement module with a built-in terminator that should not have one

D. An additional parallel resistance from a third 120-ohm termination has been introduced — three 120-ohm resistors in parallel produce 40 ohms, indicating an extra termination that must be located and removed to restore the correct 60-ohm bus impedance

57. A heavy-duty truck's instrument cluster shows the speedometer fluctuating wildly between 0 and the vehicle's actual speed while driving at a constant highway speed. All other gauges function normally. What is the most likely cause?

A. An intermittent vehicle speed sensor signal or a faulty speed signal source — the sensor, its wiring, or its connector has an intermittent connection that drops out during driving, causing the speedometer to oscillate between the actual value and zero as the signal comes and goes

B. The instrument cluster's speedometer stepper motor is failing internally, causing the needle to oscillate

C. The transmission output shaft speed sensor is faulty and sending conflicting data to the instrument cluster

D. The tire size programming in the ECM does not match the actual tire size on the vehicle, causing a periodic calibration error

58. A technician discovers that a truck's rear-facing camera display in the cab shows a clear image when the transmission is in reverse but the image has significant electrical noise (interference lines) at all other times when the display is also used as a mirror monitor. What is the most likely cause?

A. The camera lens is dirty and the noise is caused by the display's algorithm attempting to sharpen the degraded image

B. The camera itself is faulty and needs replacement because its image sensor is degrading

C. An electromagnetic interference (EMI) source near the camera or its video cable is inducing noise on the signal — common sources include alternator output, ignition circuits, or aftermarket accessories that share the same routing path as the camera cable

D. The display unit is designed to operate only in reverse and produces artifacts when used in continuous monitoring mode

59. A truck equipped with an electronic instrument cluster has a condition where all warning lamps on the cluster illuminate simultaneously and stay on continuously, even when the engine is running normally with no detected faults. What is the most likely cause?

A. Multiple simultaneous faults have occurred across the engine, transmission, and ABS systems causing all lamps to illuminate legitimately

B. The alternator is overcharging, providing excessive voltage that activates all warning lamp circuits

C. The vehicle's main fuse box has a loose connection that is sending intermittent power spikes to the cluster

D. The instrument cluster has an internal fault or has lost CAN bus communication — without data from the vehicle's modules, the cluster defaults to illuminating all warning lamps as a fail-safe indication that it cannot verify system status

60. A heavy-duty truck has a parasitic draw test result of 350 milliamps with the vehicle fully shut down and all modules in sleep mode. The acceptable parasitic draw specification is 50 to 85 milliamps. How should the technician isolate the source of the excess draw?

- A. Remove fuses one at a time from the fuse panel while monitoring the ammeter — when the parasitic draw drops to the acceptable range, the circuit protected by the last-removed fuse contains the fault that is drawing the excess current
- B. Disconnect the alternator output cable to verify that the alternator's diodes are not conducting current in reverse
- C. Disconnect all trailer connections and retest to determine if the trailer wiring is the source of the parasitic draw
- D. Replace the batteries with new units, as aged batteries develop internal leakage that can appear as a parasitic draw

61. A heavy-duty truck's backup alarm does not sound when the transmission is shifted into reverse. The backup alarm worked correctly last week. The backup lights illuminate when reverse is selected. What is the most likely cause?

- A. The reverse signal switch on the transmission has failed and is no longer providing a ground path for the backup alarm
- B. The backup alarm relay is stuck in the open position due to corrosion on its internal contacts
- C. The backup alarm unit itself has failed — since the backup lights work (confirming the reverse signal switch and the reverse circuit are functional), the fault is isolated to the alarm unit or its dedicated wiring
- D. The CAN bus communication has failed between the transmission module and the body controller that controls the backup alarm output

62. A truck's turn signals work correctly at normal flash rate on the left side but flash at double speed on the right side. All right-side bulbs appear to illuminate. What is the most likely cause?

- A. The turn signal relay (flasher) is faulty and flashes at different rates depending on which output circuit is activated
- B. One of the right-side turn signal bulbs (either front or rear) has been replaced with an incorrect wattage bulb that draws less current than the original — the flasher detects the reduced current draw on the right circuit and increases the flash rate, which is the same response as a burned-out bulb

C. The right-side turn signal wiring has a short to ground that is doubling the current draw and speeding up the flasher

D. The body controller module is commanding a faster flash rate on the right side due to an internal programming error

63. A technician is diagnosing a no-communication condition with the scan tool connected to the 9-pin diagnostic connector. The scan tool powers on (battery voltage is present at pins A and B) but cannot establish communication on either J1939 or J1708. What should be checked?

A. The scan tool cable and adapter for damage, loose connections, or bent pins that may prevent the data link signals from reaching the tool

B. The alternator output, which must be above 13.5 volts for the CAN bus modules to communicate

C. The engine ECM's power supply fuse, which if blown would prevent all vehicle communication

D. The diagnostic connector itself — pins C and D (CAN H and CAN L) and pins F and G (J1708) must be inspected for corrosion, damage, or pushed-back pins that prevent the data link signals from reaching the scan tool

64. A truck's electric window on the passenger side operates normally from the driver's master switch but does not operate from the passenger door switch. What is the most likely cause?

A. The passenger door window switch, its wiring, or the connector between the passenger door harness and the main harness has a fault — since the motor works from the driver's switch, the motor and its power/ground circuit are functional, isolating the fault to the passenger-side control circuit

B. The window motor has a secondary winding that only responds to the driver's switch due to a voltage priority circuit

C. The body controller module locks out the passenger switch when the driver's window is in the fully closed position

D. The child safety lockout switch is activated on the driver's door panel, disabling all passenger window controls

65. A truck equipped with a remote keyless entry system has a condition where the key fob will not lock or unlock the doors from more than 1 metre away. Previously, the fob worked from 15 metres. What is the most likely cause?

A. The vehicle's receiver antenna has been damaged or disconnected, reducing its ability to detect the fob's signal

B. Electromagnetic interference from a nearby radio tower is blocking the key fob's transmission frequency

C. The key fob's battery is weak, reducing the transmission power and limiting the effective range — replacing the fob battery is the first and most likely solution

D. The body controller module's keyless entry receiver has a firmware fault that limits the reception range

66. A technician is testing a heavy-duty truck's glow plug system. The glow plug relay energizes when the ignition is turned to the ON position, but the engine is difficult to start in cold weather. The technician measures the resistance of each glow plug individually. Three glow plugs read 0.5 ohms each, and three read infinite (OL). What do the infinite readings indicate?

A. The three infinite-reading glow plugs are functioning at a higher voltage setting designed for extreme cold conditions

B. The three infinite-reading glow plugs have failed open — their heating elements have broken internally, and they are not generating any heat to assist cold starting, which explains the difficulty starting in cold weather since only three of six cylinders are receiving glow plug assistance

C. The infinite readings are caused by the glow plug relay dropping voltage to those three cylinders due to internal contact resistance

D. The meter is malfunctioning and the infinite readings should be disregarded if the glow plug relay is confirmed as energizing

67. A heavy-duty truck has an intermittent check engine lamp that illuminates during heavy rain and wet road conditions but extinguishes when the weather is dry. No other symptoms are present. What is the most likely cause?

- A. Water is dripping onto a hot exhaust component and creating steam that a sensor interprets as excessive exhaust gas temperature
- B. The tires are hydroplaning intermittently, causing the wheel speed sensors to detect a discrepancy that triggers an engine fault
- C. The alternator belt is slipping on the wet pulleys, causing a brief charging system dip that the ECM interprets as a voltage fault
- D. Moisture is intruding into an electrical connector, sensor, or wiring harness — the water creates a conductive path that alters a sensor signal or creates a circuit fault that the ECM detects and logs as a fault code; when the connector dries, the fault disappears

68. A truck's horn honks by itself intermittently — without the driver pressing the horn button. The problem occurs randomly and cannot be predicted. What should the technician check?

- A. The horn button and its wiring in the steering column, including the clockspring — an intermittent short in the horn button circuit, a worn clockspring conductor, or a pinched wire in the steering column that randomly completes the horn relay coil circuit without the driver's input
- B. The horn relay, which may have a thermal cycling issue that causes the contacts to close when the relay heats up during driving
- C. The body controller module software, which may have a bug that randomly commands the horn output
- D. The horn units themselves, which may have an internal short that activates the horns independent of the horn button circuit

69. A heavy-duty truck equipped with a dual-disc clutch has a condition where the intermediate plate (center plate, floater plate) does not release freely when the clutch pedal is depressed. The clutch disc facings are not worn. What symptom does this condition produce?

- A. The clutch slips under load because the intermediate plate is applying pressure to only one disc instead of both
- B. The engine stalls when the clutch pedal is pressed because the stuck intermediate plate acts as a mechanical brake on the input shaft

C. The transmission is difficult to shift because the stuck intermediate plate keeps the second disc in contact with the flywheel or pressure plate, preventing the input shaft from stopping when the clutch is disengaged

D. The clutch releases too quickly, causing a jerky engagement that is uncomfortable but not mechanically harmful

70. A truck equipped with an 18-speed manual transmission has a condition where the range section will not shift from low range to high range. All other shifts (main box and splitter) work correctly. The range air supply has been verified as adequate. What is the most likely cause?

A. The range cylinder piston seal has failed or the range synchronizer has worn beyond its effective range, preventing the range section from completing the shift even though adequate air pressure is reaching the cylinder

B. The shift lever detent mechanism is worn and preventing the lever from reaching the position that commands the range change

C. The transmission oil level is low, which only affects the range section because it is the highest internal mechanism in the transmission

D. The splitter section is mechanically interfering with the range section due to a worn splitter synchronizer cone

71. An Allison automatic transmission has a diagnostic trouble code indicating "Torque Converter Lockup Clutch Slip — Excessive." The driver reports increased fuel consumption and a slight RPM flare at highway cruising speed. What is the most likely cause?

A. The transmission oil cooler is restricted, causing high fluid temperature that expands the lockup clutch material and prevents full engagement

B. The torque converter stator one-way clutch has failed, allowing the stator to rotate freely in both directions

C. The turbine shaft seal is leaking, reducing the hydraulic pressure available to apply the clutch packs in all forward gears

D. The lockup clutch friction material inside the torque converter is worn or the apply piston is not receiving adequate pressure to fully clamp the clutch, allowing the impeller and turbine to slip relative to each other at highway speed

72. A technician is servicing a driveshaft and finds that one U-joint bearing cap has a rust-colored stain around its perimeter where it seats in the yoke bore. What does this stain indicate?

A. Surface rust from environmental exposure that has no effect on the U-joint's structural integrity or function

B. The bearing cap has been spinning (working) in the yoke bore — the rust stain is fretting corrosion from relative movement between the cap and bore surfaces, indicating the bore has worn oversize and the cap is no longer press-fit securely

C. The U-joint grease has leaked past the bearing cap seal and oxidized on the external surface of the yoke

D. The yoke was painted at the factory and the paint has worn off around the bearing cap bore from normal vibration

73. A tandem-axle tractor's rear differential is producing a rhythmic clicking noise that occurs in direct proportion to wheel speed. The noise is present regardless of whether the vehicle is accelerating, decelerating, or coasting. The technician removes the differential cover and finds metallic debris in the gear oil. What is the most likely source of the clicking and debris?

A. A worn spider gear (differential pinion gear) that is contacting the differential case at one point per revolution

B. A damaged ring gear tooth that has chipped and is producing a click each time the damaged tooth contacts the pinion

C. A chipped or broken tooth on the ring gear that produces a clicking sound once per ring gear revolution, and the metallic debris in the oil is the material from the damaged tooth

D. A worn thrust washer between the side gear and the differential case that is allowing metal-to-metal contact with each rotation

74. A truck's clutch pedal has excessive free play — the pedal moves approximately 75 mm before any resistance is felt. The specification calls for 12 to 25 mm of free play. What is the most likely consequence if this is not corrected?

- A. The clutch will not fully release when the pedal is depressed because the excessive free play consumes too much of the available pedal travel — the release bearing does not push far enough against the pressure plate to completely disengage the disc, resulting in gear clash during shifting
- B. The clutch will engage too aggressively, causing a jerky takeoff from every stop
- C. The release bearing will overheat because it contacts the pressure plate too early in the pedal travel
- D. The pressure plate springs will weaken prematurely from being partially compressed at all times

75. A truck equipped with an automated manual transmission (AMT) has a condition where the transmission shifts normally during upshifts but hesitates and sometimes misses during downshifts. The check transmission lamp is illuminated. What should the technician investigate?

- A. The engine brake system, which on many AMT-equipped trucks is coordinated with downshifts to match RPM
- B. The clutch wear parameter in the TCU, which may indicate the clutch is too worn for reliable downshift engagement
- C. The fuel injection system, which may not be responding quickly enough to the TCU's RPM-matching commands during downshifts
- D. The transmission speed sensors (input and output shaft), the shift actuator mechanism, and the TCU fault codes — a failed speed sensor prevents the TCU from calculating the correct RPM match for the downshift, and a worn shift actuator may not move fast enough to complete the downshift engagement

76. A driveshaft on a heavy-duty truck vibrates at a frequency of two vibrations per driveshaft revolution. The U-joints are new and in good condition. What is the most likely cause?

- A. The driveshaft is bent, creating an imbalance that produces one vibration per revolution, not two

B. The U-joint operating angles at the front and rear of the driveshaft are not equal — unequal angles prevent the speed fluctuation from the front U-joint from being cancelled by the rear U-joint, and the uncancelled fluctuation produces a vibration at twice per revolution

C. The driveshaft has lost a balance weight that was welded to the tube at the factory

D. The companion flange at the rear axle is worn, creating a wobble that produces a vibration at driveshaft frequency

77. A medium-duty truck equipped with a synchronized manual transmission has a condition where the synchronizer in 3rd gear is grinding during shifts. A technician determines that the synchronizer ring is worn. What is the function of the synchronizer ring that, when worn, allows grinding?

A. The synchronizer ring locks the selected gear to the mainshaft after the speeds are matched

B. The synchronizer ring prevents the shift fork from moving too far and overshooting the gear engagement position

C. The synchronizer ring uses friction to match the speed of the selected gear to the mainshaft speed before the sliding sleeve engages — when worn, the ring can no longer slow (or speed up) the gear adequately, and the sleeve attempts to engage while the components are still at different speeds, causing the grinding sound

D. The synchronizer ring absorbs the mechanical shock of gear engagement, cushioning the transition between gears

78. A technician is diagnosing a vibration on a truck that has recently had its rear axle ratio changed from 3.55:1 to 4.11:1. The driveshaft and U-joints were not changed. The vibration was not present before the ratio change. What is the most likely cause?

A. The driveshaft operating angles have changed due to the different pinion angle of the new gear set — the new pinion position has altered the rear U-joint angle, creating unequal angles that produce vibration

B. The new gear set is producing more torque at the wheels, which is twisting the driveshaft beyond its torsional limit

C. The new ring and pinion gear set has a manufacturing defect that produces a vibration transmitted through the driveshaft

D. The driveshaft's critical speed has decreased because the higher numerical ratio turns the driveshaft faster at any given vehicle speed, and the existing driveshaft is now operating at or near its critical speed at highway velocity

79. A truck equipped with a full-floating rear axle has a condition where the right rear wheel wobbles visibly during driving. The tire is properly mounted and balanced. What is the most likely cause?

- A. The right rear brake drum is out-of-round, creating a wobble that is visible at the wheel
- B. The differential side gear on the right side is worn, allowing the axle shaft to move laterally
- C. The driveshaft U-joint nearest the rear axle has a worn bearing cap that is transferring vibration to the axle housing
- D. The right rear wheel bearing adjustment is too loose, allowing excessive end play that permits the hub and wheel assembly to wobble on the spindle as it rotates

80. A technician finds that a truck's PTO will engage but the driven hydraulic pump does not build pressure. The pump turns when the PTO is engaged. What should the technician check first?

- A. The PTO gear mesh inside the transmission for worn teeth that are slipping under load
- B. The hydraulic system — the reservoir fluid level, the pump's suction line for restrictions or air leaks, and the pump itself for internal wear — since the PTO is engaging and the pump is turning, the fault is in the hydraulic system downstream of the mechanical PTO drive
- C. The engine RPM, which may be too low for the PTO-driven pump to generate adequate pressure
- D. The transmission oil temperature, which if too high could cause the PTO gear to expand and bind in the transmission aperture

81. A heavy-duty truck's differential lock indicator lamp on the dashboard is illuminated, indicating the diff lock is engaged, but the driver hears a grinding noise when attempting to engage the lock during a traction event. What is the most likely cause?

- A. The differential lock control solenoid is functioning correctly but the lock mechanism inside the differential is worn or damaged
- B. The air supply to the differential lock shift mechanism is insufficient, causing a partial engagement
- C. The dashboard indicator switch is faulty, illuminating the lamp without the lock actually engaging
- D. The differential lock shift collar and its engagement teeth are not aligned — the collar is attempting to engage while the axle shafts are at slightly different speeds, causing the grinding as the teeth try to mesh; the driver should momentarily release the throttle or apply the brakes to equalize wheel speeds before engaging the lock

82. A heavy-duty truck has an automatic transmission that produces a whining noise that varies with vehicle speed but is present in all gears including neutral (with the vehicle coasting). What is the most likely source of the noise?

- A. A worn gear set inside the transmission that is loaded in all gear positions and in neutral
- B. A worn front pump in the automatic transmission that is producing noise proportional to its speed
- C. The front pump (input-driven pump) of the automatic transmission, which turns whenever the engine is running and produces a whine proportional to engine/impeller speed — if the noise changes with vehicle speed rather than engine speed, the output shaft bearing or a constantly meshed gear is the suspect
- D. The torque converter, which contains no gears and cannot produce a whining noise under any condition

83. A truck equipped with an AMT displays a message "Clutch Overtemperature — Reduce Load." The driver was operating the truck in stop-and-go traffic on a steep grade with a full load. What caused this condition?

- A. The AMT's clutch engagement algorithm detected excessive heat from repeated engagement cycles on the grade — each takeoff from a stop on the grade requires the clutch to slip for a longer duration than on flat ground, generating heat that accumulates faster than the clutch can dissipate it under the continuous stop-and-go demand

- B. The transmission oil cooler has failed, allowing the transmission fluid to overheat and transfer heat to the clutch through the input shaft bearing
- C. The engine exhaust brake was active simultaneously with the clutch engagement, creating conflicting forces that generated excessive friction heat
- D. The TCU's temperature sensor is oversensitive and is triggering the warning below the actual temperature that would cause clutch damage

84. A truck's transfer case produces a loud clunking noise when transitioning between 2WD and 4WD modes. The clunking occurs during the shift but the transfer case operates normally once in the selected mode. What is the most likely cause?

- A. The transfer case lubricant has degraded and is not adequately cushioning the gear engagement during the mode shift
- B. The transfer case shift motor is operating too quickly, slamming the engagement collar into position rather than engaging smoothly
- C. The shift collar, engagement teeth, or sliding gear inside the transfer case are worn, causing a harsh engagement as the components mate — the worn teeth do not align smoothly and produce a clunking impact during the shift
- D. The front axle disconnect mechanism is not synchronizing with the transfer case shift, causing the driveline to wind up and release suddenly

85. A fleet manager asks what type of gear oil is required for a heavy-duty tandem drive axle equipped with a limited-slip differential. What is the key difference compared to the oil used in a standard open differential?

- A. Limited-slip differentials require synthetic gear oil only, while open differentials can use conventional mineral-based gear oil
- B. Limited-slip differentials use the same gear oil as open differentials with no additional additives or specifications
- C. Limited-slip differentials require a higher viscosity gear oil (SAE 140 instead of SAE 85W-140) to compensate for the additional friction surfaces

D. Limited-slip differentials require gear oil with a friction modifier (limited-slip additive) that controls the clutch engagement characteristics of the differential's friction clutch packs — without this additive, the clutch packs chatter during low-speed turns, producing a shuddering or vibrating sensation

86. A heavy-duty truck has a steering complaint where the steering wheel jerks to the left when the vehicle hits a bump with the right front tire. The steering linkage and king pins have been inspected and are within specification. What is the most likely cause?

A. Unequal tire pressure between the left and right steer tires, causing different deflection rates when a bump is encountered

B. A worn or failed steering damper (stabilizer) that can no longer absorb the road shock transmitted through the steering linkage — without the damper's hydraulic resistance, the bump force is transmitted directly through the drag link to the steering wheel as a kick

C. The power steering pump is producing inconsistent pressure that fails to counteract the bump force on the right side

D. The steer axle U-bolt torque has decreased, allowing the axle to shift on the springs during impact loading

87. A heavy-duty truck has a leaking power steering hose. The technician replaces the high-pressure hose. After starting the engine, the steering operates normally for a few seconds, then the new hose bursts. What is the most likely cause?

A. The replacement hose was not tightened adequately at the fittings, causing a blowout at the connection point

B. The replacement hose was the wrong inside diameter, which restricted flow and created a pressure spike

C. The power steering fluid was contaminated with brake fluid, which deteriorated the new hose from the inside

D. The replacement hose has an inadequate pressure rating for the application — the hose burst pressure is below the power steering system's maximum operating pressure, which peaks during full-lock steering efforts against the relief valve setting

88. A truck equipped with a solid I-beam steer axle has both front tires wearing on their outside edges. What alignment condition is the most likely cause?

- A. Excessive positive camber — the tops of the front wheels are tilted outward, loading the outside edges of the tires against the road surface and causing accelerated wear on those edges
- B. Excessive toe-in, which scrubs both tires inward and wears the inner edges rather than the outer edges
- C. Excessive negative caster, which causes the front wheels to tilt rearward and load the outer tire edges
- D. Excessive toe-out, which scrubs both tires outward and predominantly wears the inner edges of the tread

89. A heavy-duty truck's frame is being inspected after the vehicle was involved in a side-impact collision. The technician measures the frame width at multiple points and finds that the frame is 15 mm narrower at the point of impact compared to the manufacturer's specification. What is the significance?

- A. The measurement is within the manufacturer's acceptable tolerance for frame width variation due to manufacturing processes
- B. The narrowed frame dimension is a cosmetic issue that does not affect structural integrity or vehicle operation
- C. The frame has been permanently deformed (bent inward) by the collision impact, which may affect body mounting, drivetrain alignment, axle alignment, and the structural integrity of the frame — the deformation must be assessed by a qualified frame repair facility to determine if the frame can be straightened or must be sectioned
- D. The frame width variation is caused by thermal contraction from the cold weather at the time of inspection and will return to specification when the ambient temperature rises

90. A truck equipped with air ride suspension on the trailer has a condition where one corner of the trailer sits lower than the other three corners. The air bag at the low corner appears fully inflated. What should the technician investigate?

- A. The height control valve linkage at the low corner for a bent or misadjusted sensing arm that is providing incorrect ride height information to the valve
- B. The shock absorber at the low corner for a seized condition that is preventing the suspension from extending fully
- C. The trailer frame for a local deformation or crack near the low corner that has allowed the frame to sag at that point
- D. The air spring at the low corner for internal damage or a bulge that is allowing the bag to inflate to a reduced height — even though the bag appears fully inflated externally, an internal bladder failure can limit its effective height, or the air spring piston has shifted, reducing the installed height

91. A driver reports that the truck's steering feels heavy at low speeds during parking maneuvers but normal at highway speed. The power steering fluid level is correct and the belt tension is adequate. What should the technician check?

- A. The steer axle alignment, which if significantly out of specification could increase steering effort at low speed where tire scrub forces are highest
- B. The power steering pump's flow rate and pressure output — the pump may be producing adequate flow for highway driving (where less assist is needed) but insufficient flow at low-speed, high-demand situations (parking maneuvers) where the steering gear requires maximum hydraulic assist
- C. The front tire pressures, which if very low would dramatically increase the friction between the tires and the pavement during low-speed turning
- D. The steering column U-joints for binding, which would be more noticeable at low speeds when the driver applies more force to the steering wheel

92. A truck's wheel bearing was recently repacked and adjusted by a junior technician. Shortly after the service, the driver reports that the hub on the serviced wheel is significantly hotter than the hub on the opposite side after a 100 km drive. What is the most likely cause?

- A. The wheel bearing was adjusted too tightly, preloading the bearing beyond its design clearance and creating excessive friction that generates heat during rotation
- B. The bearing grease was the wrong type and has a lower melting point than the specified product

C. The hub seal was installed backward, creating friction between the seal lip and the spindle that generates heat

D. The wheel was torqued unevenly, creating a bending load on the hub that generates heat at the bearing

93. A truck's fifth wheel is described as an "air-release" type. What does the air-release feature do?

A. It uses air pressure to release the locking jaws from the king pin, allowing the trailer to be uncoupled without the driver manually lifting the release handle — the air actuator replaces the mechanical effort of pulling the release handle

B. It uses air pressure to apply the locking jaws around the king pin during coupling for a stronger initial lock

C. It vents the air from the tractor's suspension before coupling to lower the fifth wheel height to match the trailer

D. It releases compressed air around the fifth wheel plate to blow debris off the coupling surface before the trailer is backed onto it

94. A flatbed trailer equipped with an air ride suspension has a condition where the suspension dumps (deflates) completely when the trailer is parked overnight. The air system has no leaks when tested. What is the most likely cause?

A. The air springs are defective and losing pressure through their fabric reinforcement during temperature changes

B. The height control valve is stuck in the vent position and slowly exhausting the air from the springs

C. The air tanks are draining through the automatic moisture ejector valves, removing the air supply for the suspension

D. The suspension dump valve (a manual or automatic valve that exhausts air from the suspension for dock-height loading or trailer parking) is activated or is leaking internally, exhausting the air spring pressure while the trailer is parked

95. A technician is diagnosing a tire vibration that is felt through the cab floor rather than through the steering wheel. The vibration increases with vehicle speed. Which tire position is most likely the source?

- A. The left front steer tire, which would transmit vibration through the steering column to the steering wheel
- B. A drive axle or trailer axle tire, which transmits vibration through the suspension and frame to the cab floor rather than through the steering linkage — steer tire vibrations are felt in the steering wheel, while rear tire vibrations are felt through the cab floor and seat
- C. Both steer tires simultaneously, which would create a balanced vibration felt in the floor rather than the wheel
- D. The spare tire, which if improperly secured can bounce against its carrier and transmit vibration to the frame

96. A truck's steer axle has been measured for alignment and the following results are obtained: Left camber $+0.5^\circ$, Right camber $+1.5^\circ$, Left caster $+3.0^\circ$, Right caster $+3.0^\circ$, Total toe 2 mm toe-in. The specifications call for camber $+0.5^\circ$ to $+1.0^\circ$ per side, caster $+2.5^\circ$ to $+4.0^\circ$ per side, and total toe 1.5 to 3.0 mm toe-in. Which measurement is out of specification?

- A. The right camber at $+1.5^\circ$ exceeds the maximum specification of $+1.0^\circ$ — this indicates a bent steer axle, a worn king pin, or a bent steering knuckle on the right side that must be corrected
- B. The left caster at $+3.0^\circ$ is below the minimum specification and needs correction
- C. The total toe at 2 mm toe-in is at the center of the specification range and is correct
- D. The caster measurements are unequal side-to-side, which will cause a steering pull

97. A heavy-duty truck has a broken center bolt on the right front leaf spring. The spring leaves have shifted laterally. What is the consequence of this condition?

- A. The spring will be slightly stiffer on the right side, creating a minor ride height difference
- B. The broken center bolt is a minor fastener failure that has no effect on axle location or alignment

C. The leaves will separate and the spring will disassemble during the next suspension compression event

D. The steer axle has likely shifted laterally on the spring seat, changing the axle alignment and potentially altering the vehicle's tracking — the center bolt locates the axle on the spring, and without it, the axle can move off-center, changing toe, wheelbase, and tracking alignment

98. A technician is inspecting a set of tandem trailer tires and finds that the inner tire of a dual pair has a nail embedded in its sidewall. The nail does not appear to have penetrated through to the inside of the tire. What is the correct action?

A. Leave the nail in place as it is acting as a plug and remove it only if the tire begins to lose pressure

B. Remove the nail and inspect the wound — a sidewall puncture, even if not currently leaking, weakens the structural integrity of the sidewall and the tire should be removed from service because sidewall repairs are not permitted on commercial vehicle tires

C. Apply an external patch over the nail location to reinforce the area and continue operating the tire

D. Move the affected tire to a non-critical position such as the trailer tag axle where the load is lower

99. A truck equipped with hub-piloted wheels has a recurring issue of lug nuts loosening on the left rear drive position. The studs, nuts, and wheel have been replaced, and the torque is verified as correct. The re-torque after the first 100 km is performed. Despite these measures, the nuts loosen again within 5,000 km. What should the technician investigate?

A. The hub pilot pad surface and the wheel bore for matching fit — if the hub pilot and wheel bore dimensions do not match properly (the wheel does not center precisely on the hub), the wheel will micro-move on the hub during driving, gradually loosening the nuts despite correct torque, correct re-torque, and correct hardware

B. The tire and wheel balance, which if severely incorrect could create a centrifugal force that loosens the nuts

C. The axle shaft splines, which if worn could allow the axle to oscillate and transfer vibration to the hub and wheel

D. The brake drum mounting, which if loose could create a vibration that works the wheel nuts loose

100. A transit bus has a condition where the rear air suspension on the right side is riding higher than the left side. The height control valves have been swapped left to right with no change in the symptom. What should the technician investigate next?

- A. The right-side air spring for an internal defect that is causing it to over-inflate
- B. The left-side shock absorber for a seized condition preventing full extension on the left side
- C. The height control valve sensing linkage and mounting — if the right-side valve's sensing arm is bent, the linkage length is incorrect, or the mounting point has shifted, the valve will hold the right side at an incorrect height regardless of which valve body is installed because the positional error is in the linkage, not the valve
- D. The air tank on the right side for higher-than-normal pressure that is feeding the right-side spring with excessive air

101. A truck is equipped with self-steering lift axle on the trailer (a steerable tag axle). The driver reports that the trailer tracks poorly and the tag axle tires are wearing rapidly on the inside edges. What is the most likely cause?

- A. The tag axle self-steering mechanism is not functioning correctly — the steering geometry is misaligned, the self-steering bushings are worn, or the centering mechanism is not returning the axle to the straight-ahead position, causing the axle to run at a toe-out angle and scrub the inside edges of the tires
- B. The tag axle air springs are overinflated, forcing the tires into excessive contact with the road surface
- C. The tag axle tires are a different size than specified, creating a rolling diameter mismatch with the main tandem tires
- D. The tag axle tires are mounted in the wrong rotational direction, causing the tread pattern to wear against the designed direction of travel

102. A technician is performing a tractor-trailer coupling procedure. After backing the tractor under the trailer, the technician pulls forward to test the coupling. The tractor pulls out from under the trailer — the fifth wheel did not lock around the king pin. What error occurred?

- A. The trailer's king pin was greased and the fifth wheel jaws could not grip the slippery surface
- B. The fifth wheel jaws were not in the fully open position before coupling — the jaws must be open and the locking mechanism must be in the unlocked position for the king pin to enter the throat and trigger the jaw closure mechanism; if the jaws were partially closed, the king pin may have passed over them without engaging
- C. The tractor's approach speed was too fast, causing the king pin to bounce off the fifth wheel plate without entering the throat
- D. The trailer landing gear was set too low, preventing the king pin from reaching the fifth wheel throat at the correct angle

103. A driver reports a clunking noise from the front suspension when driving over bumps. The noise is a single clunk per bump event, not a continuous rattle. Steering linkage ball joints are tight. What should the technician inspect?

- A. The steer axle shock absorber upper and lower mounting bushings and hardware — a worn bushing, a loose mounting bolt, or a worn shock eye allows the shock absorber to shift position during suspension travel, producing a single clunk as it reaches the end of its free play with each bump
- B. The power steering gear mounting bolts, which if loose would allow the gear to shift during suspension travel
- C. The air intake hose, which if loose can contact the frame during suspension movement and produce a clunking sound
- D. The engine fan blade, which can contact the shroud during cab pitching caused by bumps

104. A truck driver reports that the cab tilts slightly to the right while driving. The tires, suspension, and frame have been verified as correct. What cab-specific component should be inspected?

- A. The fifth wheel, which may be misaligned and causing the cab to lean due to uneven trailer coupling forces
- B. The cab step assembly on the right side, which may be bent downward and creating a visual illusion of cab tilt

C. The cab mounts — if one or more right-side cab mounts have collapsed or deteriorated more than the left side, the cab will lean to the right on the frame, creating a visible tilt that is independent of the vehicle's chassis alignment

D. The HVAC system evaporator drain, which if clogged could accumulate water on the right side of the cab and add enough weight to cause a visible tilt

105. A truck equipped with electric heated mirrors finds that the right mirror heater does not clear frost while the left mirror heater works normally. What should the technician check first?

A. The heated mirror element power supply and ground circuit on the right side — verify voltage at the mirror heater connector while the heater switch is on; if voltage is present but the heater does not warm, the heating element has failed; if no voltage is present, trace the circuit back to the switch

B. The mirror defrost relay, which controls both mirrors and would cause both to fail if it were the issue

C. The body controller module, which may have disabled the right mirror heater due to a detected overcurrent condition

D. The right mirror glass mounting, which may have separated from the heating element backing, creating an air gap that prevents heat transfer

106. A truck's cab interior produces an unusual rattling noise that is present only at specific engine RPM ranges (approximately 1,100-1,300 RPM) and disappears above and below that range. What is the most likely source?

A. A crack in the exhaust manifold that resonates at the specific RPM range and transmits the sound through the cab floor

B. The engine's fuel injectors, which produce a distinctive clicking at that RPM range that is amplified by the cab structure

C. The turbocharger, which may be surging at that specific RPM due to a VGT position error that generates a resonance transmitted to the cab

D. A loose cab interior component — a dashboard panel, a trim piece, a cup holder, a storage compartment door, or an item stored in the cab — that resonates at the engine's vibration frequency in the 1,100-1,300 RPM range and vibrates against an adjacent surface producing the rattle

107. A bus driver reports that water drips from the HVAC housing onto the passenger floor during A/C operation. The system provides adequate cooling and operates normally in all other respects. What is the most likely cause?

A. The evaporator core has a pinhole leak that is releasing refrigerant and condensate together onto the passenger floor

B. The condensate drain tube from the evaporator housing is clogged with debris, preventing the normal moisture drainage from exiting under the vehicle — the accumulated condensate overflows inside the cab onto the passenger floor

C. The heater core has a small leak that only becomes apparent when the A/C system is operating because the temperature difference causes condensation on the leaking surface

D. The blower motor is oversized and is drawing excessive moisture into the HVAC housing from the exterior air intake

108. A transit bus has electrically operated passenger door warning chimes that sound when the doors are open. The chime for the rear door sounds continuously even when the door is closed and secured. What is the most likely cause?

A. The rear door glass has a crack that is vibrating at the same frequency as the door chime, creating a false sound

B. The rear door air actuator has a small leak that allows the door to shift slightly, intermittently activating the door-open switch

C. The rear door position switch or sensor is faulty — it is indicating "door open" to the door control system even though the door is physically closed and secured, causing the warning chime to sound continuously

D. The door chime relay has welded contacts that keep the chime circuit powered regardless of the door switch input

109. A technician discovers that the floor of a dry van trailer has extensive rot damage in the rear quarter of the cargo area. The floor boards are soft and have visible decay. What is the most likely cause, and what is the primary concern?

- A. Water infiltration through damaged or deteriorated rear door seals has allowed persistent moisture to contact the wood floor, causing rot over time — the primary concern is structural floor failure under cargo weight and forklift traffic that could drop cargo through the floor or injure personnel
- B. The floor was manufactured from a substandard wood species that is not rated for transportation use
- C. Chemical cargo from a previous load has deteriorated the wood preservative coating and accelerated natural decomposition
- D. Condensation from the trailer's normal temperature cycling between loaded and unloaded states has gradually moistened the floor

110. A trailer's air supply (emergency) gladhand seal is leaking despite being a new seal. The technician has tried multiple new seals with the same result. What should be investigated?

- A. The gladhand coupling faces on both the tractor and trailer sides for warping, corrosion, physical damage, or debris that is preventing the seal from mating flat against the coupling surface
- B. The brand of replacement seal, which may be incompatible with the gladhand manufacturer
- C. The air pressure setting on the tractor, which may be too high for the gladhand seal's pressure rating
- D. The seal's installation direction — the seal may be installed inside-out, preventing proper seating against the coupling face

111. A technician inspecting a tanker trailer's internal baffles through the manhole openings discovers that one baffle has a large crack extending across approximately half its width. What is the function of the baffles, and what is the concern with this crack?

- A. Baffles divide the tank into independent compartments for carrying multiple products — a crack allows product cross-contamination
- B. The baffles reduce the surge effect of liquid cargo during braking and acceleration — a cracked baffle is less effective at controlling surge, which increases the stopping distance and the risk of rollover from sudden weight shift during braking or cornering
- C. Baffles serve as structural reinforcement for the tank shell — a crack weakens the tank and risks a rupture under pressure

D. Baffles are cosmetic dividers that help measure the volume of liquid in each section — a crack is a minor issue that does not affect vehicle safety

112. A trailer equipped with spring brakes on all axle positions has a condition where the trailer will not move even though the tractor's air supply to the trailer is at full system pressure. The trailer was parked for three weeks in freezing conditions. What is the most likely cause?

A. The trailer ABS system has activated a parking lock feature that prevents trailer movement until a diagnostic reset is performed

B. The trailer's relay valve has frozen shut, preventing application air from reaching the brake chambers

C. The trailer's spring brake chambers have frozen — moisture in the air system has frozen inside the spring brake chambers or their air supply lines, preventing the hold-off air from reaching and compressing the springs even though the tractor is supplying adequate pressure

D. The trailer's axle bearings have seized from lack of use during the three-week parking period

113. A trailer's load securement anchor points (tie-down rings and stake pockets) show visible cracks at the weld joints where they are attached to the trailer frame. What is the risk of operating the trailer with this condition?

A. Under the forces of cargo restraint during braking, cornering, or uneven road surfaces, the cracked anchor points could fail suddenly, releasing the cargo securement and allowing the cargo to shift or fall from the trailer — this creates a serious safety hazard for other road users and the driver

B. The cracked anchor points are a cosmetic issue only, as the cargo straps and chains provide adequate securement independent of the anchor point strength

C. The cracked welds will self-arrest and not propagate further because the anchor points are made from ductile steel

D. The anchor points only need to support the weight of the securement hardware itself, not the forces of cargo restraint

114. A trailer equipped with electric-over-air brakes (EOB) has a condition where the brakes do not apply when the tractor's brake signal is sent. The trailer has its own air supply from the tractor's supply line. What is the most likely cause?

- A. The tractor's brake signal is not reaching the trailer's EOB controller because of a faulty electrical connection at the J560 connector
- B. The trailer's air compressor has failed and cannot generate the air pressure needed for brake application
- C. The trailer's ABS module is overriding the EOB signal because it has detected a wheel speed sensor fault
- D. The trailer's electric-over-air brake controller or the solenoid valve that converts the electrical brake signal into an air brake application has failed — the electrical signal from the tractor is not being converted into the pneumatic action needed to apply the trailer's air brakes

115. A reefer trailer's TRU (transport refrigeration unit) compressor cycles on and off every 30 seconds while attempting to maintain setpoint. The cargo temperature is stable at the setpoint. What does the rapid compressor cycling indicate?

- A. Normal operation — the TRU is maintaining setpoint by cycling the compressor to prevent overcooling
- B. The TRU's thermostatic control has too narrow a dead band (differential), causing the compressor to cycle on when the temperature rises slightly above setpoint and off when it drops slightly below — the system is maintaining temperature but the frequent cycling increases wear on the compressor clutch and electrical components
- C. The TRU compressor is oversized for the trailer and reaches setpoint too quickly, requiring frequent cycling
- D. The TRU's condenser fan is intermittently failing, causing the system to overheat and shut down on high-pressure safety, then restart when pressure drops

116. A trailer's side marker lamp is mounted with the lens cracked and the bulb exposed. The lamp still illuminates. Is the trailer acceptable for operation?

- A. The lamp is acceptable for operation as long as it continues to illuminate and is visible from the required distance
- B. The trailer must have the lens repaired before entering service, as the cracked lens may alter the light color
- C. The cracked lens only affects the aesthetic appearance and has no regulatory significance
- D. The lamp must be repaired because a cracked lens allows moisture to enter the fixture, which will cause premature bulb failure and corrosion, and the damaged fixture may not display the correct light color or pattern required by CMVSS 108

117. A truck's A/C system is charged to the correct specification but the evaporator outlet temperature is 10°C, well above the normal 1-3°C. The manifold gauge readings are within normal range. What is the most likely cause of the elevated evaporator temperature?

- A. The A/C system has an excessive amount of refrigerant oil that is coating the evaporator tubes and insulating them from the air passing over the fins
- B. The evaporator fan speed is too high, pushing air across the evaporator too quickly for adequate heat transfer
- C. Insufficient airflow across the evaporator — a clogged cabin air filter, a blower motor operating at reduced speed, or a restricted duct is reducing the volume of air passing over the evaporator, but the air that does pass is cooled adequately; the thermometer is measuring the temperature of the reduced airflow, which has been warmed by mixing with unconditioned air before reaching the vent
- D. The expansion valve is restricting refrigerant flow, starving the evaporator despite normal system pressures

118. A truck driver reports that the windshield defrost is effective on the driver's side but the passenger side remains fogged. Both sides receive airflow from the defrost vents. What is the most likely cause?

- A. The heater core has a partial internal blockage that reduces coolant flow to the section that heats the passenger-side defrost air

- B. The defrost ductwork on the passenger side has a leak, a disconnection, or a partial collapse that allows the heated air to escape before it reaches the windshield surface on that side, reducing the effective defrost airflow and temperature on the passenger side
- C. The passenger-side windshield glass has a different UV coating that retains moisture differently than the driver's side
- D. The blend door is only partially opening on the passenger side due to a dual-zone control system fault

119. A technician suspects that a truck's A/C system has a small refrigerant leak. The system cools adequately now but has required a recharge twice in the past year. What is the most effective long-term leak detection method?

- A. Pressurize the system with nitrogen and apply soap solution to every connection and component
- B. Use an electronic leak detector wand at every connection and component while the system is charged
- C. Listen for a hissing sound at each connection with the system running under load
- D. Inject UV fluorescent dye into the system and operate it normally — at subsequent inspections, use a UV lamp to scan all components and connections for fluorescent traces that indicate the leak location; the dye remains in the system and marks the leak point over time, even if the leak rate is very slow

120. A truck's heater produces hot air when the engine is at highway RPM but only warm air at idle. The coolant level is correct and the thermostat has been tested and verified as functioning correctly. What is the most likely cause?

- A. The water pump impeller has partial erosion — it produces enough coolant flow at higher RPM to supply both the engine and the heater core, but at low idle RPM, the reduced pump output prioritizes the engine's internal passages and cannot deliver adequate flow through the heater core's smaller-diameter supply hoses for maximum heat output
- B. The heater core is clogged and cannot pass adequate coolant at any flow rate
- C. The heater control valve opens based on engine RPM and is programmed to restrict flow at idle to conserve energy

D. The blend door actuator moves to a partially closed position at idle speed to reduce engine load from the HVAC system

121. A truck's A/C compressor makes a loud knocking noise immediately after startup. The noise diminishes after a few minutes of operation. What is the most likely cause?

A. The compressor's internal bearings are worn and produce noise when cold but quiet down as the oil warms and circulates

B. The compressor is attempting to start against a high-side pressure that has equalized with the low side during shutdown — the compressor must work harder to overcome this equalized pressure during the first few minutes

C. Liquid refrigerant has accumulated in the compressor during the off period (liquid slugging) — when the compressor starts, it attempts to compress the incompressible liquid, producing the knocking noise until the liquid evaporates and clears the compressor

D. The compressor clutch plate has a warped surface that creates a cyclic contact noise during the first few engagements until thermal expansion eliminates the warp

122. A truck's A/C system has been serviced and the technician is preparing to evacuate the system before charging. The vacuum pump pulls the system down to 500 microns, but within 5 minutes the vacuum rises to 2,000 microns. What does this indicate?

A. The vacuum pump needs oil and cannot maintain a deep vacuum due to worn internal seals

B. The system has a leak or there is moisture present — a rising vacuum indicates that air is entering the system through a leak or that moisture inside the system is evaporating and raising the pressure; the technician must determine which condition exists before proceeding

C. The system volume is too large for the vacuum pump capacity and a larger pump is needed

D. The rise in vacuum reading is normal for a heavy-duty truck A/C system due to the large system volume and the evaporation of residual refrigerant oil

123. A transit bus's A/C system uses a rooftop-mounted condenser unit. The system produces adequate cooling in spring and fall but cannot maintain the setpoint temperature during peak summer heat. What is the most likely cause?

- A. The refrigerant charge decreases during summer due to thermal expansion and needs to be topped off seasonally
- B. The compressor is undersized for the bus's passenger load during summer when the bus is at maximum capacity
- C. The A/C system is correctly sized for normal conditions but lacks the capacity for extreme heat, requiring a system upgrade
- D. The rooftop condenser is not rejecting heat effectively in high ambient temperatures — dirty condenser fins, a failed condenser fan, or recirculation of hot engine exhaust across the condenser reduces its ability to reject heat during peak summer conditions

124. A technician is performing a hydraulic pump efficiency test. The pump is rated at 25 gpm at 1,800 RPM. At no load, the pump delivers 24 gpm. At 2,000 psi system pressure, the pump delivers 20 gpm. What is the pump's volumetric efficiency at 2,000 psi?

- A. 80% — calculated by dividing the actual flow under load (20 gpm) by the rated flow (25 gpm); this indicates the pump has moderate internal wear but may still be acceptable for the application depending on the manufacturer's minimum efficiency specification
- B. 96% — calculated by dividing the no-load flow by the rated flow
- C. 50% — calculated by dividing the pressure by the flow
- D. 100% — the pump is delivering its rated flow and is in new condition

125. A hydraulic cylinder on a boom truck extends smoothly but retracts in a jerky, erratic manner. The system pressure is adequate and the directional control valve operates smoothly in both directions. What is the most likely cause?

- A. The cylinder rod is bent, causing it to bind as it retracts into the barrel — the rod clears the rod seal and guide bushing during extension but catches and binds during retraction as the bend enters the seal and bushing
- B. The rod-side port on the cylinder has a restriction from contamination that limits flow during retraction
- C. Air is trapped in the rod-end of the cylinder, compressing and expanding during retraction and creating the jerky motion
- D. The cylinder's piston seal is worn on one side only, causing the piston to tilt inside the bore during retraction and creating intermittent binding

126. A hydraulic system's reservoir is equipped with a sight glass for fluid level indication. The technician observes that the fluid in the sight glass appears foamy with visible air bubbles. What is the most likely cause and primary concern?

- A. The hydraulic fluid is being aerated from a low fluid level exposing the pump inlet to air, a suction line leak, or a failed shaft seal on the pump
- B. The fluid is foamy because it was recently changed and has not settled from the pouring agitation
- C. The reservoir is overfilled and the excess fluid is being churned by the return line flow entering the reservoir
- D. Air in the hydraulic system causes the fluid to become compressible, resulting in spongy, erratic actuator operation, cavitation damage to the pump, increased heat generation, and accelerated oxidation of the fluid — the air source must be identified and eliminated immediately

127. A truck-mounted crane has a hydraulic circuit with a holding valve (counterbalance valve) that is chattering — the boom oscillates slightly when lowering a load. What is the most likely cause?

- A. The load on the boom exceeds the crane's rated capacity and is overwhelming the holding valve's control
- B. The counterbalance valve's pilot ratio is incorrectly set or the valve's internal orifice is partially blocked, causing the valve to alternately open and close rapidly instead of maintaining smooth, proportional flow — the result is the chattering oscillation as the valve hunts for a stable position

- C. The main hydraulic pump is surging at the engine RPM being used for the crane operation
- D. The hydraulic fluid viscosity is too low for the ambient temperature, allowing the valve to open too quickly

128. A technician replaces a hydraulic pump on a dump truck's hoist circuit. After installation, the technician fills the pump housing with clean hydraulic fluid before starting the engine. Why is this pre-fill important?

- A. Pre-filling the pump housing with fluid ensures that the pump has immediate internal lubrication upon startup — without pre-fill, the pump runs dry for the first seconds of operation until the suction side draws fluid from the reservoir, and the dry metal-to-metal contact during those seconds can score the pump's internal surfaces and significantly reduce its service life
- B. Pre-filling displaces air from the pump housing that would otherwise be pumped into the system and cause foaming
- C. Pre-filling ensures the pump reaches full output pressure within the first revolution of operation
- D. Pre-filling is only necessary for piston pumps and is optional for gear pumps in dump truck applications

129. A hydraulic system on a refuse truck has a condition where all hydraulic functions operate normally except the packer blade cylinder, which extends and retracts very slowly. All other cylinders on the same system operate at normal speed. What is the most likely cause?

- A. The main hydraulic pump is worn and cannot supply adequate flow to the entire system simultaneously
- B. The relief valve is set too low, limiting the pressure available to the packer blade circuit
- C. The flow control valve or directional control valve section dedicated to the packer blade circuit has a restriction — a stuck flow control, a contaminated orifice, or a partially stuck valve spool in the packer blade circuit is limiting the flow specifically to that function, while all other functions receive normal flow from the same pump
- D. The packer blade cylinder's internal bore has corroded, increasing the friction between the piston and barrel

130. A hydraulic system's pressure gauge fluctuates rapidly (oscillates) during operation. The oscillation is approximately 200 psi peak-to-peak around the operating pressure. What is the most likely cause?

- A. The pressure gauge itself is faulty and has a stuck needle that bounces between positions
- B. The hydraulic fluid temperature is too low, causing the pump to deliver pulsating flow at the thick-fluid condition
- C. The gauge isolation valve is partially closed, creating a restriction that dampens the peak pressure readings
- D. The hydraulic pump is producing pressure pulsations — caused by worn pump elements, a damaged pump drive coupling, a cavitating pump, or a failing relief valve that is opening and closing rapidly (chattering) — the gauge is displaying the actual pressure variations in the circuit

131. A technician is troubleshooting a hydraulic tailgate lift that extends and retracts but cannot support a loaded pallet without slowly lowering. The directional control valve is in the neutral (hold) position. The cylinder rod seal shows no external leakage. What is the most likely cause?

- A. The hydraulic pump check valve is leaking, allowing pressure to bleed back through the pump when the valve is in neutral
- B. The holding valve in the cylinder circuit is leaking internally, or the cylinder's piston seal is bypassing — fluid is crossing from the high-pressure side to the low-pressure side inside the cylinder or leaking past the holding valve, allowing the load to drift downward under gravity
- C. The directional control valve return spring is weak, allowing the spool to shift slightly off-center and open a return path to the tank
- D. The cylinder rod is slightly bent, creating a gap between the piston and the barrel wall that allows fluid bypass

132. A battery electric delivery truck has a condition where the vehicle decelerates more aggressively than expected when the driver lifts off the accelerator pedal, without pressing the brake pedal. What system is causing this deceleration?

- A. The regenerative braking system — the vehicle control unit is commanding the traction motor to operate as a generator when the accelerator is released, converting kinetic energy to electrical energy and creating a retarding force that decelerates the vehicle; the aggressiveness may be adjustable through the vehicle's regenerative braking setting
- B. The foundation brakes are partially applied due to a faulty brake switch that activates when the accelerator is released
- C. The parking brake is partially engaged due to a faulty parking brake solenoid that activates at low throttle positions
- D. The transmission is downshifting aggressively when the accelerator is released, creating engine braking through the gear reduction

133. A hybrid electric transit bus has a series hybrid architecture. The diesel engine is running but the bus is not moving and the driver reports no response to the accelerator pedal. The dashboard shows the battery state of charge at 5%. What is the most likely cause?

- A. The diesel engine's fuel injection system has derated the engine to idle-only mode due to a detected emission fault
- B. The transmission has failed in the locked position, preventing any power from reaching the drive wheels
- C. The battery SOC is critically low, and the vehicle control unit has disabled propulsion because the traction motor in a series hybrid is powered by electricity — even though the engine is running and generating electricity through the generator, the system cannot provide adequate power to both charge the depleted battery and drive the motor simultaneously at the current engine output level
- D. The accelerator pedal position sensor has failed and is not sending a throttle demand signal to the VCU

134. A technician needs to remove a high-voltage battery pack from a battery electric truck for service. The de-energization procedure has been completed and verified. What additional precaution must be taken during the physical removal of the battery pack?

- A. The pack must be disconnected from the cooling system before removal to prevent coolant leakage

B. The pack must be lifted with an engine hoist rated for the pack's weight since battery packs are extremely heavy

C. The pack must be kept level during removal to prevent the electrolyte from spilling out of the cells

D. The pack must be handled according to the manufacturer's procedure for weight, lifting points, and orientation — battery packs are extremely heavy (often 500-2,000 kg), must be lifted using the designated lifting points to prevent structural damage, and may have orientation requirements to prevent internal damage to cells and cooling circuits

B. All of these considerations plus the workspace must be free of water, conductive debris, and the pack must be stored in a designated area away from heat sources and flammable materials

135. A battery electric truck's traction motor has a diagnostic fault code for "Motor Overtemperature." The vehicle was operating on a steep grade with a full load in high ambient temperature. What is the most likely cause?

A. The motor's permanent magnets have partially demagnetized from the high temperature, generating excess heat in a feedback loop

B. The motor's thermal management system (cooling circuit) cannot dissipate the heat generated by the high continuous torque demand of climbing a grade under full load in hot ambient conditions — the motor's sustained current draw on the grade exceeds the cooling system's heat rejection capacity

C. The motor's bearing lubricant has degraded from the high temperature, increasing friction and generating additional heat

D. The inverter is sending an incorrectly shaped AC waveform that is causing the motor to draw excessive current and overheat

Practice Exam 4: Answer Key and Explanations

1. A — Sulfuric acid contact with the eyes is a medical emergency requiring immediate, continuous flushing with clean water for a minimum of 15 to 20 minutes. The eyelids must be held open during flushing to ensure the water reaches all affected surfaces. Delaying flushing — even by 30 seconds — allows the acid to continue burning the corneal and conjunctival tissue, potentially causing permanent vision loss. The technician must then seek immediate medical attention regardless of whether the pain subsides.

2. C — Oxygen and fuel gas (acetylene) cylinders must be stored at least 6 metres (20 feet) apart or separated by a non-combustible barrier at least 1.5 metres (5 feet) high with a minimum 30-minute fire rating. If an acetylene cylinder develops a leak near an oxygen cylinder, the oxygen-enriched atmosphere dramatically accelerates the combustion of the fuel gas, potentially creating an explosive fire that cannot be controlled. This separation requirement applies during both storage and active use.

3. B — The employer has a legal duty under the OHS Act to provide comprehensive health and safety orientation before the new worker is exposed to any workplace hazard. This orientation must cover the specific hazards of the workplace (not just generic safety information), the location and use of emergency equipment (eyewash stations, fire extinguishers, first-aid kits, emergency exits), WHMIS training for hazardous products in the workplace, required PPE, and the worker's three fundamental rights. Generic employee handbooks do not satisfy this obligation.

4. D — A CAT III or CAT IV rated meter is designed to safely measure voltages at the distribution level — voltages in the hundreds of volts range with the high fault current capacity found in vehicle high-voltage systems. A standard automotive meter (typically CAT I or unrated) does not have the input protection, internal fusing, or arc-flash resistance to safely handle 600 VDC. Using an inadequately rated meter on a high-voltage circuit risks meter failure, arc flash, and electrocution — the meter itself becomes the hazard.

5. A — Bending at the waist with a rounded back and straight legs places the entire load on the lumbar spine's intervertebral discs and supporting ligaments. The disc pressure in this position can be five to ten times higher than when the load is properly supported by the leg muscles with a straight back. This lifting posture is the leading cause of occupational back injuries in the trades and can result in disc herniation, muscle tears, and chronic pain that ends careers. Proper technique uses bent knees, a straight back, and the powerful leg muscles to bear the load.

6. C — Emergency exits are life-safety systems regulated by fire code and the OHS Act. Blocking an emergency exit prevents occupants from escaping in a fire, chemical release, or other emergency. The obstruction must be removed immediately — not scheduled for later cleanup. Every minute an exit is blocked is a minute that personnel could be trapped if an emergency occurs. The responsibility to maintain clear exits belongs to every person in the workplace, and the condition must be corrected as soon as it is discovered.

7. B — A hydraulic press generates extreme force that can cause components to fragment violently when they release from the press. Bearing races, retaining rings, and pressed components can crack and eject fragments at high velocity. Safety glasses with side shields protect against lower-energy debris, and a face shield provides additional protection for the entire face against larger fragments. Hearing

protection is warranted if the pressing operation produces impact noise levels that exceed the exposure limit.

8. D — Used engine oil is classified as recyclable hazardous waste under Canadian environmental regulations. It contains heavy metals, combustion byproducts, and chemical contaminants that are harmful to human health and the environment. It must be collected in dedicated waste oil containers, stored in compliance with provincial regulations, and picked up by a licensed waste oil recycler for proper processing. Dumping used oil in drains, on the ground, or in general waste is a violation of environmental protection laws and subject to significant penalties.

9. B — The injector cut-out test sequentially disables each injector while monitoring the engine's response. When a functioning cylinder is disabled, the engine loses power from that cylinder and RPM drops noticeably. When disabling cylinder four produces no change in RPM or engine sound, it confirms that cylinder four was already contributing nothing to engine output — the injector is either not firing (electrical or mechanical failure), not receiving fuel, or the cylinder lacks the compression needed for combustion. The fault is definitively isolated to that cylinder.

10. D — Excessive valve lash (clearance greater than specification) means the cam lobe must rotate further past its base circle before it contacts the follower and begins lifting the valve. This delays valve opening relative to the intended timing. Similarly, the valve closes earlier because the follower separates from the lobe sooner on the closing ramp. The net effect is reduced valve open duration — the exhaust port is open for less crankshaft rotation than designed, reducing exhaust gas flow. The excess clearance also produces an audible clicking as the cam lobe impacts the follower across the enlarged gap.

11. A — Two adjacent cylinders with equally low compression is the signature pattern of a head gasket failure between those cylinders. The gasket has failed at the fire ring between the two cylinder bores, creating a path for compression pressure to leak from each cylinder into the other. During the compression stroke, each cylinder loses pressure to its neighbor rather than building full compression. A single cylinder with low compression could have multiple causes, but two adjacent cylinders with matched low readings is almost always a head gasket breach between them.

12. C — Diesel fuel contains naturally occurring paraffin wax that remains dissolved in the fuel at moderate temperatures. As ambient temperature drops below the fuel's cloud point (the temperature at which wax crystals first become visible), the wax precipitates out of solution and forms crystals that accumulate on the fuel filter media. The waxy residue on the filters confirms paraffin crystallization as the cause. Winter-grade fuel with a lower cloud point, fuel filter heaters, and approved anti-gel additives are the preventive measures for Canadian winter operations.

13. B — Blue smoke specifically indicates oil burning in the combustion chamber. A puff of blue smoke at startup after overnight sitting that clears within seconds points to oil that has accumulated in the cylinder while the engine was off. Worn valve stem seals are the most common cause — oil seeps past the seals and runs down the valve stems into the cylinder during the hours the engine sits. The accumulated oil burns on the first few combustion events after startup, producing the brief puff of blue smoke before the positive crankcase ventilation and ring seal clear the remaining oil.

14. D — An EGR cooler failure that allows coolant to leak into the exhaust passage produces three characteristic symptoms: coolant loss without visible external leakage (the coolant is entering the exhaust stream and being expelled as vapor), white steam or vapor from the tailpipe (the coolant vaporizes in the hot exhaust), and in some cases a sweet coolant odor near the tailpipe. Because the leak is internal to the exhaust system, there is no puddle under the vehicle — the coolant simply disappears, which often delays diagnosis until the coolant level drops significantly.

15. C — Engine oil's primary function is to maintain a thin film between the bearing surfaces and the journal surfaces that prevents metal-to-metal contact. The film thickness is directly related to viscosity — thicker oil creates a thicker film. When fuel dilutes the oil, the viscosity drops below the oil's rated specification, and the film becomes too thin to separate the bearing and journal surfaces under the dynamic loads of engine operation. Metal-to-metal contact causes rapid bearing wear, elevated wear metals in the oil, and if uncorrected, bearing failure and potential engine seizure.

16. A — The thermostat's wax pellet sensing element must face the hot engine coolant to accurately sense the engine's temperature. Installed correctly, the sensing element is on the engine side and opens the valve when it detects coolant at the designed temperature. Installed backward (upside down), the sensing element faces the cooler radiator-return coolant and never reaches its opening temperature because it is sensing the cooler fluid returning from the radiator rather than the hot fluid leaving the engine. The thermostat remains closed, coolant cannot reach the radiator, and the engine overheats.

17. D — The DEF quality sensor in the tank measures the urea concentration and reports it to the ECM. If the bulk DEF supply has degraded from improper storage (exposure to heat above 32°C, exposure to sunlight, or storage beyond its shelf life) or has been contaminated (with water, cleaning agents, or non-DEF fluids), the concentration will deviate from the required 32.5%. The ECM detects this deviation through the quality sensor and sets the fault code. The contaminated DEF must be drained and replaced with certified ISO 22241-compliant DEF.

18. B — The crankcase ventilation system is designed to handle a normal volume of blow-by gas. When the piston rings and cylinder liners wear, the seal between the combustion chamber and crankcase deteriorates, and combustion gases leak past the rings in progressively greater volume. When this blow-

by volume exceeds the ventilation system's capacity, the excess pressure and vapor are forced out through the breather tube visibly. Excessive blow-by is the most widely used field indicator that the engine's ring-to-liner seal has degraded to the point of needing an overhaul.

19. A — The DPF differential pressure sensor measures the pressure difference between the inlet and outlet of the DPF. Elevated differential pressure means the filter is restricting exhaust flow more than normal. The two causes are soot accumulation (from insufficient regeneration, typically due to low-load duty cycles that prevent adequate exhaust temperatures) and ash accumulation (from engine oil consumption over the DPF's service life). The ECM detects the elevated reading, determines that the DPF cannot regenerate itself under current conditions, and initiates a derate to limit further soot accumulation and force operator attention.

20. C — This is the classic presentation of worn bearings combined with temperature-dependent oil viscosity. At cold startup, the oil is thick (high viscosity) and can maintain adequate film thickness even in worn bearing clearances. As the engine warms, the oil thins to its operating viscosity — and the worn bearings' enlarged clearances now allow the thinner oil to leak through faster than the pump can replace it. The pressure drops progressively as temperature rises because the oil gets progressively thinner. At full operating temperature, the combination of worn clearances and minimum viscosity drops pressure to near zero.

21. D — A broken compressor blade creates two immediate problems. First, the compressor can no longer pressurize air as effectively because the blade damage disrupts the airflow pattern and reduces the compressor's efficiency — the result is reduced boost pressure, power loss, and black smoke from insufficient air for the fuel being injected. Second, the broken blade fragment enters the intake manifold and can be ingested into a cylinder, where it impacts the piston crown, valve faces, and cylinder walls at extreme velocity, potentially causing catastrophic internal engine damage.

22. B — The air compressor's piston rings seal the compression chamber from the oil-lubricated crankcase. When these rings wear, engine oil passes into the compression chamber and is pumped into the air discharge line with the compressed air. The discharge line operates at temperatures well above the oil's flash point (from the heat of compression), causing the oil to bake onto the internal surfaces of the line. Over time, this baked oil carbonizes into a hard, restrictive deposit that progressively narrows the discharge passage, reducing the compressor's ability to deliver air to the system.

23. A — A DPF substrate crack from thermal shock occurs when accumulated soot burns uncontrolled in a single event — either from a manual regeneration initiated on a heavily loaded filter, from a regeneration that started during driving and continued after the vehicle stopped, or from a fuel-system fault that introduced excess hydrocarbon into the DPF. The soot combustion generates temperatures

exceeding the substrate's thermal tolerance (potentially above 1,000°C in localized areas), and the rapid, uneven heating creates thermal gradients that crack the brittle ceramic material.

24. C — An air leak downstream of the throttle introduces unmetered air into the intake manifold. At idle, the throttle is nearly closed, and even a small air leak represents a significant percentage of the total airflow — enough to raise idle speed. The ECM detects the elevated RPM and reduces fuel to bring it down. The reduced fuel drops RPM below the target, and the ECM adds fuel to recover, creating the oscillation. At higher RPM, the throttle is open wide and the leak's contribution to total airflow is proportionally insignificant, so the engine runs smoothly.

25. D — The DOC plays two critical roles in DPF regeneration. It converts NO to NO₂, which is a much more effective oxidizer of soot than oxygen alone — this NO₂ drives passive regeneration at temperatures (300-350°C) that are achievable during normal highway driving. It also generates the heat for active regeneration by catalytically oxidizing the hydrocarbons injected by the post-injection or exhaust doser, raising exhaust temperatures to the 550-600°C needed for thermal soot oxidation. A replacement DOC that is not performing to specification fails at both functions, requiring more frequent regeneration attempts.

26. B — DEF consumption is proportional to the engine's NO_x output — the more NO_x the engine produces, the more ammonia (from DEF) is needed to convert it to nitrogen and water in the SCR catalyst. If one truck produces more engine-out NO_x than its identical counterparts (due to an EGR system fault, advanced injection timing, or a turbocharger issue that affects combustion temperatures), its SCR system must inject more DEF to achieve the same tailpipe NO_x standard. The root cause is the elevated engine-out NO_x, not the DEF system itself.

27. C — The DOC outlet / DPF inlet temperature sensor (Sensor 2) provides the ECM with the information it needs to verify that the DOC is generating adequate heat during active regeneration. Without this sensor, the ECM cannot confirm that the DOC's exothermic reaction is raising the exhaust temperature to the 550-600°C required for soot oxidation in the DPF. As a safety measure, the ECM disables active regeneration because it cannot verify the process is occurring correctly. Without active regeneration, soot accumulates progressively until the ECM initiates a derate.

28. D — A cylinder contribution test measures each cylinder's relative contribution to total engine output. When one cylinder contributes 30% less than the average, the deficiency could be in any of the three factors that determine cylinder output: fuel delivery (the injector may be delivering less fuel due to wear, clogging, or an electrical fault), compression (the rings or valves may not be sealing adequately), or valve timing (incorrect lash could be reducing the effective intake or exhaust flow). All three must be investigated to identify the specific cause of the contribution deficit.

29. A — The ECM uses the coolant temperature sensor signal to determine when to engage the cooling fan. If the replacement sensor has a different resistance characteristic than the original (wrong part number, wrong resistance range for the application), the ECM interprets the signal as a temperature that differs from reality. If the ECM reads a temperature significantly higher than actual, it commands the fan to full engagement as a protective cooling response — even though the engine is not actually overheating. Verifying the replacement sensor's part number and resistance specification against the manufacturer's requirements resolves the issue.

30. C — A cracked compressor head can allow engine oil (which lubricates the compressor's internal components) to enter the compression chamber through the crack. The oil is then pumped into the air system with the compressed air. This oil contamination is far more damaging than the external leak — the oil saturates the air dryer desiccant (destroying its moisture-removal capability), travels downstream to coat every valve, seal, and diaphragm in the brake system, and causes accelerated deterioration of rubber components. The external leak is the visible symptom; the internal contamination is the real concern.

31. A — The air dryer purge valve is triggered by the governor's unload signal — each time the governor cuts out, it sends a signal that simultaneously unloads the compressor and opens the purge valve. If the governor is cycling rapidly (because a system leak drops pressure to cut-in almost immediately after reaching cut-out), the purge valve cycles with it. The rapid purge cycling is a symptom of the leak, not a dryer malfunction. Fixing the leak eliminates the rapid cycling because the governor no longer needs to cycle frequently.

32. D — A bent rear axle housing shifts the position of the brake drum relative to the shoes and the S-cam mechanism on each side. The bend creates unequal geometry — one side's shoes contact the drum more fully or sooner than the other side's. This asymmetry produces unequal braking force between the left and right wheels on that axle, causing the vehicle to pull toward the side with more effective braking. The bent housing must be straightened or replaced to restore the correct shoe-to-drum geometry.

33. B — Brake pads that were recently replaced should have started at maximum thickness, which positions the caliper pistons fully retracted in their bores. As the new pads wear, the pistons gradually extend to compensate, displacing fluid from the reservoir into the caliper bores. However, at only 3,000 km, the pads should not have worn enough to cause a noticeable fluid level drop. A consistently low fluid level this soon after pad replacement suggests a hydraulic leak — at a caliper seal, a brake hose, a line fitting, or the master cylinder — that must be located and repaired.

34. A — A brake shoe return spring that is weak or broken cannot retract the shoe fully from the drum when the brakes are released. The shoe remains in partial contact with the drum during driving, generating continuous friction heat. The affected drum becomes significantly hotter than the others because it is being heated by the dragging shoe at every wheel revolution. The pushrod stroke may still be within specification because the shoe is close to the drum — but the shoe is not fully retracting to its designed clearance position.

35. C — The crossing arm is a separate pneumatic circuit from the stop arm. It has its own air control valve (which receives a signal when the stop arm deploys), its own solenoid (which opens the air path to the actuator), and its own air line running to the actuator. Since the air system is functioning normally for all other functions, the fault is isolated to the crossing arm's dedicated circuit — a failed solenoid, a restricted air line, or a faulty control valve in that specific circuit is preventing air from reaching the crossing arm actuator.

36. B — During a long descent using the engine brake, the service brakes are not applied, and the brake drums cool to ambient temperature. When the service brakes are first applied after the descent, the cold drums initially provide less friction than warm drums because the brake lining material has a lower coefficient of friction at cold temperatures. After one or two applications, the friction heat warms the drum and lining surfaces, restoring their optimal friction coefficient. This is a known characteristic of some lining formulations and is sometimes called "cold-drum fade" or "green fade."

37. D — This is the air brake system's fail-safe emergency function operating exactly as designed. A major air leak has caused system pressure to drop below the operating minimum. The sequence of events follows the designed safety chain: the low-pressure warning (buzzer/light) activated at approximately 60 psi to alert the driver, and when pressure dropped further to the 20-40 psi spring brake release threshold, the spring brakes applied automatically because there was no longer enough air pressure to hold the springs compressed. The spring brakes brought the vehicle to a stop through mechanical spring force — no air required.

38. A — The air system build-up time standard requires the system to build from 85 psi to 100 psi in 45 seconds or less at governed engine RPM. A build-up time of 5 minutes (300 seconds) is approximately seven times longer than the maximum allowable. Either the compressor is severely worn and cannot pump efficiently (worn intake/discharge valves, worn rings, restricted intake) or a significant air leak is consuming the compressor's output almost as fast as it is produced. Both conditions must be investigated — the compressor for pumping efficiency and the system for leaks.

39. C — After coupling, the tractor supplies air to the trailer. The trailer's relay valve receives this supply air and directs it to the brake chambers if any signal pressure is present. If a previous brake

application left residual pressure trapped in the service circuit — from a kinked line, a stuck relay valve exhaust, or a contaminated quick-release valve — that trapped pressure continues to partially apply the brakes even after the foot valve is fully released. The restriction prevents the trapped application air from exhausting back through the normal return path.

40. B — On air disc brakes, the pushrod stroke reflects the pad-to-rotor clearance because the caliper's internal lever-and-tappet mechanism translates pushrod travel into pad clamping motion. A longer pushrod stroke indicates greater pad-to-rotor clearance (the pads are farther from the rotor, requiring more pushrod travel to bring them into contact). Measuring pushrod stroke with the brakes applied and comparing to the manufacturer's specification verifies that the caliper's automatic adjuster is maintaining correct clearance. This is the same fundamental measurement technique used on drum brakes.

41. D — Brake chamber diaphragms fail from a combination of factors accumulated over their service life. Oil contamination from the air system softens and swells the rubber. Moisture exposure promotes internal corrosion and rubber degradation. Heat from brake operation during every application thermally ages the rubber. And mechanical fatigue from thousands of application and release cycles stretches and weakens the diaphragm material. The most accelerating factor is oil contamination — a compressor passing oil dramatically shortens diaphragm life.

42. A — The tractor's drive axle brakes and the trailer brakes are on separate circuits, but both respond to the driver's brake pedal. If the drive axle slack adjusters are severely out of adjustment (excessive pushrod stroke), the air entering those chambers must first push the pushrods through the excess free play before the shoes contact the drums. This consumes most of the air volume without generating braking force, resulting in weak drive axle braking. Meanwhile, the trailer brakes (properly adjusted) apply at full force with minimal pushrod travel, creating the described imbalance.

43. C — Heat checking is a common phenomenon on brake drums caused by the repeated thermal stress of heating during braking and cooling during driving. Minor heat checking — fine, shallow surface cracks in a web pattern — is generally acceptable and does not compromise drum safety. However, the cracks must be inspected for depth and progression. Deep cracks that penetrate significantly into the drum wall reduce the drum's structural strength and create stress risers where a catastrophic crack could propagate. The technician must make a judgment based on crack depth, drum measurement, and the manufacturer's guidance.

44. B — The tractor protection valve is calibrated to close at approximately 40 to 45 psi on most systems. At this pressure, the valve automatically disconnects the trailer air supply to prevent the trailer from draining the tractor's remaining air. Simultaneously, it exhausts the trailer supply line, which applies the trailer's spring brakes. This dual action protects the tractor's air supply (ensuring the tractor

retains enough air for its own brakes) and stops the trailer (which might otherwise roll uncontrolled if it separated). The 40-45 psi threshold is set above the minimum pressure needed for the tractor's own spring brakes to function.

45. D — The foot valve (treadle valve) is the interface between the driver's pedal effort and the air delivered to the brake circuits. If the foot valve has internal restrictions (from contamination, wear, or a partially blocked port), the air flowing from the reservoir through the valve to the output circuits is limited. The driver must press harder to force enough air through the restriction to achieve the desired application pressure. A binding linkage has the same effect — the mechanical resistance of the linkage absorbs pedal effort before it reaches the valve, requiring more driver force for the same air output.

46. A — After any brake service, the technician must verify that the work was done correctly before the vehicle operates. Pushrod stroke measurement at each serviced wheel confirms that the automatic slack adjusters are maintaining proper adjustment with the new linings. The drums must be checked for free rotation with brakes released (to ensure the shoes are not dragging on the drum) and for proper fit. A low-speed road test verifies that braking is balanced — no pull to either side — confirming that the new linings are contacting both drums evenly. These verification steps are not optional.

47. D — Battery voltage is 10.8 volts at the posts, but only 8.5 volts reaches the starter motor terminal — the missing 2.3 volts is consumed by resistance in the cables, connections, and solenoid between the battery and the motor. The maximum allowable total voltage drop for the entire positive and negative cable circuit is typically 1.0 volt combined (0.5V each side). A 2.3-volt total drop far exceeds this limit and is directly responsible for reduced cranking speed. Voltage drop testing each segment individually (cable, connection, solenoid contacts) will isolate the specific high-resistance point.

48. B — In a parallel battery bank, both batteries share the load equally. A weak battery drags down the strong battery during cranking by pulling voltage from it, and the strong battery must compensate during charging by accepting the current that the weak battery cannot hold. Over time, this mismatch accelerates the degradation of the good battery. When replacing a failed battery in a parallel bank, both batteries should ideally be the same age, type, and CCA rating. Testing the remaining "good" battery to verify its health before pairing it with the new one is the minimum acceptable practice.

49. A — Testing a wire for resistance requires the circuit to be de-energized (to prevent the meter's internal resistance from shunting operating current) and both ends of the wire to be disconnected from their respective circuits (to prevent parallel resistance paths through other components from affecting the reading). The meter is set to ohms and connected across the two ends of the wire. A continuous wire reads near 0 ohms, confirming an unbroken conductor. An open wire reads infinite (OL), confirming a break somewhere along its length.

50. C — Pin 7 (auxiliary) on the J560 connector is a dedicated circuit that provides power from the tractor to the trailer ABS system. It has its own fuse, relay (on some systems), and wiring that is separate from the other six circuits in the connector. If Pin 7 reads 0 volts while the tractor's own ABS works normally, the fault is in the tractor's dedicated auxiliary circuit — a blown fuse, a failed relay, or an open wire between the tractor's power distribution and Pin 7 of the J560 connector. The trailer ABS system itself cannot cause 0 volts at the tractor's connector.

51. D — The charging system is producing the correct voltage and presumably charging the batteries adequately during driving. However, the batteries are depleted by the next morning. This pattern indicates that something is consuming battery energy while the vehicle is parked overnight. A parasitic draw test measures the current flowing from the battery with the vehicle fully shut down. Normal key-off draw is 50-85 milliamps. A draw significantly above this range means an electrical component or module is remaining active and draining the batteries during the parking period.

52. B — When the dimmer switch moves to the high-beam position, it should disconnect the low-beam circuit and connect the high-beam circuit. If the switch has an internal fault that opens both circuits in the high-beam position, neither the low-beam nor the high-beam filaments receive power — all headlights go dark. Returning to low beam restores the low-beam circuit through the switch's low-beam position, which is functioning correctly. The fault is isolated to the switch's high-beam position contacts, which are failing to complete the high-beam circuit while also opening the low-beam circuit.

53. A — An LED headlight that flickers intermittently during driving is experiencing an interrupted power supply. The most common cause is a connection that opens and closes with road vibration — a corroded connector pin, a damaged wire with broken strands that separate and reconnect, or a ground connection that loosens under vibration. The other headlight's normal operation confirms the charging system, fuse, and switch are functioning. The fault is isolated to the flickering headlight's individual power or ground path, which must be inspected for intermittent contact.

54. C — Scan tools use internal software databases to translate raw numerical fault codes into human-readable descriptions. Each engine manufacturer, model, and software version may have unique codes that require a specific database. If the scan tool's software does not contain the correct database for the vehicle being diagnosed, it can still read the raw code numbers from the CAN bus but cannot match them to descriptions. Updating the scan tool's software or using the manufacturer's proprietary scan tool resolves the issue.

55. B — An electric horn vibrates a diaphragm to produce sound. The frequency and volume of the sound are directly related to the voltage and current reaching the horn. A voltage drop in the power or ground circuit (from corroded connections, deteriorated wiring, or a high-resistance ground point)

reduces the voltage available to the horn. The reduced voltage causes the diaphragm to vibrate at a lower frequency and with less amplitude, producing a weaker, lower-pitched sound. Voltage drop testing the horn circuit under load identifies the resistance point.

56. D — Three 120-ohm terminating resistors in parallel produce a combined resistance of 40 ohms ($1/R_{\text{total}} = 1/120 + 1/120 + 1/120 = 3/120 = 1/40$, so $R_{\text{total}} = 40$ ohms). A properly terminated J1939 CAN bus has exactly two 120-ohm terminators — one at each end of the backbone — producing 60 ohms. A reading of 40 ohms means a third termination has been added, possibly from an aftermarket device (GPS tracker, telematics unit, or diagnostic adapter) or a replacement module that contains a built-in terminator when the original did not. The extra termination must be found and removed.

57. A — A speedometer that oscillates between zero and the actual speed while driving at a constant speed is receiving an intermittent signal. On modern trucks, the speed signal is transmitted from the vehicle speed sensor (or the transmission output shaft sensor) to the ECM and then broadcast on the CAN bus to the instrument cluster. An intermittent connection at the sensor, in the sensor's wiring, or at the sensor's connector causes the signal to drop out momentarily — the speedometer reads zero during each dropout and snaps back to the actual speed when the signal returns.

58. C — Electromagnetic interference (EMI) from nearby electrical components or wiring can induce noise on the camera's video signal cable. The interference appears as horizontal lines, static, or rolling bars on the display. The noise may not be present in reverse if the camera circuit routing changes or if the display switches to a different processing mode. Common EMI sources include alternator output cables, ignition circuits, LED lighting drivers, and aftermarket accessories that share the same routing path or ground point as the camera cable. Rerouting the cable away from the noise source or adding shielding resolves the issue.

59. D — When an electronic instrument cluster loses CAN bus communication with the vehicle's modules, it cannot receive the data it needs to display gauge readings, clear warning lamps, or report system status. As a fail-safe measure, the cluster illuminates all warning lamps to alert the driver that it cannot verify the condition of any vehicle system. This all-lamps-on condition is the cluster's way of saying "I have no information — assume all systems may have faults until communication is restored." Restoring CAN bus communication clears the condition.

60. A — Parasitic draw isolation is performed by systematically removing fuses one at a time while monitoring the ammeter. Each fuse protects a specific circuit or group of circuits. When the fuse for the circuit containing the parasitic draw is removed, the ammeter reading drops to the normal range because the offending circuit is now disconnected. The technician then examines that circuit — inspecting each

component, module, and connection protected by that fuse — to identify the specific device that is drawing current when it should be off.

61. C — The backup lights illuminate when reverse is selected, confirming that the reverse signal switch on the transmission is functional and the reverse detection circuit is complete. Since the same reverse signal typically triggers both the backup lights and the backup alarm, the fact that the lights work isolates the fault to the alarm side of the circuit — either the alarm unit itself has failed (burned-out speaker, broken internal electronics) or the dedicated wiring between the reverse signal and the alarm unit has an open.

62. B — The turn signal flasher determines the flash rate based on the total current draw of the circuit it controls. When all bulbs are the correct wattage, the current draw matches the flasher's design, and it flashes at the normal rate. If one bulb is replaced with a lower-wattage substitute, the total current draw on that circuit decreases, and the flasher responds by increasing the flash rate — the same response it produces when a bulb burns out entirely. The rapid flash is the flasher's built-in "bulb out" indicator responding to the reduced current.

63. D — The scan tool has battery power (pins A and B are functional) but cannot communicate on either data link protocol. Since both J1939 (pins C and D) and J1708 (pins F and G) are non-functional, the most likely common cause is physical damage at the diagnostic connector — bent, corroded, or pushed-back pins on the data link pins preventing the scan tool from receiving data. Inspecting pins C, D, F, and G for physical condition and repairing or replacing the connector resolves the communication failure.

64. A — The master (driver's) switch can operate the passenger window because the motor's power and ground circuits are complete — the motor, wiring, and relay/BCM driver are all functional. The passenger door switch is a separate control input that commands the same motor through a different signal path. Since the motor works from the master switch but not the passenger switch, the fault is isolated to the passenger switch, its wiring, or the connection between the passenger door harness and the main vehicle harness.

65. C — Key fob range is determined by the fob's transmission power, which is supplied by its internal battery. As the battery voltage drops, the fob's radio transmitter produces a weaker signal that cannot travel as far before falling below the receiver's detection threshold. The receiver and vehicle systems are functioning normally — the signal simply isn't strong enough to reach the receiver from a normal distance. Replacing the fob's battery restores full transmission power and range. This is the most common and simplest key fob complaint.

66. B — An ohmmeter reading of infinite (OL) across a glow plug indicates an open circuit — the heating element inside the plug has broken, and no current can flow through it. An intact glow plug reads a very low resistance (typically 0.3 to 1.5 ohms depending on the type) because the heating element is a short, thick wire designed to draw high current and produce intense heat. With three of six glow plugs failed open, only three cylinders receive cold-start heat assistance, which is often insufficient for reliable starting in cold weather — especially on a diesel engine that depends on compression heat augmented by glow plug heat for cold-start ignition.

67. D — An intermittent fault that correlates with wet weather conditions points to moisture intrusion into an electrical component. Water is conductive — when it bridges the gap between connector pins, between a sensor signal wire and ground, or between two conductors with damaged insulation, it alters the circuit's electrical characteristics. The ECM detects the altered signal as an out-of-range or irrational value and sets a fault code. When the connector dries, the water evaporates, the conductive path disappears, the signal returns to normal, and the fault clears — but the stored code remains.

68. A — A horn that sounds randomly without driver input has a completed horn relay coil circuit when it shouldn't. The horn button normally completes the relay coil circuit only when pressed. A short in the horn button wiring, a worn clockspring conductor (which maintains the electrical connection between the steering column and the rotating steering wheel), or a pinched wire in the steering column can intermittently complete the coil circuit without the button being pressed. Road vibration, steering wheel movement, and temperature changes can cause the intermittent contact in the damaged circuit.

69. C — A dual-disc clutch has three friction surfaces: the flywheel, the intermediate plate, and the pressure plate. When the clutch is released, all three surfaces must separate from the two discs to allow the input shaft to stop spinning. If the intermediate plate sticks to one of the discs (from rust, corrosion, or worn drive lugs), that disc remains in partial frictional contact even when the pressure plate is released. The input shaft continues to spin, making gear engagement impossible without grinding because the non-synchronized gears cannot mesh with a spinning input shaft.

70. A — The range shift mechanism uses an air cylinder to move the range gears inside the transmission's auxiliary section. When the air supply is verified as adequate but the shift does not complete, the fault is in the mechanism that converts the air pressure into mechanical movement. A worn range cylinder piston seal allows the air to bypass without moving the cylinder fully. A worn range synchronizer cannot match the speed of the range gears before the sliding clutch attempts to engage. Either condition prevents the range section from completing the transition from low to high range.

71. D — The torque converter lockup clutch mechanically connects the impeller and turbine to eliminate the fluid coupling slip that occurs during normal converter operation. When the lockup clutch friction

material wears or the apply piston does not receive adequate clamping pressure, the clutch slips — the impeller and turbine rotate at slightly different speeds instead of being locked together. This slip wastes energy as heat, causes the engine RPM to flare slightly above the expected lockup RPM at highway cruise, and increases fuel consumption because the engine is turning faster than necessary for the road speed.

72. B — Fretting corrosion (a rust-colored stain at the cap-to-bore interface) indicates that the bearing cap has been moving — spinning or rocking — in the yoke bore. In a properly assembled U-joint, the bearing caps are press-fit into the yoke bores and held in place by snap rings. They should not move relative to the yoke. If the bore has worn oversize from fatigue, corrosion, or a previous installation error, the cap is no longer held securely and can work (spin) in the bore. This movement damages both the cap and the bore, and the yoke must be replaced because the bore dimension can no longer provide a secure press fit.

73. C — A rhythmic click at wheel speed that is constant regardless of torque direction, combined with metallic debris in the oil, points to a damaged ring gear tooth. The ring gear rotates at wheel speed (it is bolted to the differential case, which drives the axle shafts). A chipped or broken tooth contacts the pinion once per ring gear revolution, producing the click at wheel speed. The metallic debris in the oil is the material from the damaged tooth. The ring and pinion must be replaced as a matched set, and the oil and housing must be thoroughly cleaned to remove all debris.

74. A — Excessive clutch free play means the pedal must travel too far before the release mechanism begins to act on the pressure plate. If the free play consumes so much of the available pedal travel that the remaining travel is insufficient to fully disengage the clutch, the disc remains in partial contact with the flywheel and pressure plate when the pedal is fully depressed. The input shaft continues to spin, and engaging gears without clashing is difficult or impossible because the non-synchronized gears require the input shaft to be stopped for clean engagement.

75. D — AMT downshifts require the TCU to match engine RPM to the higher RPM that the lower gear requires at the current road speed. This process depends on accurate speed sensor data (input and output shaft speeds) for the TCU to calculate the correct RPM target, and on a responsive shift actuator to complete the gear engagement within the speed-matching window. A failed speed sensor provides incorrect data that causes the TCU to miscalculate the RPM match, and a worn actuator may move too slowly to complete the engagement before the speed window closes.

76. B — A vibration at exactly two times per driveshaft revolution is the specific frequency produced by unequal U-joint operating angles. When the angles are equal, the inherent twice-per-revolution speed fluctuation of the front U-joint is exactly cancelled by the rear U-joint. When the angles are unequal, the

cancellation is incomplete, and the residual fluctuation manifests as a vibration at $2\times$ driveshaft frequency. Since the U-joints are new and in good condition, the issue is geometric — the operating angles must be measured and equalized by adjusting the transmission mount, carrier bearing position, or axle angle.

77. C — The synchronizer ring is a friction device that matches the speeds of two components before they are mechanically locked together. The ring's inner cone surface contacts the mating cone on the selected gear, using friction to slow down (or speed up) the gear until its speed matches the mainshaft. When the ring is worn, its friction surface is depleted and cannot generate enough friction force to equalize the speeds in the time the driver takes to complete the shift. The sleeve advances before speeds are matched, and the mismatched teeth grind against each other.

78. A — Changing the ring and pinion ratio changes the pinion gear's position in the axle housing because the new gear set has different tooth geometry. The new pinion angle may differ from the original, which changes the rear U-joint's operating angle. If the angle change makes the front and rear U-joint angles unequal, the inherent speed fluctuation of the Cardan U-joints no longer cancels, producing a vibration. The solution is to measure the operating angles and correct them — often by shimming the axle or adjusting the pinion angle — to restore equality.

79. D — On a full-floating rear axle, the vehicle's weight is carried by the wheel bearings on the axle housing spindle. If the bearings are adjusted too loosely, excessive end play allows the entire hub and wheel assembly to wobble on the spindle during rotation. The wobble is visible as a side-to-side oscillation of the wheel and increases with speed. The tire is properly mounted and balanced, eliminating those as causes. The bearing adjustment must be corrected to bring end play within the manufacturer's specification.

80. B — The PTO is engaging (mechanically connecting the PTO gear to the transmission), and the pump is turning (confirming the mechanical drive between the PTO and pump is intact). But the pump is not building pressure — this means the hydraulic system downstream of the mechanical drive has a fault. The first checks are the reservoir fluid level (a dry pump cannot build pressure), the suction line (a restriction or air leak prevents fluid from reaching the pump), and the pump itself (internal wear can prevent a pump from building pressure even though it turns). The mechanical PTO drive has been confirmed as functional.

81. D — The differential lock engagement teeth must mesh with the corresponding teeth on the axle shaft or side gear. If the two components are rotating at different speeds (which occurs during a traction event when one wheel is spinning), the teeth cannot align and mesh smoothly. The grinding noise is the engagement teeth repeatedly contacting and bouncing off each other without engaging. Momentarily

equalizing wheel speeds — by releasing the throttle or lightly applying the brakes — allows the teeth to align and mesh cleanly.

82. C — An automatic transmission's front pump is driven by the engine through the torque converter impeller and turns whenever the engine is running. If the noise varies with vehicle speed rather than engine speed, the source is not the front pump — it is a component that turns at output speed. The output shaft bearing, the parking pawl mechanism, or a constantly meshed gear set that rotates at output speed regardless of the selected gear are the suspects. The fact that the noise is present in neutral (while coasting) confirms it is related to output shaft rotation, not engine-driven components.

83. A — Stop-and-go traffic on a steep grade is the most demanding condition for an AMT clutch. Each takeoff from a stop requires the clutch to slip for an extended period to smoothly engage the heavily loaded vehicle against the grade's resistance. This extended slip duration generates heat with each engagement cycle. In continuous stop-and-go conditions, the heat accumulates faster than the clutch can dissipate it because there is insufficient cooling time between engagements. The TCU's temperature monitoring detects the accumulated heat and issues the warning to protect the clutch from thermal damage.

84. C — The clunking during the mode shift indicates that the engagement components inside the transfer case are not meshing smoothly. Worn engagement teeth, a worn shift collar, or worn splines on the sliding gear create a rough interface that produces impact noise when the components mate. Once the shift is complete and the components are fully engaged, the wear does not affect operation because the teeth are under load in one direction. But during the shift, the worn surfaces must find alignment, and the impacts during this alignment process produce the clunk.

85. D — Limited-slip differentials use clutch packs (or cone clutches) to transfer torque from the spinning wheel to the wheel with traction. The friction characteristics of these clutch packs must be controlled by a specific friction modifier additive in the gear oil. Without this additive, the clutch packs engage and disengage abruptly during low-speed turns (when the differential must allow speed differences between the wheels), producing a shuddering vibration felt through the vehicle. The friction modifier provides smooth, controlled clutch engagement that eliminates the chatter.

86. B — The steering damper functions as a shock absorber for the steering linkage — it dampens rapid, sudden inputs from road impacts that would otherwise be transmitted directly through the drag link to the pitman arm and steering wheel. A worn or failed damper has lost its hydraulic resistance and cannot absorb the impact force. When the right front tire hits a bump, the force travels through the knuckle, tie rod, and drag link to the steering wheel as a sharp kick because nothing is absorbing the energy before it reaches the driver's hands.

87. D — A new hose that bursts immediately upon pressurization was rated below the system's maximum operating pressure. Power steering systems generate peak pressures at the relief valve setting — typically 1,400 to 2,000+ psi depending on the vehicle. If the replacement hose is rated for a lower pressure (for example, a return line hose rated at 500 psi used in a pressure line application), it will fail the first time the system reaches peak pressure during a full-lock steering effort. The replacement must match or exceed the original hose's pressure rating.

88. A — Outside-edge tire wear on both front tires indicates that the tops of the wheels are tilted outward — positive camber. The tilted wheels load the outside edges of the tires against the road surface, concentrating all the wear forces on those edges while the inside edges carry minimal load. On a solid I-beam steer axle, camber is determined by the axle geometry and king pin position. Excessive positive camber indicates a bent steer axle (bowed upward excessively) or worn king pin bushings that allow the knuckle to tilt outward.

89. C — A frame that has been permanently deformed (narrowed) by a collision has lost its designed structural geometry. The narrowed section affects the alignment of everything mounted to the frame in that area — body mounting, drivetrain components, suspension brackets, and axle positions. The deformation may also have created internal stress concentrations that weaken the frame at the impact point. A qualified frame repair facility must measure the frame against the manufacturer's specifications at multiple points to determine whether the frame can be straightened to specification or whether section replacement is required.

90. D — The air spring appears fully inflated externally, but the corner sits lower than the other three. If the air spring's internal bladder has separated or the rubber bellows has bulged into a shape that limits its effective height, the spring may look inflated but not achieve the same extended height as the other three springs. Similarly, if the air spring piston (the base that the bellows seats on) has shifted or is damaged, the effective height of the assembly is reduced even with full air pressure. The spring must be inspected for internal damage and compared dimensionally to the other three.

91. B — Power steering assist is most critical during low-speed, high-effort maneuvers — parking, tight turns, and dock maneuvering. At highway speed, the tires roll more easily and less assist is needed. A pump that is producing marginal flow or pressure may provide sufficient assist at highway speed (where demand is low) but cannot keep up with the high flow demand of full-lock steering at low speed. A power steering analyzer measures the pump's actual pressure and flow output under load, revealing whether the pump can meet the system's maximum demand.

92. A — A wheel bearing that is adjusted too tightly (preloaded beyond specification) forces the rollers against the races with excessive force at all times. This constant preload generates friction that converts

to heat during every hub revolution. The heat is directly proportional to the preload — the tighter the adjustment, the more friction, and the more heat. The opposite hub (properly adjusted) runs at normal temperature because its bearing preload is within specification. The bearing must be readjusted to the correct end play specification immediately to prevent bearing failure.

93. C — An air-release fifth wheel uses a pneumatic actuator to release the locking jaw mechanism, replacing the manual effort of pulling a mechanical release handle. This feature allows the driver to uncouple the trailer from inside the cab (or from a convenient air valve location) without crawling under the trailer to reach the release handle. The air actuator pushes the locking mechanism to the open position, allowing the king pin to slide out of the jaws when the tractor pulls forward.

94. D — A suspension dump valve (sometimes called a kneeling valve or dock-height valve) is designed to exhaust air from the air ride suspension for specific operational purposes — lowering the trailer to dock height for loading, or dumping the suspension for parking. If this valve is leaking internally or has been left in the dump position, it continuously vents air from the air springs, deflating the suspension. The valve must be inspected for a stuck/leaking condition and the control mechanism checked to verify it is in the ride (closed) position.

95. B — Steer tire vibrations are transmitted through the steering linkage to the steering wheel — the driver feels the vibration in their hands. Rear axle (drive or trailer) tire vibrations are transmitted through the suspension and frame to the cab structure, and the driver feels the vibration through the cab floor and seat. This distinction in where the vibration is felt helps the technician narrow the search to the correct axle group before inspecting individual wheels.

96. A — The right camber at $+1.5^\circ$ exceeds the maximum specification of $+1.0^\circ$. Excessive positive camber on the right side means the top of the right wheel tilts outward more than designed, loading the outside edge of the right steer tire and causing accelerated outside-edge wear on that tire. The cause is a geometric condition — a bent steer axle (right side bowed upward), worn right-side king pin bushings (allowing the knuckle to tilt), or a bent right steering knuckle. The left camber, both caster values, and the toe are all within specification.

97. D — The center bolt's primary function is to locate the axle on the spring — it passes through the center of the spring pack and into a corresponding hole in the spring seat on the axle. When the bolt breaks, the spring leaves can shift laterally relative to the axle and frame. This lateral shift changes the effective position of the axle, altering toe, wheelbase, and tracking alignment. The vehicle may track (dog-track) at an angle to its direction of travel, causing accelerated tire wear, handling instability, and increased driver effort to maintain a straight course.

98. B — Commercial vehicle tire regulations prohibit sidewall repairs. Unlike tread punctures that can be repaired with a proper plug-patch combination if within the repairable area, sidewall damage compromises the tire's structural integrity because the sidewall flexes continuously during rolling and is the primary structural member that contains the inflation pressure. A repair in the sidewall cannot withstand the cyclic flexing loads and will fail. The tire must be removed from service regardless of whether the current puncture is leaking or not.

99. A — Hub-piloted wheels center on the hub through the machined pilot pad, and the lug nuts provide the clamping force that holds the wheel tight. If the hub pilot and wheel bore dimensions do not match precisely — from wear, corrosion, or a parts mismatch — the wheel cannot center accurately on the hub. An off-center wheel experiences micro-movement during rotation as the clamping force vectors shift with each revolution, gradually loosening the nuts. Correct torque, correct hardware, and correct re-torque cannot compensate for a dimensional mismatch at the centering interface.

100. C — Swapping the height control valves left-to-right did not change the symptom — the right side still rides high. This eliminates the valve itself as the cause because the "problem" followed the position, not the valve. The fault must be in the positional element — the sensing linkage that tells the valve what height to maintain. A bent sensing arm, an incorrect linkage length, or a shifted mounting point on the right side causes the valve to maintain an incorrect height at that position, regardless of which valve body is installed.

101. D — The self-steering tag axle must track straight when the trailer is moving in a straight line and steer to follow the trailer's turn path during cornering. If the steering mechanism is misaligned, the centering bushings are worn, or the centering device is not returning the axle to the straight-ahead position, the tag axle runs at a constant toe-out angle. This angle causes the tires to scrub inward against the road surface with every revolution, wearing the inside edges and degrading the trailer's tracking stability.

102. B — For the fifth wheel to lock around the king pin, the locking jaws must be in the fully open position before the tractor backs under the trailer. If the jaws are partially closed or the locking mechanism is in a halfway position, the king pin may contact the jaw faces and slide over them without entering the throat opening deeply enough to trigger the jaw closure mechanism. The tractor-trailer appears coupled but the king pin is not captured — pulling forward reveals the failed coupling immediately.

103. A — A single clunk per bump event (not a continuous rattle) from the front suspension with tight steering linkage points to a component that has a specific amount of free play that is taken up once per suspension cycle. Shock absorber mounting bushings and hardware are common sources — a worn

upper or lower bushing allows the shock body to shift on its mount during suspension compression, producing a single clunk as it contacts the end of its free play. A loose mounting bolt has the same effect. These components are often overlooked during steering linkage inspections because they are not part of the steering system.

104. C — If the tires, suspension, frame alignment, and fifth wheel have been verified as correct, the cab tilt must be caused by the cab's own mounting system. Cab mounts are rubber isolators positioned between the cab and the frame at four or more points. If one or more mounts on the right side have collapsed from deterioration (age, heat, oil contamination), the cab sits lower on that side relative to the frame. The vehicle itself may be level, but the cab leans because its mounting is uneven. Comparing the mount condition and height side-to-side confirms the diagnosis.

105. A — The electric heated mirror has its own power supply wire and ground wire. Checking for voltage at the mirror's heater connector while the heater switch is on determines whether the electrical circuit is delivering power to the heating element. If voltage is present but the mirror does not warm, the heating element has failed (open circuit). If no voltage is present, the fault is upstream — in the switch, the wiring, the connector, or a blown fuse. Since the left mirror heater works, the switch and fuse (which typically control both sides) are likely functional, pointing to the wiring or connector on the right side.

106. D — A rattle that occurs only within a specific RPM range is caused by a component vibrating at a frequency that matches the engine's vibration frequency in that range. Above and below that RPM, the frequencies do not match and the component does not resonate. Common sources include loose dashboard panels, trim pieces, cup holders, storage compartment doors, and items stored in the cab that contact adjacent surfaces when excited by the specific vibration frequency. A systematic inspection — tapping, pressing, and isolating interior components while the engine is held at the offending RPM — locates the source.

107. B — The evaporator removes humidity from the cab air during A/C operation. The moisture condenses on the evaporator fins and drains downward through a condensate drain tube that exits the bottom of the HVAC housing and drips under the vehicle. If this drain tube is clogged (with debris, mold, or insect nests), the condensate accumulates inside the HVAC housing until it overflows onto the passenger floor. The A/C cools normally because the evaporator is functioning — the drain is simply blocked and cannot remove the water.

108. C — The rear door position switch or sensor provides the door control system with the information about whether the door is open or closed. If the switch is stuck, misadjusted, or has failed in the "open" position, it continuously reports the door as open to the control system. The control system responds by sounding the warning chime because it believes the door is open, even though the door is physically

closed and secured. Inspecting and replacing the door position switch or adjusting its mounting resolves the false indication.

109. A — Water infiltrating through damaged rear door seals is the primary cause of wood floor rot in dry van trailers. The rear doors face the weather during driving and parking, and deteriorated seals allow rain, melting snow, and road spray to enter the trailer. The moisture settles on the wood floor at the rear of the trailer (where it is most exposed), and over time, the persistent moisture promotes fungal growth that decomposes the wood fibers. The primary concern is structural failure — a rotted floor can collapse under forklift traffic or heavy cargo, dropping loads through the floor and potentially injuring personnel below.

110. D — If multiple new seals have failed to seal the connection, the seal is not the problem — the mating surfaces are. Gladhand coupling faces must be flat, smooth, and free of warping, corrosion, and physical damage to create a proper seal against the rubber seal. A warped, corroded, or damaged face cannot create a uniform contact surface regardless of how many new seals are installed. Both the tractor-side and trailer-side coupling faces must be inspected, and any damaged coupling replaced.

111. B — Internal baffles in a tanker trailer are designed to reduce the surge effect of liquid cargo during braking, acceleration, and cornering. Without baffles (or with damaged baffles), the entire liquid mass moves freely as a single body, creating dangerous surge forces that can push the trailer forward during braking (increasing stopping distance), pull the trailer sideways during cornering (increasing rollover risk), and rock the trailer fore-and-aft during acceleration changes. A cracked baffle that extends across half its width has lost a significant portion of its surge-control capability.

112. C — Moisture in the air system is the primary cold-weather concern for any air-operated system. When the trailer is parked for three weeks in freezing conditions, any water that has accumulated in the spring brake chambers or their supply lines freezes. The ice physically blocks the air passage, preventing the hold-off air from reaching the spring brake piston even though the tractor is supplying full system pressure. The springs remain extended (applied) because the air cannot get past the ice to compress them. The chambers and lines must be thawed before the brakes will release.

113. A — Load securement anchor points must withstand the forces specified by the cargo securement regulations — forces that can exceed several times the cargo's static weight during emergency braking, evasive maneuvers, or rough road conditions. Cracked weld joints at anchor points are structural failures that compromise the anchor's rated strength. If an anchor point fails during a dynamic load event, the strap or chain it was holding is released, and the cargo is free to shift, fall from the trailer, or impact other vehicles. This is a serious safety hazard that must be repaired before the trailer carries secured cargo.

114. D — Electric-over-air (EOB) brake systems receive an electrical brake signal from the tractor (rather than a pneumatic signal through the gladhand) and convert it to a pneumatic brake application using a solenoid-controlled air valve on the trailer. If the EOB controller or the solenoid valve fails, the electrical signal cannot be converted into air pressure at the brake chambers, and the brakes do not apply. The trailer has its own air supply from the tractor's supply line, so air is available — but the conversion device that translates the electrical command into a pneumatic action has failed.

115. B — Compressor cycling every 30 seconds while maintaining stable setpoint temperature indicates the control system's dead band (the temperature differential between the compressor's turn-on and turn-off points) is too narrow. The temperature rises a fraction of a degree above setpoint, the compressor starts, cools the air a fraction below setpoint, and shuts off — then the cycle repeats 30 seconds later. While the temperature is maintained, the frequent cycling places excessive wear on the compressor clutch, electrical contactors, and starting components, shortening their service life.

116. A — A cracked lens may alter the transmitted light color (the lens material is colored to produce the required amber or red signal color), reduce the lamp's visibility distance, and allow moisture and debris to enter the fixture, causing premature bulb failure and corrosion of the socket and wiring. CMVSS 108 requires that lamps display the correct color and be maintained in proper working condition. While the lamp currently illuminates, the cracked lens compromises its regulatory compliance and will lead to premature failure. The lamp assembly must be repaired or replaced.

117. C — Normal manifold gauge readings and correct refrigerant charge indicate the refrigeration cycle is functioning properly. The elevated evaporator outlet temperature despite normal system pressures suggests the air passing over the evaporator is not being cooled adequately — but the reduced airflow from a clogged cabin filter or slow blower means less air contacts the cold evaporator surface. The small volume of air that does pass over the evaporator is cooled, but it mixes with warmer air in the duct system before reaching the vent, producing a measured temperature higher than the evaporator surface temperature.

118. B — The defrost system delivers air through dedicated ductwork to the windshield surface. If the ductwork on the passenger side has a leak, disconnection, or collapse, the heated air escapes before reaching the windshield — the passenger side of the windshield receives insufficient airflow and remains fogged while the driver's side (with intact ductwork) clears normally. The temperature and humidity of the air are the same for both sides at the HVAC housing outlet — the difference is in the delivery path.

119. D — UV fluorescent dye is the most effective method for locating slow, intermittent refrigerant leaks. The dye is injected into the system and circulates with the refrigerant and oil permanently. At the

leak point, the dye escapes with the refrigerant and deposits a fluorescent trace on the external surface that glows brightly under UV light. Because the dye accumulates over time at the leak location, even very slow leaks that an electronic detector might miss during a single inspection become visible as a growing fluorescent stain over weeks or months of operation.

120. A — A water pump with partial impeller erosion produces flow proportional to its remaining impeller area. At higher RPM, the pump turns faster and can still move adequate coolant volume through the engine and heater core despite the reduced impeller area. At low idle RPM, the pump's output drops to the point where it can barely maintain engine cooling through the large-volume engine block passages and cannot simultaneously supply adequate flow through the heater core's smaller-diameter circuits. The reduced heater core flow means less heat transfer and only warm (not hot) air delivery.

121. C — Liquid refrigerant accumulating in the compressor during the off period (called liquid slugging or liquid flooding) occurs when refrigerant migrates to the coldest point in the system — which is often the compressor in cold ambient conditions. When the compressor starts, it attempts to compress this liquid, but liquid is incompressible. The mechanical shock of the pistons or scroll mechanism hitting the incompressible liquid produces the knocking noise. As the compressor runs, the liquid evaporates and clears, the noise diminishes, and the system operates normally on vapor.

122. B — A vacuum that holds at 500 microns and then rises to 2,000 microns within 5 minutes indicates one of two conditions: a leak that is allowing ambient air to enter the system, or moisture inside the system that is evaporating at the low vacuum pressure and raising the internal pressure. The technician must differentiate between the two — if the vacuum continues to rise over time without stabilizing, it is likely a leak; if the vacuum rises and then stabilizes at a higher level, moisture is evaporating and has reached equilibrium. Either condition must be resolved before charging.

123. D — A rooftop condenser on a transit bus is exposed to direct sunlight, ambient heat, and potentially recirculated hot air from the engine compartment or other rooftop equipment. During peak summer conditions with high ambient temperature, the condenser's ability to reject heat is reduced because the temperature differential between the hot refrigerant inside and the hot ambient air outside is smaller. Dirty condenser fins reduce the effective surface area for heat transfer, a failed fan reduces airflow, and recirculated engine exhaust heats the air before it reaches the condenser. All these factors limit the system's maximum cooling capacity during extreme heat.

124. A — Volumetric efficiency compares the pump's actual output under load to its rated output at the same speed. At 2,000 psi, the pump delivers 20 gpm out of a rated 25 gpm: $\text{efficiency} = 20/25 = 0.80 = 80\%$. This means 20% of the pump's theoretical output is leaking back through internal clearances under pressure. An 80% efficiency may be acceptable for some applications but indicates moderate wear. The manufacturer's minimum efficiency specification (typically 75-85%) determines whether the pump can continue in service or requires rebuilding.

125. C — A cylinder that extends smoothly but retracts erratically (jerkily) has different behavior in each direction, pointing to a mechanical issue that affects retraction more than extension. A bent rod clears the rod seal and guide bushing during extension (the bend exits the barrel), but during retraction, the bent portion re-enters the barrel and must pass through the seal and bushing, catching and binding intermittently. The rod's deflection alternately catches and clears the seal lip, producing the jerky, inconsistent motion during retraction.

126. A — The four most common sources of system aeration are a low fluid level that exposes the pump inlet to air, a loose or damaged suction line fitting that allows air to be drawn in under the pump's suction, a failed pump shaft seal that admits air, and a return line that terminates above the fluid level and introduces air bubbles into the reservoir.

D — The consequences of aerated fluid include compressible (spongy) actuator operation because air is compressible, cavitation damage to the pump from collapsing air bubbles, accelerated fluid oxidation from the increased air exposure, and elevated operating temperatures from the energy absorbed by compressing and expanding the entrained air. The air source must be found and eliminated.

127. B — A counterbalance valve that chatters (rapidly alternates between open and closed) produces an oscillating boom because each open-close cycle allows a small burst of fluid to pass, then blocks it, then allows another burst. The chattering is caused by an incorrect pilot ratio (the valve's sensitivity to the pilot pressure signal) or a partially blocked internal orifice that disrupts the valve's proportional control. The valve oscillates because it cannot find a stable equilibrium between the pilot pressure commanding it to open and the load pressure pushing it closed.

128. A — A hydraulic pump relies on the thin film of oil between its internal moving parts for both lubrication and sealing. When a pump is installed dry (without pre-filling the housing), the first seconds of operation occur with no oil film — the pump's gears, vanes, or pistons run metal-to-metal until suction draws fluid from the reservoir. These few seconds of dry running can score and gall the pump's precision-machined surfaces, permanently reducing the pump's efficiency and service life. Pre-filling ensures lubrication is present from the first revolution.

129. C — All other hydraulic functions on the same system operate at normal speed, confirming the main pump, reservoir, and common circuit components are functional. The slow operation is isolated to the packer blade circuit, which has its own dedicated control valve section, flow control valve, and plumbing. A restriction in any of these dedicated components — a stuck flow control, a contaminated orifice, or a partially stuck valve spool — limits the flow specifically to that function while all other functions receive their normal share of the pump's output.

130. D — A pressure gauge that fluctuates rapidly is displaying actual pressure variations in the circuit. The source of these pulsations is typically the pump (worn elements produce uneven flow, a damaged drive coupling creates cyclic loading, or cavitation causes erratic pressure) or the relief valve (a chattering relief valve rapidly opens and closes around its set point, causing the system pressure to oscillate). The gauge is functioning correctly as a measurement device — it is showing what is actually happening in the circuit.

131. B — A tailgate lift that cannot hold a stationary load has fluid leaking from the high-pressure side to the low-pressure side somewhere in the hold circuit. Since the rod seal shows no external leakage, the leak is internal. The two most likely paths are the cylinder's piston seal (allowing fluid to bypass from the cap end to the rod end inside the cylinder) and the holding valve (allowing fluid to pass through the valve to the return line). Isolating the cylinder from the valve — by blocking the lines at the valve — determines which component is leaking.

132. A — Regenerative braking uses the traction motor as a generator during deceleration — the motor extracts kinetic energy from the vehicle's forward motion and converts it to electrical energy for battery charging. This energy extraction creates a retarding force that decelerates the vehicle, similar to engine braking on a conventional vehicle. Many BEVs allow the driver to adjust the regenerative braking aggressiveness through a selectable setting, ranging from light coasting feel (minimal regeneration) to aggressive one-pedal driving (maximum regeneration that can bring the vehicle nearly to a stop without the brake pedal).

133. C — In a series hybrid, the traction motor is the only propulsion source — the engine has no mechanical connection to the wheels. The motor requires electricity to operate, which comes from either the battery or the generator driven by the engine. At 5% battery SOC, the battery is nearly empty and can provide minimal energy. The engine is running and the generator is producing electricity, but the combined output may be insufficient to both charge the critically depleted battery (which the BMS prioritizes to prevent overdischarge) and simultaneously power the traction motor for propulsion. The VCU disables propulsion to protect the battery.

134. D — High-voltage battery packs are extremely heavy (often 500-2,000 kg for commercial vehicles), and improper handling during removal can cause injury and damage. The pack must be lifted using only the manufacturer's designated lifting points — lifting at other locations can deform the enclosure, damage internal bus bars and cell connections, or crack the sealed housing. Orientation requirements prevent damage to internal cell stacking, cooling circuit connections, and sensor harnesses. The workspace must also be prepared — free of water, conductive debris, and flammable materials — and the pack must be stored in a designated area with appropriate environmental controls.

135. B — The motor overtemperature condition is the result of sustained high current draw exceeding the thermal management system's cooling capacity. Climbing a steep grade under full load requires continuous high torque from the traction motor, which draws continuous high current from the battery through the inverter. This current generates resistive heating (I^2R losses) in the motor windings. The motor's cooling circuit (typically liquid cooling) is designed to handle normal duty cycle heat loads, but the sustained maximum-torque demand of a loaded grade climb in high ambient temperature generates heat faster than the cooling system can remove it.