

PRACTICE EXAM 6: RED SEAL 310T SIMULATION (135 QUESTIONS)

1. A technician is using a portable crane (cherry picker) to lift a heavy-duty transmission from a truck. As the crane arm extends with the load, the crane begins to tilt forward on its casters. What is the primary cause of this instability?

- A. The crane's hydraulic cylinder does not have adequate capacity for the transmission's weight at any boom extension
- B. The load exceeds the crane's rated capacity at the current boom extension — portable cranes are rated by the combination of load weight and boom length, and the effective capacity decreases as the boom extends further from the base
- C. The crane's casters are not rated for hard shop floors and are sinking under the concentrated load
- D. The transmission's center of gravity shifted during the lift, creating an unbalanced condition the crane cannot correct

2. A technician finishes an engine oil change on a heavy-duty truck and starts the engine to check for leaks. Oil pressure does not register on the gauge for approximately 8 seconds, then rises to normal. What should the technician do?

- A. This delay is normal for any engine after an oil change and requires no further attention or action
- B. Shut down immediately and replace the oil pump since a delay exceeding 3 seconds indicates pump failure
- C. Continue monitoring for 5 minutes to determine if the delay recurs during subsequent engine startups
- D. Verify that the oil filter was pre-filled before installation and that the correct filter was used — on some engines a dry filter and empty gallery passages create a delay that exposes bearings to momentary dry running, and pre-filling reduces this delay

3. A technician is preparing to weld on a truck frame near the fuel tank. The fuel tank is approximately 0.5 metres from the planned weld location. What precaution is mandatory?

- A. The fuel tank must be removed, drained, and purged, or a fire-resistant blanket placed between the weld area and the tank, with a fire extinguisher accessible and a fire watch maintained during and after welding to prevent ignition of vapors or the tank
- B. The welding can proceed safely as long as the fuel tank cap is tightly sealed to prevent vapor release
- C. The technician should switch from an oxy-acetylene torch to a MIG welder since the lower arc temperature eliminates risk
- D. Applying a wet towel over the fuel tank surface is sufficient protection from welding heat at 0.5 metres distance

4. A technician notices that a coworker is wearing loose-fitting clothing and a lanyard-style name badge while operating a bench-mounted drill press. What specific hazard does this create?

- A. The loose clothing and lanyard could block the technician's view of the drill point and cause inaccurate placement
- B. The lanyard's metal clip could scratch the workpiece and create a defect in the drilled component surface
- C. The loose clothing or hanging lanyard can be caught by the rotating drill bit or chuck and pull the worker into the machine, causing severe entanglement injuries including lacerations and fractures
- D. The loose clothing creates a static electricity hazard near the drill press motor that could cause an electrical arc

5. A truck repair facility has a pit in the shop floor for undercarriage access. What is the primary safety hazard associated with a shop pit that is not in active use?

- A. The pit collects rainwater that creates an electrical hazard if the shop has overhead crane tracks nearby
- B. The open pit is a fall hazard — anyone walking in the area who is unaware of or inattentive to the opening can fall into it, sustaining serious injuries from the drop; it must be covered, barricaded, or clearly marked when not in active use
- C. The pit accumulates exhaust fumes that create an asphyxiation hazard for anyone entering without ventilation running
- D. The pit's concrete walls absorb vibration from shop operations and can crack over time, creating a structural risk

6. During a vehicle inspection, a technician discovers that the truck's seat belt anchor bolt on the driver's side is missing. The seat belt appears to function but is only attached at two of its three mounting points. What is the correct action?

- A. Note the missing bolt in the inspection report and advise the driver to have it repaired at the next service
- B. Install a standard Grade 5 bolt from the shop hardware bin that matches the thread size and torque it properly
- C. Secure the seat belt webbing in a temporary knot around the seat frame to restore the third attachment point
- D. The vehicle must not be operated until the correct manufacturer-specified seat belt anchor bolt is installed — the anchor must withstand collision forces, and a missing or incorrect bolt can allow the belt to tear free during a crash

7. A shop stores compressed gas cylinders (nitrogen, oxygen, acetylene) in a designated area. What is the single most important physical security measure for stored cylinders?

- A. All cylinders must be secured in an upright position with chains, straps, or in an approved rack to prevent falling — a falling cylinder can break its valve off and the escaping high-pressure gas can propel the cylinder as an uncontrolled projectile
- B. All cylinders must be stored in a locked room accessible only to personnel with gas handling certification
- C. All cylinders must be placed on rubber mats to prevent the steel bottoms from sparking on the concrete floor
- D. All cylinders must have their regulators attached at all times during storage to prevent accidental valve opening

8. A technician is servicing a truck's air conditioning system and must handle refrigerant. What certification is required in Canada to purchase and handle regulated refrigerants?

- A. No certification is required as long as the technician uses an approved recovery machine during the service
- B. A WHMIS certificate that covers the specific refrigerant type being handled in the service operation

C. An ODS and HFC refrigerant handling certificate from a provincially recognized certification program, verifying the technician is trained in proper refrigerant identification, recovery, recycling, and handling procedures

D. A general HVAC license that covers both stationary and mobile refrigeration systems across all provinces

9. A heavy-duty diesel engine produces a sharp metallic knocking noise at idle that becomes louder when the engine is loaded. The noise is most prominent at the top of the engine. An injector cut-out test does not change the noise when each cylinder is disabled. What is the most likely source?

A. Excessive valve lash on one or more valves — the increased clearance causes the rocker arm to strike the valve stem tip with a metallic knock at each cam lobe lift, and the noise intensifies under load because combustion forces increase the dynamic loading on the valve train

B. A cracked piston skirt that contacts the cylinder wall under the increased pressure of loaded combustion events

C. A loose wrist pin that knocks as the piston changes direction at TDC and BDC during each stroke cycle

D. A worn connecting rod bearing that is amplified by the engine block structure to sound like a top-end noise

10. A diesel engine's coolant temperature gauge indicates normal operating temperature, but an infrared thermometer aimed at the thermostat housing reads only 65°C. The engine's rated operating temperature is 82-95°C. What does this discrepancy indicate?

A. The infrared thermometer is inaccurate on painted metal surfaces and the gauge reading should be trusted

B. The engine is operating normally because the thermostat housing temperature is always lower than the internal temperature

C. The coolant temperature sensor feeding the gauge has failed and is sending a false "normal" reading — the engine is actually running cold at 65°C, likely from a thermostat stuck open, and the infrared reading reflects the actual condition more accurately

D. The thermostat is functioning correctly by maintaining a 20-degree differential between the housing and the coolant

11. A heavy-duty diesel engine equipped with a Jake Brake has reduced braking effectiveness. The engine brake indicator lamp illuminates normally when activated. What should be investigated?

- A. The exhaust manifold for cracks that reduce the backpressure needed for engine braking effectiveness
- B. The turbocharger wastegate, which may be stuck open and reducing exhaust backpressure during braking
- C. The fuel injection system, which may be injecting fuel during the engine brake cycle and counteracting the force
- D. The engine brake valve lash adjustment, the solenoids, and the oil supply to the brake mechanism — incorrect slave piston lash, partially opening solenoids, or restricted oil supply prevents full exhaust valve opening during the braking event, reducing the compressed air released

12. A heavy-duty diesel engine shows a gradual decrease in oil pressure over several months. Each oil change temporarily restores normal pressure that then gradually decreases. Oil analysis shows increasing wear metals. What does this pattern indicate?

- A. The oil filter bypass valve is weakening over time and needs replacement at each service interval
- B. Progressive internal engine wear — enlarging bearing clearances allow oil to escape faster than the pump can supply, and the wear metals confirm metal-to-metal contact; fresh oil's higher viscosity temporarily masks the pressure loss by partially compensating for worn clearances
- C. The oil pressure sender is failing gradually and needs replacement for accurate pressure readings
- D. The oil viscosity is decreasing from fuel dilution that occurs during each extended oil change interval

13. A technician is performing a cylinder leakage test on a diesel engine. Cylinder 3 shows 35% leakage. Air is heard escaping from the oil fill cap opening. What does the location of the air escape indicate?

- A. The piston rings on cylinder 3 are worn or broken — compression air is leaking past the rings into the crankcase, and the escaping air is detected at the oil fill cap because the crankcase communicates with the cap through oil return passages and the breather system
- B. The head gasket between cylinder 3 and the oil gallery has failed, allowing compressed air into the lubrication circuit
- C. The cylinder liner on cylinder 3 has a crack below the ring travel area that connects to a crankcase oil passage

D. The oil fill cap seal is defective and atmospheric air is being drawn into the crankcase by the test apparatus

14. A heavy-duty diesel engine's exhaust appears dark grey to black under load. The turbocharger boost pressure is within specification and the air filter is clean. The fuel injection timing has been verified as correct. What should the technician investigate next?

A. The EGR system, which if flowing excessively would dilute the intake charge and reduce available oxygen

B. The engine coolant temperature, which if excessively high causes fuel to pre-ignite and produce black smoke

C. Individual injector performance — a leaking, dribbling, or stuck-open injector delivers more fuel than commanded into one or more cylinders, creating a locally rich condition that produces black smoke even though the overall air supply is adequate

D. The exhaust gas temperature sensors, which if reading incorrectly could cause the ECM to add fuel unnecessarily

15. A technician discovers that a heavy-duty diesel engine's coolant is contaminated with engine oil. The oil cooler has been tested and is not leaking. What other component could allow oil to enter the cooling system?

A. The fuel transfer pump seal, which shares a coolant passage on some engine designs and can leak oil into the coolant

B. The air compressor head gasket, which on some engines shares cooling with the engine and can leak oil into the coolant

C. The EGR cooler, which circulates exhaust gas but does not share passages with the lubrication system

D. A failed cylinder head gasket, a cracked cylinder head, or a cracked engine block where the oil gallery and coolant passage are adjacent — any of these internal failures can create a path for pressurized engine oil to enter the cooling system

16. A heavy-duty diesel engine is equipped with a wastegate-controlled turbocharger. The driver reports that the engine produces adequate power at low RPM but loses power at high RPM with excessive black smoke. What is the most likely cause?

- A. The turbocharger bearing is seizing at high RPM, preventing the turbine from spinning fast enough to produce adequate boost
- B. The wastegate is stuck open — at low RPM the exhaust energy is sufficient to produce adequate boost despite the open wastegate, but at high RPM the open wastegate bypasses too much exhaust around the turbine, limiting boost pressure and causing an air-starved condition that produces black smoke
- C. The fuel injection pump governor is over-fueling at high RPM due to a worn governor spring
- D. The charge air cooler has an internal restriction that only limits airflow at the higher volumes demanded at high RPM

17. A diesel engine's oil analysis report shows a sudden spike in sodium and potassium levels. These elements were not present in previous samples. What contamination source do sodium and potassium indicate?

- A. Coolant contamination in the engine oil — sodium and potassium are components of coolant additive packages, and their sudden appearance indicates that coolant is leaking into the oil system through a failed gasket, cracked head, or failed oil cooler
- B. Fuel contamination from a biodiesel blend that contains sodium-based additives for improved lubricity
- C. Contamination from road salt that has entered the crankcase through the air intake system during winter operation
- D. Bearing overlay material that contains sodium and potassium as hardening agents in the tri-metal construction

18. A technician is diagnosing a heavy-duty diesel engine that runs rough at idle but smooths out above 1,200 RPM. There are no active fault codes. Fuel pressure and air supply are within specification. What diagnostic test should be performed next?

- A. A cooling system pressure test to check for an internal coolant leak that affects idle combustion stability
- B. An exhaust backpressure test to verify the DPF is not creating restriction that affects idle quality
- C. A relative compression test or individual cylinder contribution test using the scan tool to identify if one or more cylinders are contributing less than the others at idle — this isolates whether the rough idle is caused by a mechanical imbalance between cylinders

D. A battery load test to verify the charging system is not causing an electrical disturbance at idle RPM

19. A heavy-duty diesel engine equipped with an SCR aftertreatment system has a diagnostic trouble code for "NOx Conversion Efficiency Below Threshold." The DEF level is adequate and the DEF quality sensor reads normal. What should be investigated?

A. The SCR catalyst, which may have become contaminated with sulfur from ultra-low-sulfur diesel fuel's residual sulfur content

B. The exhaust gas temperature sensors upstream and downstream of the SCR, which control the DEF dosing strategy

C. The DPF, which if recently regenerated may have sent excessive heat to the SCR catalyst and temporarily reduced its efficiency

D. The SCR catalyst itself for degradation, the DEF dosing valve for proper spray pattern and delivery rate, and the NOx sensors for accuracy — the low conversion efficiency could result from a poisoned or thermally damaged catalyst, insufficient or improperly distributed DEF, or a faulty NOx sensor providing incorrect feedback

20. A diesel engine has a condition where it starts and runs normally for the first 10 minutes, then begins to surge and lose power progressively. Shutting the engine off for 5 minutes and restarting temporarily restores normal operation. What is the most likely cause?

A. The engine coolant temperature sensor is reading incorrectly once the engine warms up, causing the ECM to retard timing

B. A fuel supply restriction that worsens as fuel demand continues — a partially clogged fuel filter or a weak transfer pump that can fill the fuel system during the 5-minute rest period but cannot maintain adequate supply under sustained demand, causing progressive fuel starvation

C. The turbocharger oil drain is partially restricted, and oil accumulates in the bearing housing over time until it leaks into the intake

D. The crankcase ventilation system is restricted, and crankcase pressure builds over the first 10 minutes until it prevents proper ring sealing

21. A technician is testing a diesel engine's fuel system and finds that the fuel return flow from one injector is significantly higher than the other five. What does excessive return flow from a single injector indicate?

- A. The affected injector has excessive internal leakage — fuel is bypassing the injection circuit and returning to the tank through the internal clearances of the worn injector, reducing the fuel available for injection and causing that cylinder to fire weakly or not at all
- B. The fuel rail pressure regulator is directing excess fuel to that injector's return line due to an internal valve bias
- C. The return line from that injector is a larger diameter than the others, naturally flowing more fuel volume
- D. The injector is performing correctly and the higher return flow indicates a more efficient fuel delivery cycle

22. A heavy-duty diesel engine's electronic control module stores a fault code for "Barometric Pressure Sensor — Reading Out of Range." The truck operates at various altitudes between sea level and 1,500 metres. What will the ECM do in response to this fault?

- A. The ECM will shut the engine down immediately because accurate barometric data is critical for safe operation
- B. The ECM will increase fuel delivery to maximum to compensate for the potentially reduced air density at altitude
- C. The ECM will lock the transmission in the lowest gear to prevent the engine from operating at high RPM without altitude correction
- D. The ECM will substitute a default barometric pressure value and may derate engine power as a protective measure — without accurate altitude data, the ECM cannot optimize the fuel-to-air ratio for the actual atmospheric conditions, risking either over-fueling or under-fueling

23. A technician is adjusting the overhead on a heavy-duty diesel engine and finds that the exhaust crosshead (bridge) on cylinder 4 does not sit level — one side is higher than the other when the valve lash is set. What must be corrected before completing the adjustment?

- A. The exhaust crosshead guide pin must be replaced because the uneven bridge indicates a worn guide that is tilting the bridge
- B. The exhaust valve stems must be measured for unequal length, which would explain the tilted crosshead position

C. The exhaust crosshead adjustment screw must be set first — the crosshead has an adjusting screw that contacts one valve stem and must be turned until the crosshead sits level and contacts both valve stems evenly before the valve lash is set on the rocker arm

D. The exhaust valve springs must be tested for unequal tension, which would prevent one valve from seating at the same height

24. A diesel engine is producing a rhythmic puffing noise from the air filter housing that corresponds to engine firing frequency. What is the most likely cause?

A. An intake valve that is not seating properly on one cylinder — during the compression stroke, the leaking intake valve allows compressed air to blow back into the intake manifold and air filter housing, producing the rhythmic puffing at the firing frequency

B. The turbocharger compressor wheel has a cracked blade that creates a pressure pulse with each revolution

C. The crankcase ventilation system is connected to the air filter housing and normal blow-by pulses are audible at the filter

D. The engine's firing order is creating a natural resonance in the intake manifold that amplifies at the air filter opening

25. A heavy-duty diesel engine has been recently overhauled. During the first 500 km of break-in, the technician notices that oil consumption is higher than expected. After 5,000 km, oil consumption returns to normal. What explains this pattern?

A. The replacement piston rings were defective and self-corrected during the break-in period through wear

B. The cylinder liner honing pattern was too aggressive and required machining correction at the first oil change

C. The replacement valve stem seals were installed incorrectly and reseated themselves during engine warm-up cycling

D. New piston rings and freshly honed cylinder liners require a break-in period for the rings to seat against the liner surface — during this period, the ring-to-liner seal is not yet optimal and some oil passes past the rings; as the rings seat into the liner's crosshatch pattern, the seal improves and oil consumption drops to normal

26. A technician notices that a diesel engine's coolant level drops gradually over two weeks, but there are no visible external leaks, no oil contamination, and no white exhaust smoke. Where is the coolant going?

A. The coolant is being consumed by the EGR cooler — a very small leak in the EGR cooler allows coolant to enter the exhaust stream in quantities too small to produce visible white smoke but sufficient to cause a measurable coolant level drop over time

B. A small internal coolant leak into the engine oil that is too dilute to change the oil's appearance visually

C. The coolant is evaporating from the overflow tank through a missing or damaged tank cap that does not hold pressure

D. The radiator core has microscopic leaks that weep coolant that evaporates before it can drip and form a visible puddle

27. A heavy-duty diesel engine equipped with a common rail fuel system has a diagnostic trouble code indicating "Fuel Rail Pressure Sensor — Voltage Below Normal." The engine runs but is in a severe derate. What is the most likely cause?

A. The fuel rail pressure is physically too low because the high-pressure pump has failed

B. The fuel rail has developed a leak that is reducing the actual pressure and the sensor is reading correctly

C. The fuel rail pressure sensor itself has failed or its wiring has a fault — the sensor circuit is producing a voltage signal below the expected range, which the ECM interprets as a sensor or circuit fault rather than an actual pressure problem; the ECM derates as a protective measure because it cannot trust the pressure data

D. The ECM has an internal fault on the analog input channel that reads the pressure sensor signal

28. A heavy-duty diesel engine's air compressor is gear-driven from the engine's timing gear train. During an engine overhaul, the technician notices that the compressor drive gear teeth show accelerated wear on the loaded face. What is the most likely cause?

A. The engine oil used in the timing gear train was the incorrect viscosity for the application's operating temperature

- B. The air compressor was operating with a restricted intake, causing it to work harder and load the drive gear more heavily
- C. The timing gear backlash between the compressor drive gear and its mating gear has been set too tight, causing the gears to bind and wear on the loaded faces from excessive contact pressure
- D. Normal gear wear from 500,000 km of operation that does not indicate any abnormal condition or maintenance issue

29. A diesel engine has been running on an incorrect fuel filter for 10,000 km. The incorrect filter has a 30-micron rating instead of the specified 5-micron rating. What damage may have occurred?

- A. The coarser filter allowed particles up to 30 microns to pass through to the injection system — these particles cause abrasive wear on the precision-machined surfaces of the high-pressure pump, injector plungers, and nozzle needles, accelerating wear and potentially causing premature failure of these components
- B. The 30-micron filter would have no measurable effect because modern diesel fuel contains particles smaller than 5 microns
- C. The coarser filter only affects the fuel transfer pump and has no impact on the high-pressure injection components
- D. The damage is limited to the fuel rail pressure sensor, which has a fine screen that would become contaminated

30. A technician discovers that the air governor on a heavy-duty truck has been adjusted to cut out at 135 psi instead of the standard 120-125 psi. What is the primary concern with this over-pressurized system?

- A. The higher pressure will cause the brake chambers to apply with excessive force, potentially locking the wheels
- B. The higher pressure will cause the air dryer purge cycle to activate too frequently, wasting compressed air
- C. The air compressor will cycle more frequently, reducing its service life from the increased duty cycle
- D. System components (hoses, fittings, valves, chambers, and the air dryer) are rated for the standard operating pressure range and may fail prematurely or catastrophically when subjected to pressures 10-15 psi above their design rating

31. A heavy-duty truck's air system has a condition where the compressor builds pressure to 90 psi and then pressure build-up slows dramatically, taking an additional 5 minutes to reach 100 psi. Below 90 psi, the build-up rate is normal. What is the most likely cause?

- A. The governor is partially activating the unloader mechanism at 90 psi due to a calibration error in the governor spring
- B. A system leak exists that becomes significant only at pressures above 90 psi — some leaks are pressure-dependent, only opening or becoming detectable when the system reaches a certain pressure that pushes past a marginal seal or fitting
- C. The air dryer desiccant is fully saturated and creates increasing restriction as system pressure rises above 90 psi
- D. The compressor's discharge valves are failing and cannot maintain compression above 90 psi effectively

32. A driver reports that the trailer brakes feel grabby — they apply very aggressively with minimal pedal effort. The tractor brakes feel normal. What is the most likely cause?

- A. The trailer's automatic slack adjusters have over-adjusted all trailer brake positions simultaneously
- B. The trailer's brake linings have been replaced with a higher-friction-coefficient material than the original specification
- C. The trailer's relay valve crack pressure is set too low, delivering full system pressure to the trailer brake chambers with minimal signal pressure from the foot valve — this creates a disproportionate trailer brake response relative to the pedal effort
- D. The trailer ABS system is malfunctioning and applying excessive pressure to compensate for a detected wheel speed fault

33. A technician is performing a spring brake parking test. With the spring brakes applied and the engine running at idle, the technician attempts to move the truck in first gear. The truck should remain stationary. However, the truck slowly creeps forward against the spring brakes. What does this indicate?

- A. The rear brake shoes and drums are worn beyond specification, reducing the spring brakes' mechanical advantage to a level insufficient to hold the vehicle against the engine's torque in first gear — the spring brake mechanisms may be applying full force, but the worn foundation brake components cannot convert that force into adequate holding friction

- B. The spring brake power springs have weakened from age and no longer apply sufficient force to hold the vehicle
- C. The engine idle speed is set too high and is overwhelming the spring brake's holding capacity at the elevated torque output
- D. The parking brake valve is not fully exhausting the spring brake hold-off air, leaving residual pressure that partially compresses the springs

34. A heavy-duty truck equipped with electronic stability control (ESC) has a condition where the ESC activates during normal highway lane changes that do not seem aggressive to the driver. The ESC warning lamp flashes during these events. What should be investigated?

- A. The ESC module software version, which may need updating to reduce the system's sensitivity threshold
- B. The steering wheel position sensor calibration, which if miscalibrated would cause the ESC to perceive normal steering inputs as emergency maneuvers
- C. The tire pressures and load distribution, which if significantly different from the vehicle's design parameters could make the vehicle genuinely less stable than the driver perceives
- D. The yaw rate sensor, steering angle sensor, and lateral accelerometer for calibration errors — if any of these sensors are miscalibrated, the ESC system perceives a stability condition that differs from reality and intervenes at inappropriate times

35. A transit bus equipped with hydraulic disc brakes and ABS has a pulsating brake pedal during normal stops on dry pavement. The ABS warning lamp is not illuminated. What is the most likely cause?

- A. The ABS system is activating when it should not, causing the pedal pulsation through the ABS modulator cycling
- B. A brake rotor with excessive lateral runout or thickness variation is pushing the caliper piston back during each rotation, creating a pulsation that the driver feels through the hydraulic brake pedal
- C. The master cylinder has an internal bypass that creates a rhythmic pressure fluctuation during pedal application
- D. The power brake booster diaphragm has a pinhole leak that allows vacuum to fluctuate during braking

36. A technician is diagnosing an air brake system that has adequate pressure but poor braking performance on all wheel positions. The pushrod strokes are all within specification. The drums are not oversized. What should be checked?

A. The brake lining material, which may be oil-contaminated from a system-wide air compressor oil carryover problem

B. The relay valves for internal restrictions that are reducing the volume of air delivered to the brake chambers

C. The brake lining material's coefficient of friction — if the shoes have been replaced with non-OEM linings that have a lower friction coefficient, or if the linings have become glazed from overheating, the reduced friction produces weak braking even though the mechanical adjustment is correct and adequate air pressure is applied

D. The ABS system, which may be limiting brake pressure to all wheel positions due to a system-wide fault

37. A heavy-duty truck has a condition where the front brakes drag after the service brakes are released. The pushrod on each front brake chamber returns to its fully retracted position when the brakes are released. What is the most likely cause?

A. The front brake shoe return springs have weakened or broken, preventing the shoes from fully retracting from the drum when the S-cam rotates back to the released position — even though the pushrod retracts, the shoes themselves do not pull away from the drum without adequate return spring force

B. The front brake relay valve is holding residual pressure in the front brake line after the foot valve is released

C. The front S-cam bushings are seized, preventing the cam from rotating to the released position

D. The ABS modulator on the front axle is maintaining a small amount of application pressure after the brake release

38. A tractor-trailer combination has a condition where applying the trailer hand valve (trolley valve) produces normal trailer braking, but applying the foot valve produces no trailer braking at all. The tractor brakes work normally with the foot valve. What is the most likely cause?

- A. The trailer ABS module is blocking the service brake signal from the foot valve but allowing the hand valve signal to pass
- B. The trailer's relay valve has failed and is not responding to any brake application signal
- C. The trailer's spring brake valve is intercepting the foot valve signal and diverting it to the spring brake circuit
- D. The tractor's foot valve secondary circuit (which feeds the trailer service line through the tractor protection valve) has a failed piston or seal that cannot generate signal pressure for the trailer — the trolley valve bypasses the foot valve's secondary circuit and sends its signal through a different path to the trailer, which is why it works

39. A heavy-duty truck's brake chambers on the rear drive axle are all Type 30/30. The technician replaces one chamber with a Type 24/30 from the parts inventory because the correct Type 30/30 is not available. What is the consequence of this mismatched installation?

- A. The Type 24/30 is compatible with the Type 30/30 and will function identically in all operating conditions
- B. The Type 24/30 has a smaller service-side diaphragm (24 square inches vs 30 square inches), producing less braking force on that wheel during service brake applications — this creates a brake imbalance that causes the vehicle to pull away from the under-braked wheel during stops
- C. The Type 24/30 has a larger spring brake section that will produce excessive parking brake force on that wheel
- D. The mismatched chamber will not physically mount on the bracket because the mounting bolt pattern differs between sizes

40. A technician is testing the air brake system and discovers that the compressor unloads properly at the correct cut-out pressure, but the air dryer does not purge. The technician traces the governor signal line to the air dryer and finds that it is connected to the wrong port on the dryer. What is the consequence of this incorrect connection?

- A. The air dryer operates in reverse, pushing moisture back into the compressor discharge line
- B. The purge cycle activates during the compressor's loading cycle instead of the unloading cycle, wasting the purge air

C. The air dryer purge cycle cannot activate because the governor signal is not reaching the purge valve through the correct internal passage — the desiccant is never regenerated, and moisture passes through the saturated desiccant to the downstream reservoirs

D. The incorrect port connection has no effect on dryer function because all ports connect to the same internal chamber

41. A school bus equipped with hydraulic disc brakes has a condition where the brake pedal sinks slowly to the floor when held at a constant pressure during a stop. The fluid level is correct and no external leaks are visible. What is the most likely cause?

A. The master cylinder has an internal seal leak — the primary piston seal is allowing fluid to bypass past the piston under sustained pressure, causing the pedal to slowly sink; when the pedal is released and re-applied, the seal momentarily re-seats and the pedal feels firm initially

B. The brake pads are compressing under the sustained clamping force, allowing the caliper pistons to advance further

C. The ABS modulator has an internal valve that slowly bleeds pressure during sustained applications

D. Air trapped in the hydraulic system is slowly compressing under the sustained pedal pressure

42. During a brake inspection on a drive axle, a technician finds that both brake drums on the tandem rear axle show a deep, continuous groove scored into the friction surface. The groove runs around the entire circumference at the center of the shoe contact area. What caused this groove?

A. A foreign object (such as a bolt, stone, or piece of debris) became trapped between the brake shoe and drum during normal operation

B. The brake shoes were installed with the lining bonding rivets exposed above the lining surface

C. The automatic slack adjuster over-adjusted the brakes, causing the shoe edge to dig into the drum surface

D. The brake shoe lining has worn through to the rivets or the steel shoe table at one point, and the exposed metal has been scoring the drum as the wheel rotates — the groove runs at the contact point where the lining wore through first

43. A tractor-trailer combination has passed all static air system tests (build-up time, pressure drop with brakes applied, pressure drop without brakes applied). However, during a road test, the driver reports

that the brakes feel different from normal — the pedal travel is longer and the braking force feels reduced compared to the last trip. What should the technician investigate?

- A. The brake shoe or pad lining thickness across all wheel positions, including the trailer
- B. The brake drums or rotors for dimensional changes from heat that would have occurred since the static test was performed
- C. The tire pressures, which if low would require more braking force to decelerate the vehicle at the same rate
- D. The governor cut-out pressure, which may have dropped since the last trip and is reducing the available application pressure

44. A heavy-duty truck's air brake system has a condition where the dash-mounted air pressure gauge for the primary circuit fluctuates rapidly — the needle oscillates 5-10 psi above and below the actual pressure. The secondary circuit gauge is steady. What is the most likely cause?

- A. The primary circuit relay valve is chattering, causing pressure fluctuations that the gauge is displaying
- B. The compressor is producing pulsating output that is only affecting the primary circuit due to a failed check valve
- C. The primary circuit gauge sender or the line connecting the sender to the primary circuit has a loose connection, air leak, or restriction that causes the sender to receive an unstable pressure signal — since the secondary gauge is steady, the air system itself is stable and the fault is in the gauge circuit
- D. The governor is rapidly cycling the compressor between loaded and unloaded states, but only the primary gauge is sensitive enough to display the fluctuation

45. A technician replaces the air compressor on a heavy-duty truck. After installation, the compressor builds pressure normally but produces a loud knocking noise. The compressor is new and was verified as the correct part number. What is the most likely cause of the noise?

- A. The timing gear alignment between the compressor drive gear and the engine's gear train is incorrect — misaligned gears produce a knocking or grinding noise as the teeth mesh improperly, and the misalignment may also accelerate wear on both gears
- B. The new compressor has a manufacturing defect in its crankshaft that will self-correct during the break-in period

C. The compressor mounting bolts were not torqued to specification, allowing the compressor to shift position during operation

D. The compressor's discharge line has a restriction that is causing the compressed air to hammer back against the discharge valve

46. A transit bus has an air-over-hydraulic brake system. The bus has adequate air pressure but the brake pedal effort is high and braking force is reduced. What component should be inspected?

A. The air brake relay valve that supplies pressure to the hydraulic master cylinder booster

B. The ABS modulator, which may be restricting hydraulic pressure to the calipers during every application

C. The brake caliper slide pins, which if seized would prevent the calipers from applying evenly

D. The air-over-hydraulic booster (the component that converts air pressure into hydraulic force to assist the master cylinder) — if the booster diaphragm is ruptured, the air line is leaking, or the booster control valve is stuck, the air assist is reduced or absent, requiring the driver to apply greater pedal effort for the same braking force

47. A technician is testing a circuit with a 12-volt source, a 10-ohm resistor, and a 20-ohm resistor in series. What is the voltage drop across the 20-ohm resistor?

A. 12 volts

B. 8 volts — in a series circuit, voltage drops proportionally across each resistor according to its share of the total resistance; the 20-ohm resistor carries $20/30$ (two-thirds) of the total 30 ohms, so it drops $2/3 \times 12V = 8$ volts

C. 4 volts

D. 6 volts

48. A heavy-duty truck has two batteries connected in series for a 24-volt starting system, with a series-parallel switch that connects them in parallel for the 12-volt charging and accessory systems. The series-parallel switch fails in the series position. What is the consequence?

A. The 12-volt accessories and lighting will receive 24 volts instead of 12 volts, potentially damaging or destroying bulbs, electronic modules, and other components rated for 12-volt operation

- B. The starter motor will not crank because it requires the parallel configuration for adequate cranking current
- C. The alternator will overcharge both batteries because it cannot regulate voltage in the series configuration
- D. The batteries will discharge unevenly because the series connection prevents the alternator from charging both batteries

49. A truck's ABS system has a fault code for "Left Rear Modulator Valve — Circuit Open." The ABS lamp is illuminated. What is the consequence for the driver?

- A. The left rear brake will not apply at all during any brake application because the modulator controls the air supply
- B. The left rear brake will be locked on continuously because the modulator defaults to the applied position when its circuit is open
- C. The left rear wheel loses anti-lock protection — the modulator cannot modulate (release and re-apply) the brake pressure on that wheel during a lockup event, so the foundation brake applies normally but has no ABS protection; the rest of the ABS system continues to function on the other wheels
- D. All four wheels lose ABS protection because a single modulator fault disables the entire ABS system

50. A technician is diagnosing an intermittent starting problem on a heavy-duty truck. Sometimes the starter cranks normally; other times there is no crank and no click. When the problem occurs, battery voltage at the starter solenoid S terminal reads 0 volts. What should be investigated?

- A. The starter motor brushes, which may be intermittently contacting the commutator
- B. The starter solenoid internal contacts, which may be intermittently failing to close under load
- C. The battery terminals, which may be loose and intermittently losing contact under vibration
- D. The starting circuit control path — the ignition switch, the neutral safety switch, and the wiring between them and the solenoid S terminal; 0 volts at the S terminal means the control signal is not reaching the solenoid, and the break is somewhere in the path from the ignition switch through the safety interlocks to the solenoid coil

51. A truck equipped with LED tail lights draws significantly less current than a truck with incandescent tail lights. What concern does this reduced current draw create for the turn signal flasher?

- A. The flasher may not work at all because it cannot detect the LED's current draw
- B. A conventional thermal flasher may flash at an abnormally fast rate (or not at all) because it relies on the current draw of the incandescent bulbs to heat and cool its bimetallic strip — the lower current draw of LEDs does not generate enough heat to cycle the flasher at the correct rate
- C. The LEDs will flicker at high frequency due to the flasher's incompatible output waveform
- D. The reduced current will cause the flasher to overheat because it dissipates the unused energy as heat

52. A heavy-duty truck's CAN bus has been repaired after a backbone wire was accidentally cut during a frame modification. The repair was made by splicing the wire with a crimp connector. After the repair, intermittent communication faults appear on multiple modules. What is the most likely cause?

- A. The crimp splice has introduced an impedance mismatch on the CAN bus — the CAN bus is a controlled-impedance communication line, and a splice that changes the wire's characteristic impedance creates signal reflections that corrupt data, causing intermittent communication errors across the bus
- B. The crimp connector is creating a voltage drop that reduces the CAN signal amplitude below the detection threshold
- C. The splice location is too close to a terminating resistor, which amplifies the splice's resistance in the termination measurement
- D. The crimp connector is galvanically incompatible with the copper CAN bus wire, creating a corrosion cell at the splice

53. A technician measures the voltage at a headlight socket and reads 14.0 volts with the engine running and the lights on. The headlight bulb is dim compared to the other side, which also reads 14.0 volts at the socket. Both bulbs are the same type. What is the most likely cause?

- A. The alternator is producing inconsistent voltage between the left and right output circuits
- B. The dim bulb has internal resistance from a partially broken filament — the bulb receives full voltage but draws less current through the compromised filament, producing less heat and less light; voltage at the socket is normal because the bulb's reduced current draw eliminates the voltage drop that would occur with a healthy, higher-current bulb
- C. The headlight switch has a higher resistance on the dim side that is not detectable by a voltage measurement
- D. The dim side's ground connection has excessive resistance that reduces the current flow through the bulb

54. A heavy-duty truck has a condition where the instrument cluster displays all zeroes on the digital readouts and the analog gauges rest at their minimum positions. The engine runs normally. The technician connects a scan tool and communicates normally with all modules. What is the most likely cause?

- A. The CAN bus backbone has a fault that affects the instrument cluster's data feed but not the scan tool's communication
- B. The engine ECM is not broadcasting the gauge data on the J1939 bus because of an internal fault
- C. The alternator has a voltage regulation fault that is causing the instrument cluster to enter a low-power mode
- D. The instrument cluster itself has an internal fault — the cluster receives data from the CAN bus (confirmed by the scan tool's ability to communicate with all modules) but cannot process or display the data due to an internal electronics failure

55. A truck's electric cooling fan runs continuously at full speed regardless of engine temperature. The engine temperature is normal. The A/C is not running. What is the most likely cause?

- A. The fan relay has welded contacts that keep the fan circuit permanently energized regardless of the ECM's command
- B. The coolant temperature sensor is reading higher than actual, causing the ECM to command the fan continuously
- C. The fan motor has an internal short that bypasses the relay and control circuit entirely
- D. The ECM has defaulted the fan to continuous operation as a protective response to a detected fault — either a coolant temperature sensor fault, a fan control relay fault, or an internal ECM output driver fault that causes the ECM to command the fan on permanently as a safe-mode strategy

56. A technician is diagnosing a truck that has a battery drain of 2 amps with the vehicle fully shut down. The technician cannot locate the drain using the fuse-pull method because removing each fuse individually does not significantly reduce the draw. What is the most likely explanation?

- A. The drain is caused by an internal battery defect that creates a self-discharge path that mimics an external parasitic draw
- B. The drain is in a circuit that is not protected by a fuse — unfused circuits such as the alternator output, the starter solenoid, or a direct-wired aftermarket accessory bypass the fuse panel entirely

C. The drain is distributed equally across all fuses and removing any single fuse only reduces the draw by a small amount

D. The ammeter is malfunctioning and displaying a phantom 2-amp reading that does not represent an actual current draw

57. A truck has an aftermarket auxiliary battery installed for a sleeper berth inverter. The auxiliary battery drains overnight even though the inverter is turned off. The main batteries remain charged. What is the most likely cause?

A. The inverter draws a standby current even when turned off, gradually draining the auxiliary battery over the parking period

B. The auxiliary battery has a phantom current path through the inverter's power cable — even with the inverter "off," the cable connecting the auxiliary battery to the inverter passes through a junction box where a parasitic path (corroded terminal, pinched wire, or unintended ground) allows current to drain the battery independently of the inverter's switch

C. The auxiliary battery is defective and has an internal self-discharge rate much higher than a healthy battery

D. The main batteries are drawing current from the auxiliary battery through the battery isolator relay's reverse leakage

58. A heavy-duty truck has a condition where the windshield wipers operate at full speed for approximately 10 seconds after the ignition is turned off, then stop. What is the most likely cause?

A. The wiper motor's internal thermal protector is resetting after the ignition is turned off and momentarily powers the motor

B. The wiper module is damaged and sends a random speed signal during shutdown

C. The ignition switch has a faulty accessory position that maintains power to the wiper circuit during the shutdown transition

D. The wiper system's park function is completing its cycle — the wiper motor continues to operate after the switch is turned off until the blades reach their parked (home) position at the base of the windshield; this is normal operation and ensures the wipers always return to the parked position before stopping

59. A technician is installing a new electronic module on a heavy-duty truck. The installation instructions specify connecting to a "switched ignition" power source. What does "switched ignition" mean?

A. A power source that is only energized when the ignition key is in the ON or RUN position, and is de-energized when the key is OFF — this ensures the module only receives power when the vehicle is in operation and does not drain the battery during extended parking

B. A power source that alternates between battery voltage and ground at a specific frequency for module communication

C. A power source that is always energized directly from the battery regardless of key position for continuous module operation

D. A power source that provides a reduced voltage (6 volts) during ignition ON for module initialization purposes

60. A truck's left headlight has a noticeably different (yellowish) color than the right headlight, even though both bulbs are the same part number and were installed at the same time. What is the most likely cause?

A. The left headlight lens has UV degradation that is filtering the light and shifting its color toward yellow

B. The left headlight reflector has tarnished internally, changing the reflected light spectrum toward the warmer end

C. The left headlight circuit has excessive voltage drop in the power or ground path — the reduced voltage causes the halogen filament to burn at a lower temperature, producing a yellowish, dimmer light; a filament at full voltage glows white-hot, but at reduced voltage it glows at a lower temperature that shifts the color toward yellow

D. The bulb manufacturer produced a batch with different gas fills that produce different color temperatures

61. A heavy-duty truck's electronic throttle pedal (accelerator position sensor) has a fault code for "Pedal Position Sensor 1 and Sensor 2 — Correlation Error." The engine idles normally but will not respond to throttle input. Why does the ECM disable throttle response?

- A. The ECM requires both sensors to agree within a specified tolerance — if the two sensors disagree, the ECM cannot determine the driver's actual throttle intent and defaults to idle as a safety measure
- B. The ECM uses the correlation between the two sensors to calculate engine torque, and without this calculation it cannot inject fuel
- C. The two sensors must produce opposite signals (one increases while the other decreases) and a correlation error means both are increasing together, indicating a stuck throttle condition
- D. The ECM is protecting the throttle pedal's mechanical linkage from damage that would occur if only one sensor were used for control

62. A technician is troubleshooting a truck that has intermittent ABS faults. The fault codes point to multiple wheel speed sensors losing signal simultaneously. The sensors and reluctor rings have been inspected and are in good condition. What should be investigated?

- A. The wheel bearings on all affected axle positions for excessive play that could affect reluctor ring position
- B. The tire sizes on the affected axle positions for mismatched diameters that produce conflicting speed signals
- C. The ABS module power supply and ground connections for intermittent contact that causes the module to momentarily lose power
- D. The ABS module's shared wiring harness or connector — if multiple sensor signals travel through the same harness and connector, a fault in the common harness or connector can affect all sensors simultaneously, producing multi-sensor fault codes that appear to be individual sensor failures

63. A truck's back-up camera image appears washed out and nearly white during daytime operation. The camera worked normally when it was installed six months ago. What is the most likely cause?

- A. The camera's internal image processor has failed and is overexposing every frame regardless of ambient light
- B. The camera lens has oxidized or hazed from UV exposure, producing a diffused, washed-out image
- C. The camera lens is dirty or fogged — road spray residue, mineral deposits, or internal moisture condensation on the lens scatters the incoming light and produces the washed-out, overexposed appearance
- D. The video cable has a partial short that is adding a DC offset to the video signal, elevating the image brightness

64. A heavy-duty truck equipped with a telematics system has a condition where the telematics unit reports the vehicle's location as 500 metres from its actual position. The position error is consistent and repeatable at this location. What is the most likely cause?

- A. GPS multipath interference — the GPS signals are bouncing off nearby tall buildings, elevated highways, or other large structures before reaching the telematics antenna, and the reflected signals travel a longer path than the direct signals, causing the receiver to calculate an incorrect position
- B. The telematics unit's GPS antenna has been damaged and is receiving signals at reduced strength
- C. The vehicle's battery voltage is too low for the telematics unit to process GPS signals accurately
- D. The telematics unit's firmware has a mapping database error that offsets the position by a fixed amount

65. A truck equipped with a multiplexed (CAN-controlled) lighting system has a condition where the left rear marker light stays illuminated when all lights should be off. The body controller module (BCM) shows no active output command for that circuit. What does this indicate?

- A. The BCM's internal power transistor for the left rear marker circuit has failed in the shorted (on) condition
- B. The CAN bus is sending a phantom command to the marker light circuit from another module's interference
- C. The marker light circuit has a wiring fault that is bypassing the BCM's control entirely
- D. The BCM's output driver for the left rear marker circuit has failed in the conducting (short-to-power) state, keeping the circuit energized regardless of the BCM's software command — the hardware has failed independently of the software

66. A heavy-duty truck has a condition where the hour meter on the instrument cluster shows significantly more hours than the odometer would suggest for the vehicle's typical speed profile. What operating pattern would explain this discrepancy?

- A. The hour meter is defective and counting at double the actual rate due to a programming error
- B. The vehicle spends a significant amount of time idling — the hour meter counts all engine-running time regardless of whether the vehicle is moving, while the odometer only counts distance traveled; extended idling (overnight PTO operation, delivery stops, traffic congestion) accumulates hours without adding miles

- C. The odometer has been tampered with and is reading lower than the actual distance traveled
- D. The speed sensor is reading higher than actual, causing the odometer to advance faster than the hour meter

67. A technician discovers that a truck's aftermarket radio is causing a whining noise through the speakers that changes pitch with engine RPM. The noise is not present when the engine is off but the radio is on (accessory position). What is the most likely cause?

- A. The radio's internal amplifier is picking up the alternator's field coil magnetic pulses through the radio's chassis
- B. The radio speakers are defective and vibrating at the engine's firing frequency
- C. The aftermarket radio's power or ground wire is routed near the alternator output cable or another source of electrical noise, and the alternator's AC ripple is being induced onto the radio's power supply, producing the RPM-proportional whine through the speakers
- D. The radio's antenna cable has a broken shield conductor that allows engine compartment EMI to enter the signal path

68. A truck's scan tool retrieves an active fault code from the engine ECM for "Accelerator Pedal Position — Below Normal Operating Range." The engine runs at idle speed and does not respond to pedal input. What physical condition would produce this fault?

- A. The accelerator pedal position sensor's signal wire is open or shorted to ground, sending the ECM a voltage signal that is below the minimum expected range for any pedal position — the ECM interprets this as a sensor circuit failure rather than an actual pedal position and defaults to idle as a protective measure
- B. The accelerator pedal return spring has broken, allowing the pedal to rest below its normal minimum stop position
- C. The throttle body (if equipped) is stuck in the closed position, creating a pressure feedback that the pedal sensor detects
- D. The ECM's internal analog-to-digital converter is malfunctioning on the channel that reads the pedal position sensor

69. A heavy-duty truck equipped with a pull-type clutch has a condition where the release bearing is noisy — a grinding or growling sound is heard whenever the clutch pedal is depressed. The noise stops when the pedal is released. What does this indicate?

- A. The clutch disc torsional damper springs have broken and are rattling inside the hub assembly
- B. The flywheel pilot bearing is dry and produces noise when the input shaft rotates inside it during clutch release
- C. The pressure plate's diaphragm spring fingers are worn at the release bearing contact points from normal use
- D. The release (throw-out) bearing has failed — it is dry, worn, or damaged, and the grinding noise occurs when the bearing rotates under load against the pressure plate's release mechanism; when the pedal is released, the bearing lifts off the pressure plate and the noise stops

70. A heavy-duty truck with a 10-speed manual transmission and a single-plate dry clutch has a clutch that engages very close to the top of the pedal travel — the pedal must be released almost completely before the clutch begins to engage. What does this engagement point indicate?

- A. The clutch linkage has excessive free play that is consuming too much of the pedal travel before the release mechanism begins to act
- B. The clutch disc is worn thin — as the friction facing wears, the pressure plate moves closer to the flywheel, and the release bearing must travel further to disengage the clutch; this pushes the engagement point higher in the pedal travel because less pedal movement is needed to fully release the worn disc
- C. The clutch master cylinder has air in the hydraulic line that is delaying the engagement response
- D. The pressure plate springs have weakened from heat cycling and are clamping too early in the release bearing's travel

71. A technician performs an Allison automatic transmission fluid check using the scan tool's fluid level procedure. The scan tool indicates the fluid is 2 quarts overfull. What is the consequence of operating the transmission with an overfull condition?

- A. The excessive fluid level causes the planetary gear sets to churn through the fluid, creating aeration (foaming), elevated fluid temperature, and potential seal damage from the increased internal pressure — foamed fluid is compressible and can cause erratic shift quality and clutch slippage

- B. The overfull condition has no consequence because the excess fluid will be expelled through the transmission vent
- C. The excess fluid will be absorbed by the transmission filter, gradually returning the level to normal
- D. The overfull condition only affects the lockup clutch engagement timing and has no effect on the planetary gear operation

72. A heavy-duty truck's driveshaft has been replaced with a new unit. After installation, the technician notices that the rear U-joint operating angle is 5 degrees and the front U-joint operating angle is 1 degree. What must be corrected?

- A. The rear U-joint angle must be reduced to match the front angle within approximately one degree
- B. The front U-joint angle must be increased to match the rear angle within approximately one degree
- C. The U-joint operating angles must be equalized — the 4-degree difference between front and rear will produce a vibration at twice per driveshaft revolution; the angles must be brought within approximately 1 degree of each other by adjusting the transmission mount angle, carrier bearing height, or rear axle pinion angle
- D. The total of both angles must equal 6 degrees, and the current 5+1 configuration already meets this requirement

73. A heavy-duty truck equipped with a differential lock has a condition where the lock will not disengage after being engaged for several kilometres on a paved road. The dash indicator shows the lock is still engaged. What is the most likely cause?

- A. The lock engagement solenoid has failed in the energized position, maintaining air pressure to the lock actuator
- B. The lock mechanism's electrical circuit has a short that keeps the solenoid energized after the switch is turned off
- C. The diff lock disengagement sequence requires the driver to shift the transmission to neutral before disengaging the lock
- D. The differential lock's shift collar is mechanically bound by driveline torque — the collar cannot slide to the disengaged position because the front and rear axle shafts are under load from the torque difference created by driving on a paved surface with the lock engaged; momentarily lifting the throttle or stopping the vehicle relieves the torque and allows the collar to disengage

74. A truck equipped with an Allison automatic transmission has a condition where the transmission shifts normally when the fluid is cold but begins to slip in 3rd and 4th gear as the fluid reaches operating temperature. No fault codes are present. What is the most likely cause?

- A. The fluid viscosity decreases as it heats, and the clutch packs have worn to the point where the thinner fluid can no longer maintain adequate clamping force — at cold temperature the thicker fluid supplements the worn clutch pack's clamping; at operating temperature the fluid thins and the worn clutch surfaces cannot hold
- B. The clutch packs for 3rd and 4th gear expand thermally and release clamping pressure as they heat up
- C. The torque converter stator one-way clutch begins to slip at operating temperature due to thermal expansion
- D. The transmission oil cooler is undersized and cannot maintain fluid temperature within the optimal viscosity range

75. A technician is checking a driveshaft for runout using a dial indicator. The maximum allowable runout is 0.010 inches. The measured runout is 0.025 inches. What is the consequence of this excessive runout?

- A. The driveshaft will produce a speed-proportional vibration because the shaft's center of mass does not coincide with its rotational axis — the runout creates an imbalance that produces a vibration at once per revolution that increases in intensity with driveshaft speed
- B. The excessive runout will cause the driveshaft to rub against the frame during full suspension travel
- C. The U-joint bearing caps will wear unevenly because the runout changes the effective operating angle at each revolution
- D. The transmission output seal will leak from the oscillating motion of the slip yoke caused by the shaft runout

76. A truck's transfer case produces a whining noise that is present in 4WD but not in 2WD. The noise increases with vehicle speed. What is the most likely cause?

- A. The transfer case fluid is low, and the 4WD gear set does not receive adequate lubrication because it is positioned higher than the 2WD gears inside the case
- B. The front driveshaft U-joints are dry and produce noise only when loaded in the 4WD configuration

C. The transfer case's 4WD gear set or chain is worn — these components are only loaded when 4WD is engaged, and the wear produces noise under the driving load that is absent when the components are unloaded in 2WD mode

D. The front axle differential bearings are worn and transmit noise through the driveshaft only when the 4WD system connects the front axle to the transfer case

77. A heavy-duty truck's automatic transmission has a fault code for "Turbine Speed Sensor — No Signal." The transmission defaults to one gear and will not shift. Why does the TCM lock the transmission in one gear without this sensor?

A. The turbine speed sensor provides the TCM with the input shaft speed data — without it, the TCM cannot calculate the speed ratio between input and output, which is essential for determining slip, timing shifts, and controlling clutch engagement pressure; the TCM defaults to a single gear as a safe limp-home mode

B. The turbine speed sensor controls the torque converter lockup clutch engagement and without it the converter overheats

C. The turbine speed sensor provides the vehicle speed signal and without it the TCM cannot determine road speed

D. The turbine speed sensor controls the main pressure regulator and without it the line pressure drops to zero

78. A fleet technician notices that one truck in the fleet consistently wears through clutch discs faster than identical trucks on the same routes. The clutch adjustment and hydraulic system are correctly maintained. What operator behavior most commonly causes premature clutch wear?

A. The driver is resting their foot on the clutch pedal during driving, maintaining light pressure on the release bearing that partially disengages the clutch — even slight release bearing contact causes the disc to slip continuously under load, generating heat and accelerating facing wear

B. The driver is using the engine brake on every downhill grade, which creates reverse torque through the clutch

C. The driver is selecting gears that are too high for the load, which increases the torque multiplication at the clutch

D. The driver is using the cruise control on hilly terrain, which causes frequent clutch engagement cycling

79. A bus equipped with an automatic transmission has a condition where the transmission will not shift into reverse. All forward gears function normally. The scan tool shows no fault codes. What should the technician check?

- A. The engine's idle speed, which if too high could prevent the reverse clutch from engaging smoothly
- B. The transmission's valve body and reverse servo — a stuck manual valve, a faulty reverse servo, or a restricted reverse apply circuit can prevent the reverse clutch from applying even though the forward circuits function normally
- C. The neutral safety switch for a misadjusted neutral position that does not align with the reverse gate
- D. The torque converter one-way clutch for a seized condition that prevents the fluid coupling from working in reverse

80. A technician is replacing a clutch on a heavy-duty truck and finds deep heat cracks (a network of deep surface cracks) on the flywheel friction surface. The flywheel also has visible blue heat discoloration. Can the flywheel be resurfaced and reused?

- A. The flywheel can be resurfaced if the machine shop removes all visible cracks and the remaining thickness is above minimum
- B. The flywheel should be replaced — deep heat cracks and blue discoloration indicate that the flywheel has been severely overheated, altering its metallurgical properties (hardness and temper); resurfacing removes surface material but does not restore the original metallurgy, and the weakened material is prone to cracking again under the thermal stress of normal clutch operation
- C. The flywheel can be resurfaced and then heat-treated by the machine shop to restore its original properties
- D. The heat cracks are cosmetic and will not affect the flywheel's function with a new clutch disc installed

81. What is the purpose of the synchronizer's blocker ring (balk ring) in a synchronized manual transmission?

- A. The blocker ring physically prevents the sliding sleeve from advancing until the speed of the selected gear matches the mainshaft speed — the ring's tapered friction surface contacts the gear's cone to equalize speeds, and the ring's indexing teeth block the sleeve from passing until the speeds match

- B. The blocker ring locks the gear to the mainshaft after engagement to prevent the gear from spinning free
- C. The blocker ring limits the shift fork's travel to prevent overshooting the gear engagement position
- D. The blocker ring absorbs the impact of gear engagement to reduce noise and vibration during the shift

82. A heavy-duty truck with a tandem drive axle has a condition where the vehicle makes a clunking noise only when the inter-axle differential lock is engaged and the vehicle starts from a complete stop. What is the most likely cause?

- A. The lock engagement teeth are damaged from previous attempts to engage the lock while the vehicle was moving
- B. The inter-axle differential lock engagement collar has worn splines that have developed free play — when torque is applied from a stop, the worn splines take up the free play with a clunk before transmitting torque to the locked axles
- C. The transfer case output bearing is worn and shifts position when the lock changes the torque distribution
- D. The rear driveshaft has a worn slip yoke that clunks when the locked differential applies sudden torque from a standing start

83. A truck's PTO-driven hydraulic pump produces adequate pressure but the hydraulic functions operate at approximately half their normal speed. The PTO engages and the pump turns. The engine RPM is at the correct operating speed for PTO work. What should the technician investigate?

- A. The hydraulic pump for internal wear that has reduced its volumetric efficiency — a worn pump can still reach the relief valve's pressure setting but cannot deliver the full flow rate, causing the actuators to move at reduced speed
- B. The PTO engagement mechanism for partial engagement that slows the pump's rotational speed below the engine's PTO drive ratio
- C. The hydraulic cylinders for oversized bore diameters that require more fluid volume than the pump can supply at the correct engine RPM
- D. The hydraulic control valve for a stuck pressure compensator that is dumping excess flow to the tank

84. A heavy-duty truck equipped with a two-speed rear axle has a condition where the axle will not shift from low range to high range. The dash switch activates and the indicator lamp shows high range selected, but the axle remains in low range. What is the most likely cause?

A. The two-speed axle shift motor or air actuator is not receiving the electrical signal or air supply needed to physically move the shift mechanism inside the axle — the switch and lamp circuit functions independently of the actuator circuit, so the indicator can show the selected range while the mechanical shift does not occur

B. The vehicle speed is too high for the axle to complete the range shift and the shift mechanism has a speed-limiting lockout

C. The rear axle lubricant is too thick for the ambient temperature and is preventing the shift mechanism from moving

D. The two-speed axle's electronic control module requires a vehicle speed signal that it is not receiving

85. What is the consequence of operating a manual transmission with a lubricant that is significantly below the specified viscosity grade?

A. The transmission will shift more smoothly due to the lower viscosity reducing the drag on the synchronizers

B. The lower viscosity improves heat dissipation and extends the life of the gear teeth and bearings

C. The lubricant will foam excessively inside the transmission due to the higher RPM agitation of the thinner fluid

D. The lubricant film between the gear teeth and bearing surfaces will be too thin to prevent metal-to-metal contact under load, causing accelerated wear, pitting, and potential failure of the gears and bearings

86. A heavy-duty truck has a condition where the steering requires excessive effort to turn left but turns right with normal effort. The power steering fluid level is correct. What is the most likely cause?

A. The left steer tire is significantly underinflated compared to the right, requiring more force to turn left

B. The drag link has a bent section that binds at the extreme left turn position but clears during right turns

C. The power steering gear has an internal fault — a worn seal, a damaged spool valve, or a restricted passage on the left-turn hydraulic circuit inside the gear that reduces the hydraulic assist for left turns while the right-turn circuit functions normally

D. The left tie rod end is binding from corrosion, adding mechanical resistance to left turns only

87. A truck's steer axle has a positive caster setting of +5.0 degrees on both sides. The manufacturer's specification is +2.5 to +4.0 degrees. What symptom will excessive caster produce?

A. The steering will have increased returnability and stability but will require significantly more effort during low-speed turns because the increased caster angle tilts the steering axis further from vertical, increasing the mechanical advantage the driver must overcome to turn the wheels through the larger arc

B. The vehicle will wander at highway speed due to reduced directional stability from the excessive caster angle

C. The steer tires will wear rapidly on their outside edges from the increased camber effect of the excessive caster

D. The steering wheel will oscillate at highway speed because the excessive caster creates a resonance in the steering linkage

88. A heavy-duty truck has a condition where the right rear inside dual tire on the drive axle shows excessive wear on the inside edge while its outer dual partner shows normal wear. What is the most likely cause?

A. The right rear axle is bent, causing a toe or camber change on that wheel position only

B. The inside dual tire was mounted with incorrect inflation pressure when the truck was loaded

C. The drive axle housing is twisted from a previous overload event, changing the alignment of that wheel position

D. The inside tire of the dual pair has been running with significantly lower inflation pressure than the outer tire — the underinflated inner tire flexes excessively on its inside sidewall, concentrating wear on the inside edge while the properly inflated outer tire wears normally

89. A truck equipped with a power steering system has a condition where the steering wheel slowly drifts off-center during highway driving — the wheel gradually turns to the left over a period of 30 seconds even though the vehicle continues to track straight. What is the most likely cause?

- A. Unequal tire pressures between the left and right steer tires creating a gradual steering bias
- B. An internal leak in the power steering gear — fluid is slowly bypassing from one side of the steering gear's hydraulic circuit to the other, gradually moving the steering gear's output and the steering wheel off-center even though the road wheels remain straight because the steering linkage connection absorbs the slow movement
- C. The steering column bearing is worn, allowing the steering shaft to drift under gravity
- D. The power steering pump has inconsistent output that gradually biases the steering to one side

90. A truck with leaf spring suspension on the drive axles has a condition where one spring's center bolt has sheared. The spring is still assembled and the vehicle can be driven. What is the immediate risk?

- A. The sheared center bolt allows the axle to shift laterally on the spring seat — the spring leaves can no longer positively locate the axle, and any lateral force (from cornering, road crown, or wind) can shift the axle position, changing the wheelbase, tracking, and axle alignment on that side
- B. The spring will immediately disassemble and drop the leaves onto the road surface
- C. The vehicle will ride lower on the affected side due to the lost bolt reducing the spring's effective arch
- D. The U-bolts will loosen because the center bolt was providing the primary clamping force for the spring pack

91. A transit bus equipped with air ride suspension has a condition where the bus kneels (lowers) at the front door for passenger boarding but will not return to ride height after kneeling. The air system pressure is adequate. What should be investigated?

- A. The kneeling system is separate from the normal ride height control — it uses dedicated valves and controls
- B. The ride height control valves have failed and cannot add air to the front springs to raise the bus
- C. The bus's air suspension dump valve has been accidentally activated, preventing the system from pressurizing the springs
- D. The kneeling valve or kneeling control system — the kneeling function uses a dedicated valve that redirects air from the front suspension to lower the bus; if this valve sticks in the kneeling position, it continues to vent or bypass the front air springs and prevents the height control system from raising the bus back to ride height

92. A heavy-duty truck has both steer tires wearing evenly across the tread surface but at significantly different rates — the left tire has 50% more wear than the right tire after the same mileage. Inflation pressures are equal and alignment is within specification. What could explain the unequal wear rate?

- A. The tires are different brands or models with different tread compounds and wear rates, even though they are the same size designation
- B. The left tire was manufactured with a thinner tread layer than the right tire due to a factory quality variation
- C. The vehicle's routes involve predominantly right-hand turns, which load the left steer tire more heavily during cornering
- D. The left tire has been subjected to more heat from the brake on that side or from its proximity to an exhaust component

93. A heavy-duty truck's fifth wheel top plate shows a wear groove that extends from the throat to the back of the plate along the centerline. What operating condition causes this specific wear pattern?

- A. The trailer king pin is undersized and is rocking back and forth in the fifth wheel jaws during acceleration and braking
- B. Repeated coupling and uncoupling of the trailer — the king pin slides through the throat and across the plate each time the tractor backs under the trailer, and over thousands of coupling events, the king pin wears a groove along the path it travels from the throat to the locking position
- C. The fifth wheel plate lubricant has failed, allowing metal-to-metal contact between the plate and the trailer's upper coupler plate during normal articulation
- D. The trailer upper coupler plate has a burr or weld bead that is scoring the fifth wheel surface during normal trailer articulation

94. A truck equipped with hub-piloted aluminum wheels has a recurring problem of wheel studs cracking on one wheel position. The studs are the correct specification and the torque is verified. The technician has replaced studs three times on this position. What should be investigated that has not been checked?

- A. The hub flange and the wheel mounting surface for cracks, deformation, or debris that is preventing the wheel from seating flat — a warped hub flange or a damaged wheel mounting surface creates a bending moment on the studs with each wheel revolution that causes fatigue cracking

- B. The wheel nut type, which may be a two-piece flange nut that distributes force differently than a one-piece nut
- C. The brake drum weight on that position, which may be heavier than the other positions and creating additional stud loading
- D. The axle shaft end play, which if excessive allows the hub to oscillate and fatigue the studs

95. A trailer equipped with a spread tandem axle suspension (axles spaced farther apart than a standard tandem) has a condition where the tires on both axles are wearing on their inside edges. Inflation pressures are correct. What is the most likely cause?

- A. The suspension equalizer beam has worn bushings that are allowing both axles to toe outward
- B. The trailer frame has narrowed from a collision, pushing both axles' wheel positions inward
- C. The axle alignment has not been checked since the trailer was manufactured
- D. The tandem axle alignment is incorrect — one or both axles are not square with the trailer frame, creating a toe condition on both axles that produces inside-edge tire wear; spread tandem suspensions are particularly sensitive to alignment because the wider axle spacing amplifies any angular deviation into greater tire scrub over the longer distance between axle contact patches

96. A technician is checking a truck's front wheel bearings using the rocking method (12 and 6 o'clock). The technician detects more movement than expected. Before condemning the bearings, what other components should be checked to rule out false readings?

- A. The tire pressure, which if low could cause the tire sidewall to flex and simulate bearing play
- B. The king pin and bushings, the ball joints (if equipped), and the tie rod ends — worn king pin bushings allow the steering knuckle to move vertically, which can mimic bearing end play when the wheel is rocked at the 12 and 6 o'clock positions; the technician must stabilize or isolate the steering components before attributing the movement to the bearings
- C. The brake shoe return springs, which if broken could allow the shoes to shift and simulate hub movement
- D. The wheel lug nut torque, which if uneven could allow the wheel to rock on the hub independently of the bearings

97. A straight truck with a single rear drive axle has a condition where the vehicle dog-tracks — the rear axle follows a path that is offset approximately 25 mm to the right of the front axle's path. What is the most likely cause?

- A. The steer axle is bent, causing the front wheels to track left of the vehicle's true centerline
- B. The right rear tire is slightly larger in diameter than the left, pulling the rear axle to the right
- C. The rear axle is not perpendicular to the vehicle's frame — it is cocked slightly to one side due to a shifted leaf spring (broken center bolt), bent trailing arm, or misaligned suspension mounting hardware, causing the rear axle to steer the vehicle at an angle to its direction of travel
- D. The differential is biasing torque to the right wheel, pulling the rear of the vehicle to the right

98. A heavy-duty truck's tire pressure monitoring system (TPMS) indicates that one drive axle tire has dropped from 100 psi to 85 psi over the past 24 hours. The tire has no visible damage. What should the technician do?

- A. Reinflate the tire to 100 psi and monitor — if the pressure drops again, perform a thorough inspection including submerging the tire in water to identify the leak location, which may be at the valve stem, a bead seal, a puncture, or a cracked rim
- B. Replace the tire immediately since any pressure loss indicates a compromised tire structure
- C. Reset the TPMS sensor and continue operating — the sensor may have malfunctioned and reported an incorrect reading
- D. Switch the tire with the spare and bench-test the TPMS sensor for accuracy before investigating the tire

99. A truck's front suspension produces a squeaking noise during slow-speed driving over bumps. The noise stops when the vehicle is stationary. Lubrication of the king pins and spring shackles eliminates the noise temporarily, but it returns within a week. What does this pattern indicate?

- A. The lubricant type being used is incorrect for the application and breaks down within a week of application
- B. The king pin seals and spring shackle bushings are worn enough to expel grease quickly after lubrication

C. The noise is caused by dry leaf spring inter-leaf contact, which temporarily quiets when the spring movement distributes fresh grease from the shackle pins to the leaves but returns as the grease migrates away

D. The suspension components have worn to the point where the clearances are large enough to rapidly displace the applied grease during normal suspension articulation — the bushings and seals cannot retain the lubricant because the wear has enlarged the clearance between the pin and bushing beyond the seal's ability to contain the grease

100. A truck has a recurring problem of front tire blowouts on the right steer position. The tire pressure is correct, the tires are the correct load rating, and the steer axle weight is within the tire's rated capacity. The blowouts occur on the outer sidewall. What should be investigated?

A. The rim for cracks or damage that could cut the tire bead during operation

B. Road hazards on the vehicle's regular route that specifically contact the right front tire's outer sidewall

C. The steer axle alignment for excessive positive camber on the right side, which overloads the outer sidewall by tilting the wheel outward

D. The right front brake for a dragging condition that is generating excessive heat in the tire through the hub and wheel assembly

101. A trailer equipped with a single-point air ride suspension has a condition where the ride height is correct when measured at the axle but the trailer floor is not level — the left side is 20 mm lower than the right side. What could cause this discrepancy if the air suspension is functioning correctly?

A. The trailer frame has a twist (torsional deformation) that is independent of the suspension system — the axle and springs may be maintaining the correct distance between the axle and the spring mounting points, but the frame itself is twisted, causing one side to sit lower than the other at the deck level

B. The left side air spring has a different volume rating than the right side, producing the same ride height at the axle but different frame heights

C. The trailer's cargo is unevenly distributed, with more weight on the left side pressing the frame down

D. The height control valve's sensing arm on the left side is bent, causing the valve to hold the left side lower

102. A technician is performing a commercial vehicle inspection and measures the steer axle tire tread depth at multiple points across the tread face. The center of the tread measures $5/32$ inches and the outer

edges measure 3/32 inches. The minimum legal tread depth for a steer axle tire is 4/32 inches. Does this tire pass inspection?

- A. The tire fails inspection because the legal tread depth requirement applies to the shallowest measurement across the face of the tire
- B. The tire passes inspection because the center measurement exceeds the minimum specification
- C. The tire passes inspection because the average of all measurements exceeds the minimum specification
- D. The tire fails inspection because the 3/32 measurement on the outer edges is below the 4/32 minimum — tread depth requirements for steer axle tires apply across the entire tread face, and any measurement below the minimum at any point means the tire does not meet the standard

103. A heavy-duty truck's frame has been identified as having a diamond condition — the frame is shifted so that the right rail is forward of the left rail by approximately 20 mm. What symptoms does a diamond frame produce?

- A. The engine mounts are stressed unevenly, causing the engine to vibrate more on one side than the other
- B. The cab doors will not close properly because the cab mounting points are shifted relative to the cab structure
- C. The driveshaft will vibrate because the transmission and rear axle are no longer aligned on the same centerline
- D. The vehicle will dog-track (the rear does not follow the front), axle alignment will be affected on all axle positions, and tire wear will be accelerated because the frame's geometry — which locates all axles and components — is distorted from its designed rectangular shape

104. A heavy-duty truck's cab tilt mechanism operates hydraulically. During a cab tilt operation, the cab tilts forward approximately halfway and then the hydraulic pump motor stops running. The tilt control switch is still in the tilt position. What is the most likely cause?

- A. The cab tilt hydraulic cylinder has reached its maximum stroke and the pump motor has a pressure switch that stops it when maximum system pressure is reached

- B. The cab tilt pump motor's circuit breaker has tripped from excessive current draw — the motor drew more current than normal because the tilt cylinder, its pivot points, or the cab weight are creating more resistance than the motor can handle within its breaker rating
- C. The cab is physically contacting an obstruction (an open hood latch, a disconnected component, or an improperly routed hose) that prevents further tilting
- D. The cab tilt hydraulic reservoir is low on fluid and the pump has drawn air, causing it to lose priming and stop pumping

105. A truck driver reports that the cab vibrates significantly at highway speed but the vibration is not present at lower speeds. The engine, transmission, driveline, and tires have been checked and are not the source. What cab-specific component should be inspected?

- A. The windshield, which may have a damaged seal that allows air to enter and create a vibration at highway speed
- B. The cab air dam or front bumper components, which if loose or damaged could create aerodynamic flutter at highway speed
- C. The dashboard-mounted GPS device, which may be vibrating at its mounting bracket's resonant frequency at highway speed
- D. The cab mounts — one or more cab mounts may have deteriorated or failed, and the reduced damping allows the cab to resonate at a frequency that is excited by the vehicle's highway speed; at lower speeds the excitation frequency does not match the cab's resonant frequency and the vibration is not present

106. A transit bus has a condition where the driver's side window does not defog despite the defrost system operating normally on the rest of the windshield. What is the most likely cause?

- A. The defrost duct that routes heated air to the driver's side window area is disconnected, collapsed, or blocked — the air is reaching all other windshield areas but is not reaching the driver's side window due to a fault in the dedicated duct section
- B. The driver's side window glass has a different coating than the rest of the windshield that retains moisture differently
- C. The driver's side heater core passage is partially blocked, reducing the temperature of the defrost air on that side only

D. The blower motor produces uneven airflow that favors the passenger side of the windshield over the driver's side

107. A truck's heated seat on the driver's side stops heating after approximately 10 minutes of use. When the ignition is cycled off and back on, the seat heats for another 10 minutes before stopping again. What is the most likely cause?

A. The heated seat element has a partial break in its resistance wire that increases resistance as the wire heats up, eventually creating an open circuit

B. The seat heater's built-in timer is limiting the heating cycle to 10-minute intervals to prevent overheating

C. The heated seat controller has a thermal protection circuit that detects excessive temperature and shuts off the heating element — this could indicate a faulty temperature sensor that is reading hotter than actual, a controller fault, or a genuine overheat condition from a bunched heating element under the seat cover

D. The seat heater fuse is intermittently tripping and resetting when the ignition is cycled

108. A heavy-duty truck's cab has a water leak that allows rainwater to drip onto the driver's left leg during heavy rain while driving. The door seal and windshield seal have been inspected and are intact. What other entry point should be investigated?

A. The roof-mounted marker light or clearance light gaskets, which if deteriorated allow water to enter the cab through the mounting holes

B. The A-pillar seam or the rain gutter channel — the cab's body panel joints at the A-pillar (the pillar between the windshield and the door) may have deteriorated seam sealer, or the rain gutter channel that directs water over the door may have a crack or gap that allows water to enter the cab interior and drip down the A-pillar onto the driver's leg area

C. The HVAC fresh air intake cowl drain, which if clogged forces water into the cab through the blower housing

D. The roof panel seams, which if unsealed allow water to enter from directly above and drip down the headliner

109. A technician discovers that a trailer's brake chamber pushrod boot (the rubber cover that protects the pushrod opening in the chamber) is torn on one chamber. The pushrod moves freely and the brake functions normally. Is this a concern?

- A. The torn boot is cosmetic and has no effect on brake chamber function or reliability
- B. The torn boot allows dirt, moisture, road salt, and debris to enter the brake chamber housing and contact the diaphragm and internal components — over time this contamination accelerates diaphragm deterioration, causes corrosion that can seize the pushrod, and introduces contaminants that can damage the internal return spring and sealing surfaces
- C. The torn boot only affects the spring brake side of the chamber and does not impact the service brake function
- D. The torn boot will cause an air leak that is detectable only during a full brake application test

110. A trailer's ABS system has a condition where the ABS warning lamp illuminates during driving but extinguishes at stops. The technician retrieves a fault code for "Right Rear Wheel Speed Sensor — Intermittent Signal." What should be inspected?

- A. The right rear brake drum for an out-of-round condition that is changing the reluctor ring gap during rotation
- B. The ABS modulator valve on the right rear, which may be creating electrical feedback that interferes with the sensor signal
- C. The wheel speed sensor wiring for damage, chafing, or loose connections that are affected by wheel rotation and road vibration during driving — the intermittent signal suggests a conductor that breaks contact under movement but re-establishes contact when the vibration stops
- D. The right rear tire for a flat spot that is creating a speed variation the sensor interprets as an intermittent signal

111. A trailer used for transporting live animals has a condition where the floor boards are showing significant wear and some boards are cracked. What specific concern does this condition create beyond general structural integrity?

- A. Worn or cracked floor boards in a livestock trailer can break under the weight and movement of the animals, potentially allowing an animal's leg to fall through and become trapped — this creates an

animal welfare concern, a load security issue, and can damage the trailer's structural members beneath the floor

- B. The worn floor boards will cause the trailer to fail a weigh station inspection for overweight violations
- C. The cracked boards will release splinters that can injure the animals' hooves and contaminate the cargo
- D. The floor board condition only affects the trailer's resale value and does not impact its operational safety

112. A trailer equipped with a rear lift axle (pusher axle) has a condition where the lift axle tires are wearing excessively on the outer edges even though the inflation pressure is correct. What is the most likely cause?

- A. The lift axle is operating at too low a load share, causing the tires to be overinflated relative to the actual weight on them
- B. The lift axle tires are a different speed rating than the main axle tires and operate at a different rolling temperature
- C. The lift axle caster angle is incorrect, causing the tires to lean outward and load the outer edges during straight-line driving
- D. The lift axle alignment is set with excessive toe-out, causing both tires to angle outward and scrub their outer edges during straight-line driving — lift axle alignment is independent of the main tandem axle alignment and must be checked and adjusted separately

113. A trailer's side marker lamp is flickering. The technician replaces the bulb, but the flickering continues. What should be checked next?

- A. The alternator output on the tractor, which may have excessive AC ripple causing the lamp to flicker
- B. The lamp socket, its ground connection, and the wiring between the J560 connector and the lamp — a corroded socket, a high-resistance ground point, or a damaged wire with intermittent contact are the most common causes of lamp flickering that persist after bulb replacement
- C. The trailer ABS module, which controls power distribution to the marker light circuit
- D. The J560 connector ground pin, which if corroded would affect all trailer lights simultaneously rather than just one

114. A trailer's air ride suspension has a condition where one air spring has failed (ruptured). The driver did not notice the failure and drove 100 km with the trailer leaning to one side. What damage may have occurred beyond the air spring itself?

- A. The uneven loading may have damaged the trailer frame, the axle, the remaining air springs (from overloading on the good side), and the suspension mounting hardware
- B. The leaning condition may have shifted the cargo inside the trailer
- C. The opposite-side air spring has been subjected to approximately double its normal load for 100 km, potentially overstressing and shortening its service life — additionally, the leaning trailer has been wearing tires unevenly, may have stressed the frame and suspension hardware on the overloaded side, and could have affected the axle alignment
- D. The failed spring has vented all of the trailer's air supply through the rupture, depleting the brake system air

115. A trailer's license plate lamp is not illuminating. The bulb is good, the fuse is intact, and the socket has voltage when tested with a meter. What is the most likely cause?

- A. The ground connection at the lamp fixture is open — the lamp has voltage at the hot terminal but cannot complete the circuit to illuminate because the return path (ground) is broken from corrosion, a loose ground screw, or a deteriorated ground wire
- B. The voltage at the socket is less than the bulb's minimum operating voltage due to line losses
- C. The lamp socket contacts have corroded and are not making adequate contact with the bulb's base despite showing voltage with a high-impedance meter that draws negligible current
- D. The bulb type is incorrect for the socket and the contacts do not align with the bulb's terminals

116. A reefer trailer's TRU (transport refrigeration unit) has a condition where the evaporator coils are heavily frosted even though the setpoint is -18°C and the unit is running in cooling mode. What is the most likely cause?

- A. The defrost cycle is not activating — the TRU's defrost timer, defrost solenoid, or hot gas bypass valve has failed, preventing the periodic defrost cycle from melting the ice accumulation on the evaporator; without defrost, frost builds continuously until it blocks airflow through the evaporator
- B. The refrigerant charge is correct but the ambient temperature is too cold for the TRU's control algorithm

C. The evaporator fan motors have failed, preventing airflow across the coil and causing the frost to accumulate

D. The cargo is producing excessive moisture from respiration that overwhelms the TRU's dehumidification capacity

117. A truck's A/C system has manifold gauge readings showing: low side 50 psi, high side 150 psi. Normal readings for the current ambient temperature should be: low side 25-35 psi, high side 200-250 psi. What is the most likely system condition?

A. The system is overcharged with refrigerant, causing elevated low-side pressure and suppressed high-side pressure

B. The A/C compressor is worn internally and cannot create an adequate pressure differential between the low and high sides — the compressor is not compressing effectively, so the low side stays higher than normal and the high side stays lower than normal

C. The expansion valve is stuck open, flooding the evaporator and allowing liquid refrigerant to return to the compressor

D. The condenser fan has failed, causing the high-side pressure to drop because the refrigerant cannot reject heat

118. A truck's cab heater blows hot air from the floor vents but only lukewarm air from the dashboard and defrost vents when the temperature is set to maximum heat. What is the most likely cause?

A. A blend door or mode door actuator malfunction that is partially directing air through the A/C evaporator before it reaches the dashboard and defrost ductwork — the air passes through the cold evaporator and loses some heat before reaching the upper vents, while the floor duct bypasses the evaporator and delivers fully heated air

B. The heater core has a partial restriction that reduces coolant flow to the section that feeds the upper ducts

C. The HVAC system has separate heater cores for the floor and dashboard circuits, and the upper heater core is partially blocked

D. The dashboard ducts have a longer path than the floor ducts, and the air cools as it travels the additional distance

119. A technician is performing an A/C system leak test using an electronic refrigerant leak detector. The detector alarms at the condenser but the technician cannot find a specific leak point. What diagnostic step should be taken next?

- A. Apply UV dye and operate the system for several days to pinpoint the exact leak location
- B. Pressurize the system with nitrogen and use soap solution at the condenser to locate the exact leak point through bubble formation
- C. Clean the condenser thoroughly with water and re-test — residual refrigerant from a previous leak or service can contaminate the condenser surface and trigger false alarms from the leak detector; cleaning removes residual refrigerant and allows the detector to identify a genuine, active leak point
- D. Replace the condenser immediately since the detector confirmed a leak in that component

120. A bus's rear A/C system (the separate unit that cools the passenger compartment) operates intermittently — it cycles on for 5 minutes, then off for 10 minutes, then on again. The front A/C system operates continuously and normally. What is the most likely cause?

- A. The rear A/C system's compressor clutch is cycling on an incorrect schedule due to a faulty timer or relay
- B. The rear A/C unit's thermostat is set too close to the ambient temperature, causing the system to reach setpoint quickly
- C. The rear A/C system has a separate control module that has a communication fault with the front system's module
- D. The rear A/C system has a low refrigerant charge or a faulty low-pressure switch that intermittently opens the compressor clutch circuit — the system runs until the low-side pressure drops below the switch's cut-out point (from the low charge), then the switch opens and the compressor stops; as pressure equalizes, it rises above the cut-in point and the compressor restarts

121. A truck equipped with a diesel-fired bunk heater has a condition where the heater starts, runs for approximately 90 seconds, then shuts down with a "No Start" fault code. The heater has been inactive for the entire summer season. What is the most likely cause?

- A. The heater's glow plug has carbon buildup from the extended storage period that prevents adequate ignition temperature

B. The combustion air blower motor bearings have seized from lack of use, preventing adequate airflow for combustion

C. The fuel pump diaphragm has dried out during the storage period and cannot prime the fuel delivery system

D. The heater's fuel supply line has air-locked from the extended storage, and the fuel pump cannot prime itself — the heater starts on residual fuel in the combustion chamber but the air lock prevents continuous fuel delivery, causing the flame to die after the initial fuel burns off; purging the air from the fuel line restores operation

122. A truck's HVAC system has a musty odor when the blower first turns on, but the odor dissipates after a few minutes of operation. The cabin air filter has been replaced. What is the most likely source of the persistent odor?

A. The evaporator core has microbial growth (mold and mildew) on its surface — replacing the cabin air filter does not address the existing microbial colony on the evaporator fins, which continues to produce the odor; the evaporator must be treated with an antimicrobial agent or biocide spray to eliminate the growth

B. The new cabin air filter has an off-gassing odor from its manufacturing process that will dissipate after a few weeks

C. The heater core has a very small coolant leak that produces a musty odor similar to mold

D. The HVAC drain tube has a P-trap design that retains stagnant water, producing the musty odor until the system's airflow dries it out

123. A truck's A/C system was recently serviced and recharged. The system cools well initially but after 30 minutes of highway driving, the cooling performance degrades significantly. Stopping the vehicle for 10 minutes and restarting restores good cooling temporarily. What is the most likely cause?

A. The system was overcharged with refrigerant, and the excess refrigerant floods the condenser at highway speed when ram air forces the refrigerant temperature below its condensing threshold

B. The compressor clutch coil is overheating and disengaging after 30 minutes of continuous operation

C. The condenser is partially restricted — at highway speed, the increased airflow through the condenser initially provides adequate cooling, but the system eventually reaches thermal equilibrium at a higher-than-normal operating pressure that degrades performance; the 10-minute rest allows the system to cool and reset

D. Moisture in the system (from inadequate evacuation before charging) is freezing at the expansion valve after 30 minutes of operation, restricting refrigerant flow and reducing cooling — during the 10-minute rest period, the ice melts and flow resumes until the moisture freezes again

124. A hydraulic system's pressure gauge reads system pressure when the directional control valve is in the neutral position. On a properly functioning open-center system, the gauge should read near zero in neutral. What does this indicate?

A. The pressure gauge is faulty and is stuck at the last reading it displayed during the previous active operation

B. The gauge is reading the pilot pressure circuit, which maintains pressure at all times for valve actuation

C. The system's relief valve is stuck closed, trapping pressure in the circuit when the valve centers

D. The directional control valve's spool is not fully returning to the neutral (center) position — in an open-center system, neutral routes the pump's output directly to the tank at minimal resistance; if the spool is partially off-center, it restricts the tank return path, and the pump builds pressure against this restriction

125. A hydraulic crane's boom cylinder has a rated maximum extension force of 50,000 pounds. The cylinder has a 5-inch bore. What system pressure is required to produce this force?

A. 10,000 psi

B. Approximately 2,546 psi — calculated using $F = P \times A$, rearranged to $P = F/A$; the piston area is $\pi \times r^2 = 3.14 \times 2.5^2 = 19.63 \text{ in}^2$; therefore $P = 50,000 \div 19.63 = 2,546 \text{ psi}$

C. 5,000 psi

D. 1,273 psi

126. A hydraulic system on a truck-mounted crane has a condition where all functions work at normal speed except the swing (slew) function, which operates at half speed. The swing circuit has its own flow control valve. What is the most likely cause?

A. The swing motor's internal displacement has changed due to wear, requiring more flow per revolution than designed

- B. The swing circuit's flow control valve is partially closed or restricted, limiting the flow rate reaching the swing motor and reducing its speed while all other circuits receive their normal flow from the same pump
- C. The swing circuit's relief valve is set too high, causing excessive backpressure that slows the motor
- D. The main pump is worn and cannot supply adequate flow to all circuits simultaneously

127. A truck-mounted hydraulic system has a condition where the boom lift cylinder drifts downward approximately 25 mm per minute while holding a 5,000-pound load in the hold position. The directional control valve is in neutral. After disconnecting the cylinder lines from the valve and plugging the cylinder ports directly, the drift stops. What does this test confirm?

- A. The cylinder's piston seal is leaking internally, allowing fluid to bypass from the cap end to the rod end
- B. The counterbalance valve in the cylinder circuit is leaking and allowing fluid to escape from the cap end
- C. The directional control valve has internal leakage across its spool — fluid is crossing from the cylinder's work port to the tank port through the worn spool clearances, allowing the load to slowly push fluid out of the cylinder; blocking the cylinder ports eliminated the leak path through the valve
- D. The holding valve pilot check is not fully seating, allowing fluid to leak through the check to the tank return

128. A hydraulic system uses a variable-displacement piston pump with a pressure compensator. During operation, the technician notices that the pump maintains pressure but produces no flow when the system is in standby (no function is being commanded). Is this normal behavior?

- A. No — the pump should produce a small continuous flow even in standby to keep the circuit primed and responsive
- B. Yes — a pressure-compensated variable-displacement pump automatically reduces its displacement (stroke) to near zero when the system reaches the compensator's pressure setting and no flow demand exists; the pump maintains system pressure while producing minimal flow, reducing energy consumption and heat generation
- C. No — the zero-flow condition indicates the compensator has failed in the destroke position
- D. Yes — but only if the system has an accumulator that maintains pressure while the pump is at zero displacement

129. A hydraulic system's suction line has been accidentally kinked during a frame modification. The kink reduces the internal diameter of the line by approximately 50%. What is the immediate consequence of operating the system with this restriction?

- A. The pump will produce higher-than-normal pressure because the restricted suction creates a pumping advantage
- B. The pump will operate normally because the suction side operates at near-atmospheric pressure
- C. The system's filtration will be overwhelmed by the increased flow velocity through the reduced opening
- D. The pump will cavitate — the kinked suction line restricts the flow of fluid to the pump inlet, creating a vacuum condition that causes dissolved air and vapor bubbles to form in the fluid; these bubbles collapse violently inside the pump, causing erosion of the pump's internal surfaces, a characteristic screaming or whining noise, and progressive pump destruction

130. A technician is troubleshooting a hydraulic tailgate lift that extends but will not retract. The directional control valve shifts to the retract position and hydraulic pressure is present at the valve's work port for the retract circuit. What should be checked next?

- A. The retract line between the valve and the cylinder rod port for a blockage, kink, or closed shut-off valve — pressure at the valve's work port confirms the pump and valve are functioning, but the fluid must travel from the valve to the cylinder's rod port through the dedicated retract line; any obstruction in this line prevents the fluid from reaching the cylinder
- B. The hydraulic pump for an internal fault that prevents it from producing adequate pressure for the retract function
- C. The relief valve for a setting that is too low for the retract function's pressure requirement
- D. The cylinder rod seal for an external leak that is preventing pressure buildup on the rod side

131. A hydraulic system on a dump truck has a condition where the dump body raises normally but descends too slowly when the lower valve is activated. What is the most likely cause?

- A. The dump body hinges are binding from corrosion and resisting the body's descent
- B. The cylinder rod is bent, creating resistance as it retracts into the barrel

C. The return line from the cylinder to the reservoir has a restriction — either a clogged return filter, a kinked line, or a partially closed valve — that limits the rate at which fluid can exit the cylinder during lowering, slowing the descent speed

D. The hydraulic fluid viscosity is too high for the current ambient temperature, slowing flow through all system passages

132. A parallel hybrid transit bus uses both a diesel engine and an electric motor to drive the wheels through a shared transmission. Under what operating condition does the electric motor typically operate alone without the diesel engine?

A. During highway cruising where the electric motor's efficiency is highest at sustained high speed

B. During low-speed urban operation such as pulling away from bus stops and creeping through traffic — the electric motor provides quiet, zero-emission propulsion at low speeds and loads where the diesel engine is least efficient, and the diesel engine starts when higher power or sustained speed is needed

C. During regenerative braking events where the motor reverses its rotation to slow the vehicle

D. During cold-start conditions where the electric motor preheats the transmission before the diesel engine engages

133. A hybrid electric vehicle's regenerative braking system captures approximately 60% of the kinetic energy during braking at moderate speeds. Where does the remaining 40% of the energy go?

A. The remaining energy is stored temporarily in the vehicle's supercapacitor bank for rapid release during the next acceleration event

B. The remaining energy is recycled through the hydraulic braking circuit and returned to the engine as mechanical energy

C. The remaining energy is rejected as heat by the inverter and motor windings during the conversion process

D. The remaining energy is dissipated as heat through the friction brakes (which supplement regenerative braking at higher deceleration rates), through aerodynamic drag, through tire rolling resistance, and through electrical losses in the motor, inverter, wiring, and battery during the energy conversion process

134. A battery electric truck is being charged at a DC fast-charging station. The initial charging rate is 150 kW, but after 30 minutes the charging rate drops to 50 kW even though the battery is only at 60% SOC. What is the most likely cause of the reduced charging rate?

- A. The battery cells' temperature has risen from the high charging current, and the BMS has reduced the charging rate to prevent thermal damage — high-speed DC charging generates significant heat inside the cells, and the BMS protects the battery by limiting current as cell temperature approaches the maximum threshold
- B. The charging station's power supply has reduced its output due to grid demand during peak hours
- C. The battery's internal resistance has increased as the SOC rises, naturally limiting the charging current
- D. The charging cable has overheated and the cable's thermal protection has reduced the current to prevent cable damage

135. A technician is inspecting a high-voltage battery pack removed from a hybrid bus. One module shows visible swelling of the cell pouches. What does this swelling indicate, and what precaution must be taken?

- A. The cells are swollen from normal electrolyte expansion during the charging cycle and will return to normal dimensions when fully discharged
- B. The swelling is caused by excess electrolyte that was added during manufacturing and does not affect the module's safety or performance
- C. The swollen cells have experienced internal gas generation from electrolyte decomposition — this indicates cell degradation or damage that could progress to thermal runaway; the module must be handled with extreme caution, stored in a fire-resistant area away from other battery modules and combustible materials, and disposed of according to the manufacturer's hazardous materials procedure
- D. The swelling indicates that the cells have absorbed moisture through damaged seals and the module must be dried in an oven before reinstallation

Practice Exam 6: Answer Key and Explanations

1. B — Portable cranes (cherry pickers) have a rated capacity that decreases as the boom extends further from the base. The crane's capacity plate shows maximum load at each boom extension — a crane rated at 2,000 kg at minimum extension may only support 500 kg at full extension. The technician must verify that the load weight falls within the crane's capacity at the specific boom extension being used, not just at the crane's maximum rating.

2. D — An 8-second delay before oil pressure registers indicates that the oil galleries and filter were dry, requiring the pump to fill these passages before pressure could build. During this delay, the engine's bearings are running without an oil film — a condition that causes accelerated wear and can lead to premature bearing failure. Pre-filling the oil filter with clean oil before installation and priming the system reduces this dry-running period to an acceptable minimum.

3. A — Welding within 0.5 metres of a fuel tank creates a direct fire and explosion hazard from radiant heat, sparks, and molten metal contacting fuel vapors or the tank itself. Even a drained tank contains explosive vapors in the air space above any residual fuel. The tank must be removed and purged, or a certified fire-resistant barrier placed between the work and the tank, with a charged fire extinguisher within arm's reach and a trained fire watch maintained during and for 30 minutes after the welding operation.

4. C — Rotating machinery such as drill presses can catch loose clothing, lanyards, jewelry, or long hair and pull the worker's body into the machine in a fraction of a second. Entanglement injuries from drill presses include severe lacerations, degloving injuries, fractures, and scalping. All loose items must be secured, removed, or tucked in before operating any rotating equipment — this is a fundamental shop safety rule enforced by OSHA regulations.

5. B — An uncovered, unbarricaded shop pit is one of the most dangerous hazards in a truck repair facility. The typical pit depth of 1.5 to 2 metres produces fall injuries ranging from broken bones to spinal injuries and head trauma. A technician walking backward, carrying a heavy part, or simply distracted can step into the opening without warning. The pit must be covered with a rated cover, surrounded by a physical barricade, or clearly marked with high-visibility signage whenever it is not in active use.

6. D — Seat belt anchor bolts are engineered to withstand forces exceeding 10,000 newtons during a collision — forces that would shear a standard hardware-store bolt. The vehicle manufacturer specifies the exact grade, length, thread pitch, and torque for each anchor point. A missing anchor bolt means the belt can tear free from its mounting during a crash, and the occupant is ejected from the restraint system. The vehicle is unsafe to operate until the correct bolt is installed.

7. A — A compressed gas cylinder that falls and breaks its valve neck becomes a lethal projectile — the escaping high-pressure gas can propel the cylinder through walls, vehicles, and people. Securing all cylinders upright with chains, straps, or in an approved rack prevents falling and is the single most important physical safety measure. This requirement applies during both storage and active use, and is mandated by fire codes and occupational health and safety regulations.

8. C — Canadian federal and provincial regulations require technicians who handle refrigerants to hold an ODS (Ozone-Depleting Substances) and HFC refrigerant handling certification. This certification verifies training in refrigerant identification, recovery procedures, recycling standards, and the environmental regulations governing refrigerant handling. Purchasing regulated refrigerants requires presenting this certification, and performing A/C service without it is a regulatory violation subject to fines.

9. A — A sharp metallic knock at the top of the engine that does not change during an injector cut-out test is not combustion-related (combustion noise would diminish when the affected cylinder's injector is disabled). The noise originates from the valve train — excessive lash between the rocker arm and valve stem tip creates a gap that the rocker bridges with a sharp impact at each cam lobe lift. The noise intensifies under load because higher cylinder pressure increases the reaction force on the exhaust valve, amplifying the impact through the valve train.

10. C — The dashboard gauge shows normal temperature, but the infrared thermometer confirms the engine is actually running at 65°C — well below the 82-95°C operating range. This discrepancy means the gauge is displaying false information. The coolant temperature sensor feeding the gauge has failed and is outputting a resistance value that the gauge interprets as normal temperature. The engine is running cold (most likely from a stuck-open thermostat), and the infrared reading represents the actual condition that the faulty sensor is masking.

11. D — The engine brake indicator lamp confirming activation means the electronic control side is commanding the brake to engage. The reduced braking effect must come from the mechanical side — the components that physically open the exhaust valves to release compressed air. Incorrect slave piston lash means the pistons don't push the exhaust valves open far enough. Partially functioning solenoids deliver insufficient oil pressure. A restricted oil supply starves the brake mechanism. Any of these conditions reduces the exhaust valve opening during the braking event.

12. B — The pattern of gradually decreasing pressure between oil changes with increasing wear metals describes progressive internal engine wear. As bearing clearances enlarge from wear, oil escapes faster through the wider gaps, reducing pressure. Fresh oil's higher viscosity temporarily compensates — the thicker new oil flows through the worn clearances more slowly, briefly restoring pressure. But as the oil thins from heat cycling and use, the worn clearances dominate again and pressure drops. The increasing wear metals in each successive sample confirm the progressive mechanical deterioration.

13. A — During a cylinder leakage test, compressed air is introduced into the cylinder through the spark plug or injector port with the piston at TDC. If the air escapes past the piston rings, it enters the crankcase. The crankcase communicates with the oil fill cap through the oil return passages and breather

system, so the escaping air is audible at the cap opening. This definitively identifies the ring-to-liner seal as the leak path — not the valves (air would escape at the intake or exhaust), and not the head gasket (air would escape into the coolant or an adjacent cylinder).

14. C — Normal boost pressure and clean air filter confirm adequate air supply. Correct injection timing eliminates timing-related smoke. With adequate air and correct timing, black smoke (unburned fuel) must come from excess fuel — one or more injectors delivering more fuel than commanded. A leaking, dribbling, or stuck-open injector introduces extra fuel into its cylinder, creating a locally rich mixture that burns incompletely and produces the dark smoke. Individual injector testing (flow rate, spray pattern, and return rate) identifies the faulty injector.

15. D — If the oil cooler has been tested and cleared, the remaining internal paths where engine oil can enter the cooling system are through a failed head gasket (where an oil gallery and coolant passage are adjacent), a cracked cylinder head (where a crack connects an oil passage to a coolant passage), or a cracked engine block (same principle). These internal failures create a pressurized pathway that pushes oil into the coolant under engine operating pressure. A cooling system pressure test combined with a UV dye test in the oil helps identify the specific failure point.

16. B — The wastegate controls boost pressure by diverting exhaust gas around the turbine. A stuck-open wastegate continuously bypasses exhaust energy at all operating conditions. At low RPM, the exhaust volume is small enough that even with the wastegate open, sufficient energy reaches the turbine for adequate boost. At high RPM, the large exhaust volume being diverted through the open wastegate starves the turbine of the energy it needs, limiting boost pressure and creating an air-deficient condition that produces black smoke under the high fuel delivery of full-load, high-RPM operation.

17. A — Sodium and potassium are not naturally present in engine oil or engine wear materials. They are specific components of coolant additive packages — particularly supplemental coolant additives (SCA) and organic acid technology (OAT) inhibitor packages. Their sudden appearance in an oil sample is a definitive indicator that coolant is leaking into the oil system. The contamination source could be a failed oil cooler (even if not yet detected by other tests), a head gasket failure, a cracked head, or a cracked liner. The source must be identified immediately because coolant in the oil attacks bearing surfaces.

18. C — A relative compression test or cylinder contribution test uses the scan tool to measure each cylinder's relative contribution to engine output at idle. If one or more cylinders are contributing significantly less than the others, the rough idle is caused by a mechanical imbalance — a weak cylinder from low compression, a faulty injector, or incorrect valve lash. This test quickly identifies which

cylinders are underperforming without removing any components, directing further diagnosis to the specific cylinder or cylinders responsible for the rough idle.

19. D — Low NO_x conversion efficiency with adequate DEF level and quality means the SCR system is not converting NO_x effectively despite receiving the correct reducing agent. The three primary causes are a degraded SCR catalyst (poisoned by sulfur, hydrocarbon contamination, or thermal damage), a DEF dosing problem (the injector may be clogged, delivering incorrect spray pattern, or not injecting the correct volume), or a faulty NO_x sensor providing incorrect feedback that the ECM uses to calculate dosing. All three must be investigated to identify the root cause.

20. B — The progressive power loss over 10 minutes followed by restoration after a 5-minute rest period is the classic pattern of a fuel supply restriction. The fuel system has a finite volume of fuel between the restriction and the injection system. During the first 10 minutes, the engine draws from this stored volume. As the stored fuel is consumed and the restriction prevents the supply from keeping up, fuel pressure drops progressively, causing the surge and power loss. During the 5-minute rest, the weak supply slowly refills the depleted volume, and the cycle restarts.

21. A — Each injector has a normal amount of internal leakage that returns to the tank through the return line. This leakage should be approximately equal across all injectors. When one injector returns significantly more fuel than the others, its internal clearances have enlarged from wear — fuel bypasses the injection circuit and escapes through the return rather than being injected into the cylinder. The affected cylinder receives less fuel, fires weakly, and the excessive leakage may also reduce rail pressure stability for the entire system.

22. D — The barometric pressure sensor tells the ECM the atmospheric pressure at the vehicle's current altitude. Without accurate altitude data, the ECM cannot optimize the fuel-to-air ratio for the actual air density — at altitude, air is thinner and less fuel is needed; at sea level, air is denser and more fuel can be burned. The ECM substitutes a default value (typically a conservative mid-altitude setting) and may derate power as a protective measure to prevent over-fueling at altitude or under-fueling at sea level.

23. C — The exhaust crosshead (bridge) spans two exhaust valves on the same cylinder, allowing a single rocker arm to open both valves simultaneously. The adjusting screw on the crosshead must be set first so that the bridge contacts both valve stems evenly — if one stem is contacted before the other, only one valve opens while the other remains on its seat or opens at a reduced lift. Setting the bridge level ensures both exhaust valves open equally, and only then can the rocker arm lash be set accurately.

24. A — A rhythmic puffing from the air filter housing at the engine's firing frequency indicates that compressed air is blowing backward through an open intake passage during the compression stroke. A leaking intake valve cannot seal against the compression pressure, and the compressed charge escapes past the valve into the intake manifold and back to the air filter housing. Each compression event produces a puff, creating the rhythmic pattern. A valve lash check and compression test on each cylinder will identify the affected cylinder.

25. D — New piston rings and freshly honed cylinder liners undergo a break-in period during which the rings conform to the liner's surface profile. The honing crosshatch pattern retains oil and provides a controlled abrasion surface that helps the rings seat. During this period, the ring-to-liner seal is not yet optimized, and some oil passes the rings into the combustion chamber. As the rings seat into the honing pattern (typically over the first 3,000 to 8,000 km), the seal progressively tightens and oil consumption drops to the engine's normal rate.

26. A — A gradual coolant loss with no external leaks, no oil contamination, and no visible exhaust smoke can be caused by a very small EGR cooler leak. The EGR cooler circulates engine coolant to cool the exhaust gas before it re-enters the intake. A small crack or pinhole in the cooler allows coolant to seep into the exhaust stream in quantities small enough to vaporize completely and exit the tailpipe without producing visible white steam. Over two weeks, the cumulative loss becomes measurable at the coolant reservoir. An EGR cooler pressure test confirms the leak.

27. C — A fault code specifying "Voltage Below Normal" on a sensor circuit indicates the ECM is receiving a voltage signal that is lower than the sensor should ever produce at any physical condition. This points to a sensor or circuit fault — not a physical pressure problem. A failed sensor, a shorted signal wire (to ground), or a corroded connector can all pull the voltage below the expected range. The ECM cannot trust the pressure data and derates protectively. Testing the sensor's output voltage and inspecting the wiring and connector isolates the fault.

28. C — Accelerated wear on the loaded face of a gear tooth indicates excessive contact pressure — the teeth are being forced together harder than designed. Timing gear backlash that is set too tight increases the contact force between the meshing teeth beyond the design intent, causing the loaded face to wear faster than the unloaded face. Excessive backlash would produce noise and irregular contact, but the wear pattern would be different. The backlash must be checked and corrected to the manufacturer's specification.

29. A — Modern diesel injection systems operate at pressures exceeding 30,000 psi with internal clearances measured in microns. A 30-micron filter allows particles six times larger than the 5-micron specification to pass through to these precision components. These particles act as abrasives on the

pump's plungers and barrels, the injector needle and body, and the nozzle holes — components with clearances of 2-5 microns. The abrasive wear accelerates over 10,000 km of operation, potentially causing premature failure of components designed for 500,000+ km of service with proper filtration.

30. D — Air system components are designed and rated for the standard operating pressure range (typically 100-125 psi for most North American systems). Over-pressurizing the system by 10-15 psi exposes every component to forces beyond its design rating. Hoses may balloon and burst, fittings may crack, the air dryer housing may fail, and brake chamber diaphragms may stretch and rupture. The governor must be adjusted to the correct cut-out pressure (120-125 psi) and the safety valve must be set to open at approximately 150 psi as a last-resort protection.

31. B — A pressure-dependent leak is a leak that only becomes significant at higher pressures. Below 90 psi, the leak may be too small to affect build-up time. As pressure increases, the force acting on the marginal seal or fitting increases, opening the leak path wider and allowing air to escape at a rate that nearly matches the compressor's output. The result is a dramatic slowing of pressure build-up above the threshold where the leak becomes significant. A soap-solution test at pressures above 90 psi will reveal the leak location.

32. C — The trailer relay valve converts a small signal pressure from the foot valve into a large volume delivery from the local reservoir to the brake chambers. If the relay valve's crack pressure (the minimum signal pressure required to open the delivery port) is set too low, the valve delivers full supply pressure to the chambers with only minimal foot valve input. This creates a grabby, aggressive trailer brake response that is disproportionate to the pedal effort — a small pedal movement produces a large braking force at the trailer.

33. A — The spring brake mechanism applies mechanical force through the same foundation brake components as the service brakes — pushrod, slack adjuster, S-cam, shoes, and drum. Even if the springs are applying full force, worn shoes with reduced friction surface, a glazed drum surface, or out-of-adjustment slack adjusters reduce the effective braking friction at the drum. The spring brakes cannot hold the vehicle because the mechanical advantage is wasted on components that cannot convert the spring force into adequate friction.

34. D — The ESC system compares driver intent (from the steering angle sensor) with actual vehicle behavior (from the yaw rate sensor and lateral accelerometer). If any of these sensors is miscalibrated, the ESC perceives a discrepancy between intended and actual behavior that does not actually exist. A miscalibrated steering angle sensor, for example, may report a steering input that differs from reality, causing the ESC to "see" a stability deviation during normal lane changes. Calibrating all three sensors to the vehicle's actual dynamics eliminates the false activations.

35. B — A pulsating brake pedal during normal stops on dry pavement without ABS activation indicates a mechanical cause — the ABS is not intervening (lamp off), so the pulsation comes from the brake components themselves. A rotor with excessive lateral runout pushes the caliper piston back each revolution as the high spot passes the pad, creating a rhythmic pedal pulsation. Thickness variation has the same effect — the pad encounters thick and thin spots alternately, producing a force variation the driver feels through the pedal. Both conditions are measured with a dial indicator on the mounted rotor.

36. C — If pushrod strokes are correct (shoes are contacting the drum properly), drums are within size limits (adequate contact area), and air pressure is adequate (full force is being applied), the remaining variable is the friction material's coefficient of friction. Glazed linings (from overheating) develop a hardened, polished surface that has dramatically reduced friction compared to fresh lining material. Oil contamination from a compressor passing oil into the air system can coat every lining in the system, reducing friction uniformly across all wheel positions.

37. A — The pushrod fully retracting confirms that the brake chamber, slack adjuster, and S-cam are returning to their released positions. However, the shoes are not following — they remain in contact with the drum because their return springs have weakened or broken. The return springs pull the shoes away from the drum when the S-cam rotates back to the release position. Without adequate spring force, the shoes stay in contact with the drum, creating drag that generates heat, accelerates wear, and wastes fuel.

38. D — The trailer hand valve (trolley valve) sends its signal directly to the trailer through a path that bypasses the foot valve entirely. The foot valve's secondary circuit is the normal path for the trailer service brake signal during a foot brake application. If the secondary circuit's piston or seal has failed, the foot valve cannot generate the signal pressure needed to activate the trailer's relay valve. The trolley valve works because it takes a completely different path to the same relay valve. Repairing or replacing the foot valve restores normal foot-brake-controlled trailer braking.

39. B — The Type 24/30 chamber has a 24-square-inch service-side diaphragm versus the 30-square-inch diaphragm in the correct Type 30/30. At any given application pressure, the smaller diaphragm produces less force: $F = P \times A$, so at 100 psi, the 24 in² diaphragm produces 2,400 lbs while the 30 in² produces 3,000 lbs — a 20% reduction in braking force at that wheel position. This imbalance causes the vehicle to pull away from the under-braked wheel during stops, degrading directional stability and potentially creating an unsafe braking condition.

40. C — The air dryer's purge valve is controlled by the governor signal through a specific internal passage. If the signal line is connected to the wrong port, the signal cannot reach the purge valve through the correct internal routing. The compressor unloads correctly (the governor signal reaches the

compressor through its own separate line), but the purge cycle never activates. The desiccant is never regenerated, becomes saturated with moisture, and eventually passes moisture through to all downstream components.

41. A — A brake pedal that slowly sinks to the floor under sustained pressure but feels firm on initial application is the classic symptom of a master cylinder internal seal leak. The primary piston seal holds momentarily on initial application (pedal feels firm) but cannot maintain the seal under sustained pressure — fluid slowly bypasses the seal, and the pedal gradually sinks as the piston advances through the bypassing fluid. Releasing and re-applying quickly re-seats the seal temporarily, producing a momentarily firm pedal again.

42. D — A continuous circumferential groove scored into the drum's friction surface at a specific location indicates that a hard, metallic object was in contact with the drum at that point during every revolution. When brake lining wears completely through at one spot, the exposed rivets (on riveted shoes) or the steel shoe table contacts the drum directly. The metal-to-metal contact scores the groove into the cast iron drum as the wheel rotates. Both the shoes and the scored drums must be replaced, and the root cause of the localized lining wear must be identified.

43. B — Static air system tests verify the system's pressure integrity, not the condition of the friction components. A system can pass all air tests (proving the pneumatic circuit is sealed and the compressor is adequate) while the brake linings are worn thin across multiple wheel positions. Thin linings produce weak braking force even with correct pushrod strokes and full air pressure because the friction surface area is reduced. Measuring lining thickness across all wheel positions — including the trailer, which has its own wear rate — is the correct next step.

44. C — The secondary circuit gauge is steady, confirming the air system itself is producing stable pressure. The primary gauge fluctuation must be in the gauge's sensing circuit — the sender, the sender line, or the electrical connection between the sender and the gauge. A loose connection, an air leak in the sender line, or a faulty sender creates an unstable signal that the gauge displays as a fluctuating reading. The actual system pressure is stable; only the gauge's ability to read it accurately is compromised.

45. A — A new compressor that builds pressure normally but knocks indicates a gear mesh problem between the compressor's drive gear and the engine's timing gear train. The compressor was verified as the correct part number, ruling out a component defect. Misaligned timing marks during installation cause the compressor drive gear teeth to contact the engine gear at an incorrect mesh point, producing a rhythmic knock at the gear mesh frequency. The gear alignment must be verified and corrected according to the engine manufacturer's timing procedure.

46. D — An air-over-hydraulic brake system uses an air-powered booster to assist the hydraulic master cylinder. If the booster's diaphragm ruptures, its air supply leaks, or its control valve sticks, the air assist is reduced or eliminated. Without the air assist, the driver must provide all of the pedal force manually to push the master cylinder piston, which requires dramatically more effort for the same braking force. The hydraulic circuit downstream of the booster functions normally — the issue is the loss of the force multiplication that the booster provides.

47. B — In a series circuit, voltage divides proportionally across each resistor based on its share of the total resistance. Total resistance = $10\Omega + 20\Omega = 30\Omega$. The 20-ohm resistor represents $20/30 = 2/3$ of the total resistance. Therefore it drops $2/3$ of the source voltage: $2/3 \times 12V = 8V$. The remaining 4V drops across the 10-ohm resistor ($10/30 \times 12V = 4V$). The sum of voltage drops ($8V + 4V = 12V$) equals the source voltage, confirming Kirchhoff's Voltage Law.

48. A — If the series-parallel switch fails in the series position, the two 12-volt batteries remain connected in series, producing 24 volts continuously. All 12-volt accessories, lights, electronic modules, and charging system components receive double their rated voltage. Bulbs burn out immediately, electronic modules can be permanently damaged by the overvoltage, and the 12-volt alternator cannot regulate the 24-volt system. The switch must be repaired immediately to prevent widespread electrical damage.

49. C — An open modulator valve circuit means the ABS ECU cannot command the modulator to release and re-apply brake pressure during a lockup event on that wheel. The foundation brake on the left rear continues to function normally — it applies and releases with the foot valve just like a non-ABS brake. Only the anti-lock protection is lost on that specific wheel. The remaining modulators continue to function, providing ABS protection on all other wheel positions.

50. D — Zero volts at the solenoid's S terminal during a no-crank event means the starter control signal is not reaching the solenoid. The signal travels from the battery through the ignition switch, through the neutral safety switch (or clutch interlock), and through the wiring to the S terminal. An open anywhere in this path — a faulty ignition switch contact, a misadjusted or failed neutral safety switch, or a broken wire — prevents the signal from reaching the solenoid. Since the problem is intermittent, the open is likely at a connection that is vibration-sensitive.

51. B — A conventional thermal (bimetallic) flasher uses the current draw of the bulbs to heat its bimetallic strip, which bends and breaks the circuit, cools, reconnects, and repeats — producing the flash cycle. The flash rate depends on the heating rate of the strip, which depends on the current draw. LED turn signals draw a fraction of the current that incandescent bulbs draw. The reduced current

cannot heat the strip fast enough, causing the flasher to flash too fast (hyper-flash) or not at all. An LED-compatible electronic flasher that does not depend on current draw for timing resolves the issue.

52. A — The CAN bus operates as a controlled-impedance transmission line — the wire's physical characteristics (gauge, twist rate, spacing) are designed to maintain a specific impedance (typically 120 ohms) along the entire length. A crimp splice changes the local impedance at the splice point, creating an impedance discontinuity. Data signals traveling along the bus partially reflect off this discontinuity, and the reflected signals interfere with the original data, causing bit errors that manifest as intermittent communication faults across multiple modules. CAN bus repairs require soldered connections with proper shielding.

53. B — Both sockets read 14.0V — identical voltage — yet one bulb is dim. The circuit is delivering the same voltage to both sides, so the difference must be in the bulb itself. A partially broken filament has higher resistance than an intact filament. By Ohm's Law, the higher resistance draws less current ($I = V/R$). Less current through the filament means less heat, and the filament glows at a lower temperature, producing less light. The socket voltage appears normal because the reduced current also reduces the voltage drop in the supply wiring.

54. D — The scan tool communicates normally with all modules, confirming the CAN bus backbone is functional and all modules are broadcasting their data. The instrument cluster is receiving this data but cannot display it — all gauges at minimum and all digital readouts showing zero indicates the cluster's internal processing or display electronics have failed. The cluster's power supply, internal processor, or display driver circuit has an internal fault that prevents it from rendering the data it receives.

55. D — The ECM controls the cooling fan through a relay or PWM driver based on inputs from the coolant temperature sensor, A/C pressure switch, and other parameters. When the ECM detects a fault in any of its cooling-related inputs or outputs, it defaults to running the fan continuously as a protective strategy — ensuring the engine is always cooled even though the specific fault prevents the ECM from determining when cooling is actually needed. This safe-mode behavior prevents engine overheating at the cost of increased parasitic load and noise.

56. B — The fuse-pull method only isolates drains on fused circuits. If the 2-amp drain persists with every fuse removed, the drain is on an unfused circuit — a circuit that connects directly to the battery without passing through the fuse panel. Common unfused circuits include the alternator output cable, the starter solenoid, battery disconnect switch wiring, and direct-wired aftermarket accessories (inverters, GPS trackers, auxiliary lighting). The technician must trace the unfused circuits individually, disconnecting each one while monitoring the ammeter.

57. B — The inverter is turned off, but the 2-amp drain persists. The drain is not from the inverter's standby consumption — it's from a parasitic path in the wiring between the battery and the inverter. A corroded junction, a pinched cable, or an unintended ground contact somewhere in the power cable's routing creates a current path that bypasses the inverter's power switch entirely. The current flows from the battery, through the cable, through the parasitic path to ground, and back to the battery — the inverter switch is not in this path.

58. D — The wiper park function is a designed feature, not a fault. The wiper motor contains an internal park switch that keeps the motor energized after the dash switch is turned off until the wipers reach their parked position at the base of the windshield. This ensures the wipers always rest in the same position regardless of where they were in their sweep cycle when the switch was turned off. The 10-second run time is the motor completing its current sweep cycle and returning to the park position.

59. A — A switched ignition power source is energized only when the ignition key is in the ON/RUN position. It is de-energized when the key is OFF or in the ACCESSORY position (depending on the vehicle). This ensures that any module connected to this source only operates when the vehicle is in use, preventing battery drain during extended parking. This is in contrast to a "constant" or "battery direct" source that is always energized regardless of key position.

60. C — A halogen bulb's color temperature is directly related to the filament's operating temperature, which is directly related to the voltage applied. A headlight circuit with excessive voltage drop delivers less voltage to the bulb — the filament operates at a lower temperature and emits light that is shifted toward the yellow-red end of the spectrum. The other headlight receiving full voltage glows white-hot. The visual color difference between the two headlights is a voltage drop indicator that is often more noticeable than the brightness difference.

61. B — Electronic throttle systems use two independent position sensors in the accelerator pedal assembly for redundancy and safety verification. The ECM continuously compares the two sensor signals, which should track each other proportionally. If the sensors disagree by more than the allowable tolerance, the ECM cannot determine which sensor is correct and therefore cannot determine the driver's throttle intent. Defaulting to idle eliminates the risk of unintended acceleration from a faulty sensor signal.

62. D — Multiple wheel speed sensors losing signal simultaneously — and all returning to normal simultaneously — points to a common cause rather than multiple independent sensor failures. If the sensor signals share a wiring harness section or pass through a common connector between the sensors and the ABS module, a fault in that shared path (chafed harness, corroded connector, loose pin) affects

all sensors that route through it. The simultaneous onset and recovery pattern confirms a single shared fault point.

63. C — Camera lenses on truck-mounted cameras are exposed to road spray, dirt, mineral deposits, and UV exposure. Over six months, a film of contamination builds on the lens surface that scatters incoming light, producing a washed-out, overexposed image. Internal fogging from moisture condensation inside the camera housing has the same effect. Cleaning the lens or replacing the camera (if the fogging is internal) restores normal image quality. This is the most common and simplest cause of progressive camera image degradation.

64. A — GPS multipath interference occurs when GPS satellite signals reflect off nearby structures (buildings, overpasses, elevated highways, large vehicles) and arrive at the GPS antenna via an indirect path. The reflected signal travels a longer distance than the direct signal, and the receiver's position calculation is skewed by the incorrect distance measurement. The 500-metre error at a specific, repeatable location is characteristic of a consistent multipath environment — the same structures create the same reflections each time the vehicle passes that point.

65. D — The BCM's software shows no active output command for the left rear marker circuit — the software is correctly commanding "off." But the hardware (the output driver transistor or relay) has failed in the conducting state, keeping the circuit energized regardless of the software command. This hardware failure is independent of the software — the transistor has shorted internally and creates a direct power path to the lamp circuit that the software cannot interrupt. The BCM must be replaced or the output driver repaired.

66. B — The hour meter counts every minute the engine runs, whether the vehicle is moving or not. The odometer only counts distance traveled. A vehicle that spends significant time idling — overnight PTO operation for sleeper berth power, extended delivery stops, traffic congestion, or extended warm-up periods — accumulates engine hours without adding corresponding distance. This is why fleet managers use hours-based maintenance intervals rather than mileage-based intervals for vehicles with high idle time.

67. C — An alternator-speed-proportional whine through the speakers is caused by the alternator's AC ripple being induced onto the radio's power supply or signal wiring. The alternator produces an AC component (ripple) on its output that increases in frequency with RPM. If the radio's power or ground wire runs near the alternator output cable, the ripple is inductively coupled onto the radio's circuit and amplified through the speakers. Rerouting the radio's wiring away from the alternator cable or adding a noise filter on the radio's power supply eliminates the interference.

68. A — The fault code specifies the sensor signal is below the normal operating range — a voltage lower than the sensor should produce at any pedal position, including fully released. An open or ground-shortened signal wire sends the ECM a near-zero voltage that falls below the minimum calibrated value. The ECM recognizes this as a circuit fault (not a valid pedal position) and defaults to idle speed as a safety measure, preventing unintended acceleration from a potentially erratic sensor signal.

69. D — A noise that occurs only when the clutch pedal is depressed (release bearing loaded) and stops when the pedal is released (bearing unloaded) isolates the fault to the release bearing. The bearing rotates under load against the pressure plate's release mechanism when the pedal is pressed. A dry, worn, or damaged bearing produces the grinding or growling noise under this loaded, rotating condition. When the pedal is released, the bearing lifts off the pressure plate and stops rotating, eliminating the noise.

70. B — As the clutch disc friction facing wears thinner, the pressure plate clamp load pushes the pressure plate closer to the flywheel. This changes the geometry of the release mechanism — the release bearing's travel to fully disengage the clutch stays the same, but the engagement point shifts higher in the pedal travel because less disc thickness means the pressure plate engages sooner during pedal release. An engagement point very near the top of pedal travel indicates the disc is near the end of its service life.

71. A — An overfull automatic transmission causes the planetary gear sets and clutch packs to churn through the excess fluid, whipping air into it. The aerated (foamy) fluid is compressible — unlike liquid hydraulic fluid, which is essentially incompressible. Compressible fluid causes delayed and erratic clutch pack application, producing rough shifts. The churning also generates significant heat from the energy wasted on moving the excess fluid, and the elevated pressure from the extra volume can damage seals.

72. C — A 4-degree difference between front (1°) and rear (5°) U-joint operating angles prevents the inherent speed fluctuations of the Cardan U-joints from cancelling. The cancellation requires equal angles. The uncanceled fluctuation produces a vibration at twice per driveshaft revolution that worsens with speed. The angles must be equalized within approximately 1 degree by adjusting the transmission mount, the carrier bearing mount, or the rear axle pinion angle — whichever adjustment brings both angles into agreement.

73. D — The differential lock's shift collar engages teeth that lock both axle shafts together. When the lock is engaged on dry pavement, the axle shafts are under torsional load from the speed difference between the wheels during turns. This torsional load presses the collar's teeth against the engagement teeth with tremendous force, mechanically binding the collar in the engaged position. Relieving the

torque — by lifting the throttle, stopping the vehicle, or momentarily shifting to neutral — unloads the teeth and allows the collar to slide free.

74. A — The clutch packs function through hydraulic clamping force transmitted through the transmission fluid. As fluid temperature rises, its viscosity drops — the fluid becomes thinner. Worn clutch packs that have reduced friction surface area rely on the fluid's viscosity to supplement their clamping force. When the fluid is cold and thick, the additional viscous drag helps the worn clutches hold. At operating temperature, the thinner fluid provides less supplemental clamping, and the worn clutch surfaces cannot hold against the engine's torque, causing slippage.

75. A — Driveshaft runout means the shaft's physical centerline does not coincide with its rotational axis. As the shaft rotates, the off-center mass creates a centrifugal force that pulls the shaft outward at the high point once per revolution. This force increases with the square of the rotational speed — doubling the speed quadruples the force. The result is a vibration at one per revolution that is barely perceptible at low speed but becomes increasingly severe at highway speed.

76. C — The transfer case's 4WD gear set or chain only transmits torque when 4WD is engaged. In 2WD, these components are unloaded and do not rotate (or rotate freely without load). Wear on the 4WD gears, stretched chain, or worn sprockets produces noise only when these components are loaded — which is exclusively during 4WD operation. The whine increases with speed because the worn components' noise output is proportional to their rotational speed under load.

77. A — The turbine speed sensor provides the TCM with the transmission input shaft speed. The TCM uses this data along with the output shaft speed to calculate the speed ratio across the transmission, which tells the TCM which gear is actually engaged, how much the clutch packs are slipping, and when to command the next shift. Without input speed data, the TCM cannot perform any of these calculations and locks the transmission in a single, safe gear as a limp-home protection.

78. A — Resting a foot on the clutch pedal — even with light pressure — pushes the release bearing into contact with the pressure plate's release mechanism. This light contact partially disengages the clutch, allowing the disc to slip under the engine's torque load. The slip is too small for the driver to feel as a power loss, but it generates continuous friction heat between the disc facing, the flywheel, and the pressure plate. This heat accelerates facing wear, glazes the friction surfaces, and can damage the pressure plate's diaphragm spring from sustained heat exposure.

79. B — A transmission that shifts normally in all forward gears but will not engage reverse has a fault specific to the reverse holding element. The valve body's manual valve directs fluid to the reverse servo

or clutch when the selector is moved to reverse. If the manual valve is stuck, the reverse servo has a leaking apply piston, or the reverse apply circuit has a restriction, the reverse element does not receive adequate pressure to apply. Forward circuits are unaffected because they use different apply circuits. The valve body and reverse apply circuit must be inspected.

80. B — Deep heat cracks and blue discoloration indicate the flywheel has been subjected to temperatures that exceeded the cast iron's (or steel's) heat treatment limits. The metallurgy has been permanently altered — the hardness, grain structure, and fatigue resistance are no longer at their original specifications. Resurfacing removes the visible damage but does not restore the metallurgy. A resurfaced but metallurgically compromised flywheel will develop new cracks under the thermal stress of normal clutch operation, leading to premature failure.

81. A — The blocker ring is the synchronizer's gating device. Its tapered friction surface contacts the selected gear's cone to equalize speeds, but its indexing teeth serve the critical blocking function — they are positioned so that the sliding sleeve cannot advance past the ring until the speeds match. As long as a speed difference exists, the friction between the cone surfaces keeps the ring's teeth misaligned with the sleeve's teeth, physically blocking advancement. When speeds equalize, the friction drops, the ring aligns, and the sleeve passes through to lock the gear.

82. B — The inter-axle lock's shift collar engages splines that connect the two axle shafts. If these splines are worn, they develop free play — clearance between the male and female spline teeth. When the vehicle starts from a stop with the lock engaged, the engine applies torque to the drivetrain through the worn splines. The splines take up their free play with a clunk before transmitting torque to the locked axles. This occurs only during the torque application from a stop because the spline free play has already been loaded during steady-state driving.

83. A — The hydraulic pump turns (confirming the PTO drive is functional), and the engine RPM is correct. But the hydraulic functions are at half speed — which means half the normal flow is reaching the actuators. The pump's internal wear (enlarged clearances between gears and housing) allows fluid to leak back through the clearances under pressure rather than being pushed to the discharge port. The pump can still reach the relief valve's pressure setting (because the relief valve sets maximum pressure regardless of flow), but the reduced flow means the cylinders fill at half the rate and move at half the speed.

84. A — The two-speed axle shift motor or air actuator is the component that physically moves the shift mechanism inside the axle housing. The dash switch and indicator lamp operate on an electrical circuit that is separate from the actuator's power circuit. The switch can send the "high range" command and the indicator can show the selection without the mechanical shift actually occurring — the switch and lamp

only confirm that the electrical signal was sent, not that the physical shift was completed. The actuator, its power supply, and the mechanical shift mechanism must be inspected.

85. D — Gear oil viscosity determines the thickness of the lubricant film between the gear teeth and bearing surfaces. If the viscosity is significantly below the specification, the film is too thin to prevent metal-to-metal contact under the heavy loads transmitted through the gear train. Without adequate film thickness, the gear teeth and bearing surfaces wear through direct contact, producing pitting, scoring, and eventual failure. The correct viscosity grade specified by the transmission manufacturer must be used.

86. C — Steering effort that is different in one direction versus the other indicates a directional fault in the power steering assist circuit. The steering gear has separate internal hydraulic passages for left-turn and right-turn assist. A worn seal, a damaged spool valve, or a blocked passage on the left-turn side reduces the hydraulic assist for that direction only. The right-turn circuit remains functional, producing normal assist in that direction. Internal steering gear diagnosis requires pressure and flow testing at the gear's test ports.

87. A — Excessive caster tilts the steering axis further from vertical, which increases the arc that the tire's contact patch must travel during a turn. At low speeds (where tire-to-pavement friction is highest because the tire must scrub rather than roll through the turn), the increased arc requires significantly more force to complete. The driver perceives this as heavy steering during parking and tight turns. At highway speed, the self-centering effect of the increased caster improves stability, and the reduced scrubbing at speed makes the increased effort less noticeable.

88. D — In a dual tire pair, the inner and outer tires share the load at that wheel position. If the inner tire's inflation pressure is significantly lower than the outer tire, the inner tire flexes more under the shared load. The excessive flexion concentrates the contact forces on the inside edge of the tread, causing accelerated wear on that edge. Meanwhile, the properly inflated outer tire maintains its designed contact patch and wears normally. The inflation pressures on both tires in the dual pair must be equalized.

89. B — The steering wheel drifts off-center while the vehicle tracks straight — this means the road wheels are pointing straight ahead but the steering wheel is slowly rotating. An internal bypass leak in the power steering gear allows fluid to slowly cross from one chamber to the other inside the gear, gradually moving the gear's internal piston. This piston movement rotates the output shaft and pitman arm by a small amount, which the steering wheel follows. The road wheels do not move because the slow, low-force internal leak is absorbed by the steering linkage's compliance.

90. A — The center bolt is the sole positive locating device between the leaf spring pack and the axle's spring seat. When the bolt shears, the spring leaves can shift laterally on the spring seat. Any lateral force — from cornering, road crown, crosswind, or uneven braking — can push the axle off-center on the spring. This changes the wheelbase on that side, alters the axle's perpendicularity to the frame, and causes the vehicle to dog-track. The sheared bolt must be replaced immediately to restore positive axle location.

91. D — The kneeling system uses a dedicated valve or control circuit that overrides the normal height control to lower the bus front for passenger boarding. If this kneeling valve sticks in the kneeling position after the kneeling cycle, it continues to vent or bypass air from the front air springs, preventing the height control system from raising the bus back to ride height. The kneeling valve, its control solenoid, and the return mechanism must be inspected for a sticking or stuck condition.

92. A — Both tires are the correct size, properly inflated, correctly aligned, and operating on the same axle position. The only remaining variable is the tire itself. Different brands or models — even with the same size designation — use different tread compounds with different hardness ratings and wear characteristics. A softer compound grips better but wears faster. Standardizing tire brands and models across both steer tire positions ensures equal wear rates and eliminates the discrepancy.

93. C — The centerline wear groove from throat to lock position is created by the trailer king pin sliding across the fifth wheel top plate during each coupling event. The tractor backs under the trailer, and the king pin enters the throat and slides across the plate until it reaches the locking jaws. Over thousands of coupling events, this repeated sliding contact wears a groove along the king pin's path. Proper greasing of the fifth wheel plate reduces the wear rate but cannot eliminate it entirely.

94. A — Recurring stud cracking at one wheel position, despite correct hardware and torque, indicates a mechanical condition at that specific hub-to-wheel interface that creates cyclic bending loads on the studs. A warped hub flange or damaged wheel mounting surface prevents the wheel from seating flat. With each revolution, the cocked wheel flexes the studs back and forth through the mounting plane — this cyclic bending creates fatigue stress concentrations that propagate into cracks and eventual fracture.

95. D — Spread tandem suspensions position the axles farther apart than standard tandems, which amplifies the effect of any axle misalignment. Even a small angular deviation from perpendicular produces more tire scrub on a spread tandem because the scrubbing force acts over a longer distance between the two axle contact patches. Inside-edge wear on both axles indicates a toe condition created by one or both axles being angled relative to the trailer frame. Alignment must be checked and corrected with precision appropriate for the wider axle spacing.

96. B — The 12 and 6 o'clock rocking test is designed to detect wheel bearing end play, but worn king pin bushings also allow vertical movement at the steering knuckle. This king pin movement can mimic or add to the bearing play reading, producing a false or exaggerated result. The technician must stabilize the steering knuckle (by having an assistant apply the brakes or by blocking the knuckle) to isolate the bearing play from the king pin play before condemning the bearings.

97. C — The rear axle is not perpendicular to the frame — it is angled so that the right side is forward of the left. This angular deviation causes the rear axle to "steer" the rear of the vehicle to the right of the front axle's path. The result is visible dog-tracking — the vehicle appears to travel at a slight angle to its actual direction. Common causes include a broken center bolt allowing the spring to shift, a bent trailing arm, or misaligned suspension mounting hardware.

98. A — A 15 psi pressure loss over 24 hours with no visible damage requires systematic investigation. The first step is to reinflate to the correct pressure and monitor — if the pressure drops again at a similar rate, the leak is confirmed. Submerging the tire and wheel assembly in water reveals the leak location through a stream of bubbles. The leak could be at the valve stem (the most common slow-leak source), the bead-to-rim seal, a small puncture in the tread or sidewall, or a cracked rim.

99. D — Temporary relief from lubrication followed by rapid noise recurrence indicates that the components cannot retain the lubricant. The clearances between the pins and bushings have worn to the point where grease is displaced almost immediately by the suspension's normal articulation. The worn bushings and enlarged clearances allow the grease to migrate out of the load zone, and the metal-to-metal contact that produces the squeak returns within a week. The worn components need replacement, not repeated lubrication.

100. C — Recurring outer sidewall blowouts with correct inflation, correct load rating, and correct axle weight point to a structural overloading of the outer sidewall specifically. Excessive positive camber tilts the top of the wheel outward, shifting the tire's load concentration to the outer sidewall. The outer sidewall operates under continuous stress that exceeds its design capacity at that angle, generating heat and fatigue that leads to eventual failure. Correcting the camber to within specification eliminates the asymmetric loading.

101. A — The air suspension is functioning correctly (ride height is correct at the axle), but the trailer floor is not level. This means the discrepancy is in the frame, not the suspension. A twisted frame has its left and right rails at different heights even though the suspension maintains the correct axle-to-frame distance at the spring mounting points. The twist causes one side of the deck to sit lower than the other. Frame twist can result from uneven loading, collision damage, or fatigue from years of asymmetric cargo placement.

102. D — Steer axle tire tread depth requirements apply across the entire tread face — not just the center, not just the edges, and not as an average. The 3/32 inch measurement on the outer edges falls below the 4/32 inch minimum legal requirement for steer axle tires. Even though the center tread exceeds the minimum, the tire does not pass inspection because any measurement point below the minimum disqualifies the tire. The uneven wear pattern also indicates an alignment or inflation issue that should be investigated.

103. D — A diamond condition means the frame is parallelogram-shaped instead of rectangular — one rail has shifted forward relative to the other. This geometric distortion affects every component mounted to the frame: axle positions are shifted (causing dog-tracking and accelerated tire wear), body mounting points are misaligned (causing door fit problems), and drivetrain alignment is compromised (potentially causing driveshaft vibration). The diamond measurement is a critical frame inspection that reveals collision or fatigue damage.

104. B — The cab tilt pump motor stopping mid-tilt while the switch is still activated indicates the motor's circuit has been interrupted. A tripped circuit breaker is the most likely cause — the motor drew more current than the breaker's rating allows, which could result from a binding tilt cylinder, corroded pivot points, an obstruction in the cab's tilt path, or a mechanical interference that increases the load beyond the motor's normal operating range. The breaker protects the motor from damage by interrupting the circuit when current exceeds the safe limit.

105. D — The engine, transmission, driveline, and tires have been eliminated as vibration sources. Cab mounts isolate the cab from the frame, and when they deteriorate, they lose their vibration-damping capacity. At highway speed, the combination of road input, drivetrain vibration, and aerodynamic forces excite the cab at a frequency that the deteriorated mounts cannot dampen. At lower speeds, the excitation frequency is different and does not match the cab's resonant frequency with the degraded mounts, so the vibration is not perceptible.

106. A — The defrost system distributes heated air through dedicated ductwork to specific windshield and window areas. If the duct branch serving the driver's side window is disconnected (from vibration or maintenance disturbance), collapsed (from age or heat exposure), or blocked (by debris or a misrouted component), the heated air cannot reach that specific window area. All other areas receive normal airflow because their duct branches are intact. Inspecting the ductwork routing to the driver's side window area identifies the disconnection or blockage.

107. C — A heated seat element that works for exactly the same duration (10 minutes) before stopping, and resets when the ignition is cycled, suggests a thermal protection circuit is activating at a consistent threshold. The thermal protection circuit monitors the heating element's temperature — if a temperature sensor reads too hot (from a faulty sensor, a bunched element that creates a hot spot, or a controller fault), the protection circuit shuts off the element to prevent fire or burn injury. The ignition cycle resets the protection circuit, allowing another 10-minute run before the threshold is reached again.

108. B — The A-pillar (the structural pillar between the windshield and the door) has body panel seams sealed with seam sealer during manufacturing. Over years of service, this sealer can crack, shrink, or separate from the metal. The rain gutter channel at the top of the A-pillar directs water flowing off the roof over the door opening — if this channel has a crack or gap, water enters the cab interior at the A-pillar and runs down the inside surface to the driver's leg area. The door seal and windshield seal being intact rules out those entry points.

109. B — The pushrod boot is a protective cover that seals the opening where the pushrod exits the brake chamber housing. A torn boot allows dirt, road salt, moisture, sand, and debris to enter the chamber and contact the diaphragm, the return spring, and the pushrod guide. Over time, this contamination causes diaphragm deterioration (shortening its service life), corrosion that can seize the pushrod in its guide (preventing brake release), and internal component damage. The torn boot must be replaced to restore the environmental seal.

110. C — An intermittent wheel speed sensor signal that appears during driving but not at stops indicates a connection that is affected by the dynamic conditions of driving — vibration, wheel rotation, suspension movement, and road spray. The sensor wiring harness is exposed to all of these conditions as it routes from the sensor at the wheel to the ABS module on the frame. A chafed harness, a loose connector pin, or a wire with broken strands inside intact insulation can maintain contact when static but lose contact under the dynamic loads of driving.

111. A — Livestock trailer floors bear the concentrated loads of animal hooves and the dynamic forces of animals shifting during transport. Worn or cracked floor boards can break under these loads, allowing an animal's leg to fall through the opening and become trapped. This creates an animal welfare emergency, a load security hazard (a trapped animal can cause other animals to panic and shift dangerously), and a potential structural failure of the trailer floor. Floor condition is a critical inspection item for livestock trailers.

112. D — A lift axle's alignment is set independently from the main tandem suspension. Excessive toe-out on the lift axle causes both tires to angle outward, scrubbing their outer edges against the road surface during straight-line driving. The lift axle's alignment must be checked and adjusted separately

using the trailer's frame centerline as the reference. This is a commonly overlooked maintenance item because the lift axle is only deployed when the trailer is loaded and may not be inspected as frequently as the main tandem.

113. B — A flickering lamp that continues after bulb replacement has a circuit fault, not a bulb fault. The socket, its ground connection, and the wiring between the J560 connector and the lamp are the three remaining components. A corroded socket creates intermittent contact between the bulb base and the socket contacts. A high-resistance ground point (corroded ground bolt, deteriorated ground wire) causes intermittent voltage drop. A damaged wire with partially broken conductors makes and breaks contact with vibration. Each of these produces flickering that persists regardless of the bulb.

114. C — Operating with one failed air spring for 100 km subjected the opposite-side spring and suspension to approximately double its rated load. The overloaded spring may have stretched beyond its elastic limit, shortening its service life. The suspension hardware (mounts, brackets, shock absorbers) on the overloaded side absorbed forces beyond their design, potentially developing fatigue damage. The tires on the overloaded side carried excess weight and wore unevenly from the leaning trailer. A thorough inspection of all components on both sides is required.

115. A — The lamp socket has voltage (confirmed by the meter) but the lamp does not illuminate. The circuit requires both a power supply and a ground return. Voltage at the hot terminal only confirms the supply side. If the ground path is open — from a corroded ground screw, a broken ground wire, or a rusted-through ground point — the circuit cannot complete and no current flows through the bulb. A high-impedance voltmeter can read voltage at an open circuit because it draws negligible current, but the bulb needs substantial current to illuminate.

116. D — The defrost cycle is essential for reefer operation at freezing temperatures. As the evaporator operates below 0°C, moisture in the cargo air freezes on the evaporator fins, gradually building an ice layer that blocks airflow. The defrost cycle periodically reverses the system (using hot gas bypass) to melt this ice. If the defrost timer, solenoid, or hot gas valve fails, the ice accumulates continuously until the evaporator is completely blocked, eliminating all airflow and rendering the cooling system ineffective despite continuing to run.

117. B — Both pressures being closer together than normal — low side too high (50 vs 25-35) and high side too low (150 vs 200-250) — means the compressor is not creating an adequate pressure differential. A healthy compressor pushes refrigerant from the low side to the high side, maintaining a large pressure gap. A worn compressor with leaking valves, worn pistons, or a damaged scroll mechanism allows refrigerant to leak back through internal clearances, equalizing the pressures toward each other. The compressor must be replaced.

118. A — Hot air from the floor vents but lukewarm air from the upper vents with the system on maximum heat suggests the air destined for the upper vents is losing heat before arriving. If a blend door or mode door actuator has malfunctioned, some of the air may be routed through the A/C evaporator before reaching the upper ducts. The evaporator core retains residual cold even when the A/C is not actively commanded, and the air passing over it loses heat. The floor duct bypasses the evaporator entirely, delivering fully heated air.

119. C — Electronic refrigerant leak detectors are extremely sensitive and can detect residual refrigerant on component surfaces from previous service events, minor handling contamination, or even ambient refrigerant in shop air. Before concluding that the condenser has an active leak, the condenser surface must be thoroughly cleaned to remove any residual refrigerant. After cleaning, the detector is used again — an alarm on a clean surface confirms an active leak, while no alarm confirms the original detection was from surface contamination.

120. D — The rear A/C system cycling on and off while the front system runs continuously indicates the rear system has a condition that periodically interrupts compressor operation. A low refrigerant charge causes the low-pressure switch in the rear system's circuit to open when the suction pressure drops below the cut-out threshold during compressor operation. When the compressor stops, pressure equalizes and rises above the cut-in threshold, and the compressor restarts. If the front and rear systems share a refrigerant circuit, the front system's larger evaporator may mask the low charge.

121. B — A fuel-fired heater that has been inactive for the entire summer season commonly develops air locks in the fuel supply line. The long period of non-use allows fuel to evaporate or drain back from the supply line, replacing the fuel column with air. When the heater starts, it fires briefly on residual fuel in the combustion chamber, but the fuel pump cannot prime itself through the air-locked line to deliver continuous fuel. The flame dies after the initial fuel burns off. Priming the fuel line (bleeding air from the system) restores continuous fuel delivery.

122. A — Replacing the cabin air filter removes the filter's contribution to the odor but does not address the microbial colony growing on the evaporator core surface. The evaporator operates at temperatures near the dew point, and condensation continuously forms on its fins during A/C operation. This dark, moist environment is ideal for mold and mildew growth. The microbial colony produces the musty odor that is carried into the cab by the blower's airflow. An antimicrobial treatment applied directly to the evaporator surface kills the existing growth and inhibits regrowth.

123. D — Moisture trapped in the A/C system (from inadequate evacuation before charging) circulates with the refrigerant in liquid or vapor form. When the moisture reaches the expansion valve — the coldest point in the system — it freezes. The ice gradually restricts and eventually blocks the expansion

valve's orifice, stopping refrigerant flow and eliminating cooling. During the 10-minute rest period with the compressor off, the ice melts and the orifice clears, restoring flow when the compressor restarts. The cycle repeats until the system is properly evacuated and recharged.

124. D — In an open-center hydraulic system, the directional control valve's neutral (center) position routes the pump's output directly to the tank through an open center passage at near-zero pressure. If the spool does not return fully to center, it partially blocks this open-center passage, forcing the pump to build pressure to push fluid through the partially restricted opening. The gauge displays this built-up pressure. Common causes include a weak centering spring, contamination preventing full spool travel, or a bent spool that catches on the valve body.

125. B — Using $P = F/A$: the piston area of a 5-inch bore cylinder is $\pi \times r^2 = 3.14 \times 2.5^2 = 3.14 \times 6.25 = 19.63$ square inches. $P = 50,000 \text{ lb} \div 19.63 \text{ in}^2 = 2,546$ psi. This calculation is fundamental to hydraulic system design — knowing the required force and the cylinder bore allows the technician to determine the system pressure needed, which must be compared to the pump's capacity and the relief valve setting to verify the system can deliver the required force.

126. B — All other functions operate at normal speed from the same pump, confirming the pump's output is adequate. The slow swing is isolated to one circuit that has its own dedicated flow control valve. A partially closed or restricted flow control limits the flow reaching the swing motor while all other circuits receive their normal share of pump output. Adjusting or cleaning the flow control valve restores normal swing speed without affecting any other function.

127. C — Plugging the cylinder ports directly eliminates the path through the directional control valve. When the drift stops with the ports plugged, the cylinder's internal piston seal is confirmed as intact — it is not the leak source. The leak must have been occurring through the valve — fluid was crossing from the cylinder's work port to the tank port through worn spool clearances inside the valve. This conclusive test isolates the valve as the drift source and directs repair to the valve body or spool.

128. B — A pressure-compensated variable-displacement pump automatically adjusts its displacement (the volume of fluid pumped per revolution) based on system demand. When no function is commanded and the system reaches the compensator's pressure setting, the pump reduces its displacement to near zero — producing just enough flow to replace internal leakage and maintain pressure. This standby mode dramatically reduces energy consumption and heat generation compared to a fixed-displacement pump that would continuously dump its full output through the relief valve.

129. D — The pump requires a free-flowing supply of fluid at its inlet to operate properly. A kinked suction line restricts this supply, creating a partial vacuum at the pump's inlet. When the suction-side pressure drops below the fluid's vapor pressure, dissolved air and fluid vapor form bubbles (cavitation). These bubbles are carried into the pump's high-pressure discharge side, where they collapse violently against the pump's internal surfaces. The collapsing bubbles erode the metal surfaces, producing the characteristic screaming noise and progressively destroying the pump.

130. A — Pressure is confirmed at the valve's retract work port — the pump and valve are functioning correctly for the retract command. The fluid must travel from the valve's work port through the retract line to the cylinder's rod port. Any obstruction in this dedicated line — a kink, a blockage from contamination, or a closed shut-off valve — prevents the pressurized fluid from reaching the cylinder even though it is available at the valve. Inspecting the line between the valve and the cylinder identifies the obstruction.

131. C — The dump body raises normally (fluid flows freely from the reservoir through the pump and valve to the cylinder's cap port). During lowering, the fluid must exit the cylinder and return to the reservoir through the return path. A restriction in this return path — a clogged return filter, a kinked return line, or a partially closed valve — limits the rate at which fluid can exit the cylinder, slowing the descent speed. The dump body's weight pushes the fluid through the restriction, but the flow rate is limited by the restriction's capacity.

132. B — In a parallel hybrid, both the diesel engine and electric motor can drive the wheels through the shared transmission. The electric motor provides its greatest efficiency advantage at low speeds and light loads — exactly the conditions where a diesel engine is least efficient (high fuel consumption per unit of work). During low-speed urban operation, the system uses the motor alone for quiet, zero-emission propulsion. When higher power is needed (acceleration, hill climbing, highway cruising), the diesel engine starts and either assists the motor or takes over completely.

133. D — The regenerative braking system captures approximately 60% of the kinetic energy, but the remaining 40% is not lost to a single source. It is distributed across multiple paths: the friction brakes (which supplement regenerative braking during moderate to heavy deceleration) dissipate energy as heat, aerodynamic drag converts kinetic energy to turbulent air motion, tire rolling resistance converts energy to heat at the tire-road interface, and electrical conversion losses in the motor, inverter, wiring, and battery convert some energy to heat during the regeneration process.

134. A — DC fast charging pushes high current into the battery cells, and the cells' internal resistance converts a portion of this electrical energy into heat. At 150 kW, the heat generation rate is significant. As cell temperature rises toward the BMS's maximum threshold, the BMS progressively reduces the

charging current to limit further temperature increase. This protects the cells from thermal damage that would reduce their capacity and lifespan. The reduced charging rate (50 kW) generates less heat, allowing the cells to stabilize at a safe temperature.

135. C — Swollen cell pouches indicate internal gas generation — a process called outgassing that occurs when the cell's electrolyte decomposes. Electrolyte decomposition is caused by overcharging, overdischarging, internal short circuits, manufacturing defects, or physical damage. The generated gas pressurizes the pouch from inside, causing visible swelling. Swollen cells are in a compromised state that can progress to thermal runaway — an uncontrolled exothermic chain reaction. The module must be treated as a potential fire and chemical exposure hazard and handled according to strict hazardous materials protocols.