PRACTICE EXAM 3: RED SEAL 310T SIMULATION (135 QUESTIONS)

1. A technician is preparing to perform maintenance on a vehicle's electrical system. The truck is parked with the engine off. Another technician needs to move the truck and starts the engine without checking under the hood. What workplace safety principle was violated?

A. The second technician failed to wear hearing protection before starting a diesel engine in the shop

B. The second technician should have verified the tire pressures before moving the vehicle

C. The first technician should have placed wheel chocks before beginning work on any vehicle system

D. The lockout/tagout procedure was not followed — the first technician should have applied a personal lock to the ignition and battery disconnect to prevent unauthorized startup while working on the vehicle

2. A technician cuts their hand on a sharp piece of sheet metal while fabricating a bracket. The cut is minor and treated with the shop's first-aid kit. Under the Occupational Health and Safety Act, what must happen next?

A. Nothing further is required since the injury was treated on-site and did not require hospital attention

B. The injury must be reported to the supervisor and documented in the workplace injury log, regardless of severity, to comply with reporting requirements and to identify the hazard for prevention

C. The technician must file a claim with the Workplace Safety and Insurance Board before returning to work

D. The shop must contact the Ministry of Labour within 24 hours to report the incident and request an inspector

3. A technician encounters a chemical product on the shelf with a WHMIS 2015 pictogram showing a flame symbol inside a red diamond-shaped border. Which hazard class does this pictogram represent?

A. Corrosive material that causes severe burns to skin and eyes on contact

B. Compressed gas stored under high pressure that may explode if heated

C. Flammable material that can ignite when exposed to heat, sparks, open flames, or other ignition sources

D. Oxidizing material that can intensify a fire by releasing oxygen to support combustion

4. A shop uses an overhead bridge crane to lift heavy components such as transmissions and engines. Before each lift, what must the operator verify about the crane?

A. The crane's rated capacity exceeds the weight of the load being lifted, the rigging is appropriate for the load, and all safety devices including the hook safety latch are functional

B. The crane was manufactured within the last ten years and carries a current CSA certification sticker

C. The crane's electrical supply is disconnected from the main panel to prevent power surges during the lift

D. The crane rails have been lubricated within the last 30 days to ensure smooth travel during the lift

5. A technician is changing a tire on a truck equipped with a multi-piece rim assembly. During inflation, the lock ring fails and is propelled from the rim. What safety equipment would have prevented injury to the technician?

A. A steel-reinforced face shield worn during the inflation process to protect against rim components

B. Hearing protection rated for impulse noise levels exceeding 140 dB that a ring failure can produce

C. A tire safety cage that contains the rim components during inflation, with the technician standing outside the cage and using a clip-on chuck with a remote hose

D. Flame-resistant coveralls that protect the technician from the heat generated by a rapid tire deflation

6. A technician needs to verify the correct torque specification for a steering component. The shop manual is not available. What is the appropriate course of action?

A. Estimate the torque based on the fastener size using a general torque chart for SAE Grade 5 bolts

B. Access the manufacturer's service information system to obtain the specific torque specification for that component before proceeding with the installation

C. Tighten the fastener until it feels snug and then add a quarter-turn for safety margin

D. Ask a coworker who has worked on the same model for the approximate torque from memory

7. A technician notices that a coworker has been using compressed shop air at 120 psi to blow dust off their clothing at the end of each shift. Why is this practice dangerous?

A. Compressed air at shop pressure can damage the fabric of flame-resistant work clothing

B. The noise level from compressed air exceeds the 85 dB exposure limit for unprotected ears

C. Compressed air can redistribute hazardous dust particles into the breathing zone of other workers

D. Compressed air at shop pressure can penetrate the skin and introduce air into the bloodstream causing an air embolism, and can propel debris into the eyes or ears causing serious injury

8. A technician discovers that the fire extinguisher nearest to their work area has a gauge reading in the red (discharged) zone. What is the correct action?

A. Report the discharged extinguisher to the supervisor immediately, remove it from service, and have it recharged or replaced before any further work is performed in that area

B. Continue working and report the extinguisher condition at the next scheduled safety meeting

C. Relocate to a different work bay that has a fully charged extinguisher, regardless of the work being performed

D. Attempt to recharge the extinguisher using the shop's compressed air system to restore the pressure reading

9. A four-stroke diesel engine with six cylinders fires in a specific sequence. The firing order of a common inline six-cylinder diesel is 1-5-3-6-2-4. If cylinder 1 is at TDC on the compression stroke, which cylinder is at TDC on the exhaust stroke (its companion cylinder)?

A. Cylinder 2, which is positioned 120 degrees from cylinder 1 on the crankshaft

B. Cylinder 3, which fires immediately after cylinder 1 in the firing order sequence

C. Cylinder 6, which is the companion cylinder — when cylinder 1 is at TDC compression, cylinder 6 is at TDC exhaust

D. Cylinder 5, which is the next cylinder to fire after cylinder 1 completes its power stroke

10. A technician is inspecting a diesel engine's wet cylinder liners during an overhaul. The outer surface of one liner shows a pattern of small, deep pits concentrated on the thrust side. What has caused this damage?

A. Cavitation erosion — the rapid vibration of the liner wall during combustion creates and collapses microscopic vapor bubbles in the coolant, progressively eroding the outer liner surface

B. Galvanic corrosion from dissimilar metals between the liner and the engine block material

C. Abrasive wear from silicon particles in the coolant that have circulated through the cooling system

D. Electrolysis caused by a stray electrical current flowing through the coolant between the block and liner

11. An engine's oil analysis report shows that the Total Base Number (TBN) has dropped from 8.2 to 2.1 over the last sampling interval. What does this indicate?

A. The oil viscosity has increased beyond the acceptable range and the oil must be changed immediately

B. The oil has become contaminated with fuel dilution that has lowered its flash point to dangerous levels

C. The oil filter is bypassing and allowing unfiltered oil to circulate through the engine's lubrication circuit

D. The oil's acid-neutralizing capacity has been severely depleted — it can no longer protect internal engine surfaces from acid attack, and the oil change interval has been exceeded or combustion byproducts are overwhelming the oil's additive package

12. A heavy-duty diesel engine has a cracked exhaust manifold. The driver reports a ticking noise that increases with engine RPM and is louder when the engine is cold. What is the diagnostic significance of this symptom?

A. The ticking noise indicates a loose rocker arm that is amplified by the exhaust manifold acting as a resonance chamber

B. The cracked manifold is leaking exhaust gas externally — the ticking is the pulse of exhaust escaping through the crack, louder when cold because the crack opens wider before thermal expansion closes it partially as the manifold heats up

C. The noise is caused by a loose heat shield vibrating against the cracked manifold surface at specific RPM ranges

D. The ticking indicates that exhaust backpressure is fluctuating due to the crack, causing the turbocharger to surge

13. A technician is performing a cylinder head crack inspection on a cast iron head using the magnetic particle inspection (MPI) method. What is the principle behind this inspection technique?

A. A dye penetrant is sprayed on the head surface and drawn into cracks by surface tension for visual detection

B. The head is heated to a specific temperature and then rapidly cooled, causing cracks to become visible as the metal contracts

C. The head is magnetized and iron particles applied to the surface collect along crack lines where magnetic flux leaks from the crack, making the crack visible

D. An ultrasonic transducer is placed on the head surface and sound waves reflect off internal cracks for display on a screen

14. During an engine overhaul, a technician measures the piston ring end gap on a new compression ring installed in the cylinder. The measured end gap is 0.008 inches. The manufacturer's minimum specification is 0.015 inches. What action must be taken?

A. The ring end gap must be enlarged by carefully filing the ring ends to bring the gap within specification — an insufficient gap will cause the ring ends to butt together when the ring expands with heat, resulting in ring breakage, scuffing, and cylinder wall damage

B. The ring is acceptable as-is because a tighter end gap provides a better combustion seal and reduces blow-by

C. The ring must be replaced with the next oversize ring because the gap cannot be increased once the ring is manufactured

D. The cylinder liner must be honed to a larger diameter to increase the ring end gap to the correct specification

15. A heavy-duty diesel engine's coolant pressure cap is rated at 15 psi. What is the purpose of pressurizing the cooling system?

A. To increase the flow rate of coolant through the radiator by providing additional force beyond the water pump pressure

B. To prevent air from entering the system through the heater core connections during cold-weather operation

C. To force coolant past any minor gasket leaks and maintain system integrity despite small sealing imperfections

D. To raise the boiling point of the coolant, preventing localized boiling at hot spots within the engine and allowing the system to operate at higher temperatures without losing coolant to evaporation

16. A truck driver reports that the engine runs normally at idle and light load but lacks power under heavy load. Intake boost pressure is within specification. Exhaust gas temperature is higher than normal under load. What is the most likely cause?

A. A restricted air filter element that is limiting airflow to the turbocharger during high-demand conditions

B. One or more fuel injectors are delivering less than the commanded fuel quantity due to wear, plugging, or an electrical fault, resulting in reduced power output despite adequate air supply

C. The engine oil level is overfull, creating windage losses that consume power at high RPM under load

D. The EGR valve is stuck open, diluting the intake charge at all operating conditions and reducing available oxygen

17. What is the correct procedure for checking the oil level on a heavy-duty diesel engine?

A. Park the vehicle on a level surface, shut the engine off, wait the manufacturer-specified time for oil to drain back to the pan, then pull and read the dipstick — ensuring the reading falls between the minimum and maximum marks

B. Check the oil level with the engine running at idle to ensure the oil pump is circulating and the reading reflects the actual volume in the system

C. Check the oil level with the engine running at 1,500 RPM to simulate highway driving conditions and get an accurate operating level

D. Check the oil level immediately after shutting down a fully warm engine to capture the measurement at the highest oil temperature

18. A technician finds that the air filter restriction indicator on a heavy-duty diesel is showing red (maximum restriction). The filter was replaced 5,000 km ago. What condition would cause premature filter loading?

A. An oversized filter element that has more surface area than the original and traps particles more aggressively

B. Operating the vehicle at consistently high altitudes where reduced air density causes the indicator to trigger falsely

C. Using a synthetic filter element instead of the original paper element specified by the manufacturer

D. Operating in an extremely dusty environment such as a construction site, mine road, or unpaved agricultural area that loads the filter with airborne particulate much faster than normal highway operation

19. A heavy-duty diesel engine is running with a knocking noise from the lower end that is loudest at idle and diminishes under load. The noise sounds like a deep, dull knock rather than a sharp metallic click. What is the most likely source?

A. A worn wrist pin (piston pin) that produces a double knock at idle speed when cylinder pressure is low

B. Excessive valve lash on the exhaust valves that creates a rhythmic clicking from the valve train at idle

C. A worn main bearing or connecting rod bearing that knocks under the low oil film pressure conditions at idle — the increased oil pressure at higher RPM partially cushions the bearing and reduces the noise intensity

D. A cracked flywheel that resonates at the engine's idle frequency but is dampened by the load at higher speeds

20. What distinguishes a HEUI (Hydraulic Electronic Unit Injector) fuel injection system from a conventional common rail system?

A. HEUI systems use electrical solenoids to directly open the injector nozzle, while common rail systems use piezoelectric actuators exclusively

B. HEUI systems use high-pressure engine oil acting on an intensifier piston inside the injector to generate injection pressure, while common rail systems maintain constant high-pressure fuel in a shared rail using a dedicated high-pressure fuel pump

C. HEUI systems operate at lower injection pressures than common rail systems and are used primarily on gasoline engines

D. HEUI systems do not require an electronic control module, relying entirely on mechanical oil pressure regulation

21. A technician notices that the coolant recovery tank (overflow tank) on a heavy-duty diesel is consistently overfull and there is oily residue floating on the coolant surface. What is the most likely cause?

A. Combustion gases are leaking into the cooling system through a cracked head, cracked liner, or blown head gasket, pressurizing the coolant and forcing it into the overflow tank — the oily residue is from combustion byproducts contaminating the coolant

B. The coolant mixture ratio is incorrect, with too high a concentration of antifreeze that expands excessively when heated

C. The water pump is oversized for the application and generating excessive pressure that forces coolant past the cap

D. The radiator fan clutch is engaging too early, overcooling the engine and causing thermal shock that pushes coolant into the recovery tank

22. A diesel engine's timing gear train uses a series of meshing gears to connect the crankshaft, camshaft, and accessory drives. What is the consequence of excessive gear train backlash?

A. Excessive backlash improves engine performance by reducing parasitic friction between the gears at high RPM

B. Excessive backlash has no measurable effect on engine operation as long as the timing marks are aligned

C. Excessive backlash causes a minor fuel economy reduction but does not affect valve or injection timing

D. Excessive backlash causes timing variation between the crankshaft and camshaft positions, gear noise, and accelerated gear wear that can eventually lead to a timing failure

23. A truck operates in a region where biodiesel blends (B20 — 20% biodiesel, 80% petroleum diesel) are commonly sold. What maintenance consideration is unique to biodiesel operation?

A. Biodiesel requires a higher-cetane glow plug to achieve proper cold-start combustion temperatures

B. Biodiesel has solvent properties that can loosen deposits in the fuel system, potentially plugging fuel filters more frequently during the initial transition from petroleum diesel to biodiesel blends

C. Biodiesel requires a dedicated fuel injection pump that is different from the pump used with petroleum diesel

D. Biodiesel must be stored in pressurized tanks because it evaporates more readily than petroleum diesel at ambient temperatures

24. A heavy-duty diesel engine has a diagnostic trouble code indicating the exhaust backpressure sensor reading is higher than expected for the current operating conditions. The engine is in a derate condition. What is the most likely cause?

A. The turbocharger wastegate is stuck open, reducing exhaust energy available to the turbine

B. The exhaust manifold has a crack that is reducing backpressure below the sensor's expected range

C. The diesel particulate filter is heavily loaded with soot or ash, creating excessive resistance to exhaust flow that the sensor detects as elevated backpressure

D. The exhaust gas temperature sensor has failed and is sending a false signal to the ECM

25. A technician is replacing the water pump on a heavy-duty diesel engine. During removal, the technician notices that the impeller vanes are severely eroded — nearly half of each vane is missing. What would this impeller condition cause during operation?

A. Severely reduced coolant flow through the engine because the eroded impeller cannot effectively pump coolant, leading to localized overheating particularly under load despite a full coolant system and functioning thermostat

B. Excessive coolant flow that overwhelms the thermostat and prevents the engine from reaching operating temperature

C. Cavitation noise from the pump but no measurable reduction in cooling system performance

D. Coolant leaking past the water pump seal due to the imbalanced impeller creating excessive shaft vibration

26. What happens inside a diesel engine cylinder during the brief period of valve overlap — when both the intake and exhaust valves are open simultaneously?

A. Fuel is injected during overlap to preheat the incoming air charge for improved combustion efficiency

B. The engine's compression ratio is temporarily reduced to zero, eliminating all cylinder pressure

C. The overlap allows lubricating oil to be drawn into the cylinder from the valve guide clearance for ring lubrication

D. The momentum of the outgoing exhaust gases helps draw fresh intake air into the cylinder, improving volumetric efficiency — this scavenging effect is enhanced on turbocharged engines where boost pressure assists the airflow

27. A technician performs a cooling system pressure test and the system holds pressure with no drop for 15 minutes. However, the engine continues to overheat under load. The coolant level is correct. Which component should be investigated next?

A. The thermostat, which may be functioning but opening at too high a temperature, delaying coolant flow to the radiator until the engine has already exceeded its optimal temperature range under load

B. The oil cooler, which may be transferring excessive heat from the oil into the coolant circuit at a rate the radiator cannot dissipate

C. The coolant temperature sensor, which may be reading higher than the actual temperature and triggering a false overheat indication

D. The exhaust gas temperature sensor, which may be contributing to an incorrect ECM calculation of cooling demand

28. A diesel engine equipped with a variable geometry turbocharger has a diagnostic code for "VGT Over-Speed." The engine produces excessive boost pressure at high RPM and the turbocharger makes a high-pitched whine. What is the most likely cause?

A. The VGT actuator has failed mechanically and cannot respond to ECM commands to adjust vane position

B. The VGT vanes are stuck in the closed or partially closed position, restricting exhaust flow and forcing the turbine to spin faster than designed because the exhaust energy is concentrated through a smaller opening

C. The turbocharger bearing oil supply is restricted, reducing the lubrication film and allowing the shaft to accelerate freely

D. The charge air cooler has a leak that is reducing boost pressure, causing the ECM to close the VGT vanes in an attempt to increase boost

29. A fleet manager asks a technician to explain why one truck in the fleet consistently achieves better fuel economy than an identical truck on the same route. Both trucks have the same engine, transmission, axle ratio, and tire size. What mechanical condition should be investigated on the lower-economy truck?

A. The higher-economy truck may have a more efficient alternator that reduces parasitic engine load

B. The higher-economy truck likely has a newer air filter with less restriction that improves turbocharger efficiency

C. The lower-economy truck should be checked for conditions that increase rolling resistance or parasitic load — dragging brakes, low tire pressure, a failed fan clutch that runs the fan continuously, a thermostat stuck open causing cold running, or misaligned axles that cause tire scrub

D. Both trucks should be weighed to verify they are carrying identical cargo loads on the comparison route

30. A technician is diagnosing an air compressor that builds pressure normally but the discharge air feels excessively hot and contains visible oil mist at the air dryer inlet. What is the most likely cause?

A. The compressor's piston rings are worn, allowing excessive oil to pass from the crankcase into the compression chamber and be pumped into the air system along with heated compressed air

B. The compressor's discharge valve is stuck open, allowing compressed air to recirculate and overheat

C. The air dryer heating element is stuck on, heating the incoming air before it enters the desiccant bed

D. The compressor is oversized for the system and is generating excessive heat from over-compression

31. During a brake service, a technician discovers that the S-cam brake shoes on a rear drive axle are contaminated with axle lubricant. The brake shoes have visible grease on their friction surfaces. What additional inspection is required beyond replacing the shoes?

A. The brake drums must be resurfaced to remove any grease embedded in the friction surface of the drum

B. The air brake chambers must be replaced because the grease may have entered the diaphragm area

C. The tire pressures must be checked because grease contamination often correlates with incorrect inflation

D. The axle hub seal must be inspected and replaced, as the grease contamination source is most likely a failed hub seal that is allowing axle lubricant to migrate outward onto the brake components

32. A school bus driver reports that the brake pedal feels normal but the bus takes significantly longer to stop than usual. All brake adjustments are within specification and the air system pressure is normal. What should the technician investigate?

A. The tire tread depth and condition, which if severely worn would reduce the tires' traction capability regardless of brake system condition

B. The brake lining material, which may have become glazed (hardened and polished from overheating), dramatically reducing its coefficient of friction and braking effectiveness despite appearing to have adequate thickness

C. The ABS system, which may be activating prematurely and releasing brake pressure before adequate deceleration is achieved

D. The air dryer, which may be allowing moisture into the brake chambers and reducing the effective diaphragm area

33. An air brake system's safety valve (pressure relief valve) on the wet tank is popping off at 145 psi. The governor is set to cut out at 125 psi. What does this indicate?

A. The governor has failed to signal the compressor to unload at the cut-out pressure, allowing the compressor to continue building pressure until the safety valve opens at its relief setting — the governor must be diagnosed and repaired

B. The safety valve spring is too weak and is opening at too low a pressure

C. The compressor discharge valve is stuck open and is bypassing the governor's unloading mechanism

D. The air dryer purge valve is stuck closed, trapping air and creating excessive pressure in the supply circuit

34. A tractor-trailer combination is parked on a steep grade. The driver applies the parking brakes and exits the vehicle. The vehicle begins to roll slowly downhill. What is the most likely cause?

A. The trailer brakes are not equipped with spring brake chambers and rely solely on the tractor's parking brakes

B. The air system has a slow leak that is gradually reducing spring brake hold-off pressure, allowing the springs to partially release

C. The rear brake linings are severely worn or the slack adjusters are significantly out of adjustment, reducing the spring brakes' mechanical advantage against the drum to a level insufficient to hold the vehicle on the grade

D. The parking brake valve in the cab has returned to the released position due to a broken detent spring

35. A technician is replacing a brake chamber on a drive axle. The new chamber is a Type 30/30 long-stroke dual chamber. What does the "30/30" designation indicate?

A. The chamber has a 30-cubic-inch displacement on both the service side and the spring brake side

B. The chamber has a 30-square-inch effective diaphragm area on both the service side and the spring brake side, which determines the force output of each section at a given air pressure

C. The chamber is rated for a maximum of 30 psi on the service side and 30 psi on the spring brake side

D. The chamber has a 30-degree mounting angle and a 30-mm pushrod diameter for compatibility with the slack adjuster

36. A heavy-duty truck's ABS modulator valve on the right front wheel is leaking air continuously from its exhaust port even when the brakes are not applied. What does this indicate?

A. The ABS system is performing a continuous self-test that vents small amounts of air through the modulator

B. The modulator's internal return spring is worn, causing the valve to remain partially in the release position

C. The foot valve is sending a residual pressure signal to the right front circuit that is activating the modulator

D. The modulator valve has an internal seal failure or a stuck valve component that is allowing system air to leak through the exhaust port — the modulator must be replaced

37. What is the primary difference between a Type 30 standard-stroke brake chamber and a Type 30 long-stroke brake chamber?

A. The long-stroke chamber has a deeper housing that allows the pushrod to travel farther before reaching its maximum effective stroke, providing a greater adjustment reserve and more consistent braking force as the linings wear

B. The long-stroke chamber operates at higher air pressure than the standard-stroke chamber for increased braking force

C. The long-stroke chamber has a larger diaphragm area than the standard-stroke chamber for higher force output

D. The long-stroke chamber is designed for front axle steer brakes only, while the standard-stroke is used on drive axles

38. A technician is performing a brake inspection and notices that one of the front brake drums has a blue discoloration on the inside friction surface. What does this discoloration indicate?

A. The drum was manufactured with a surface treatment that produces a blue tint and is cosmetic only

B. The drum has been contaminated with a cleaning solvent that has stained the friction surface

C. The drum has been severely overheated, likely from a dragging brake, stuck caliper, or prolonged braking — the heat has changed the metallurgical properties of the drum and it must be replaced regardless of its dimensional measurements

D. The drum has been exposed to moisture during storage and has developed surface oxidation that will wear off during normal use

39. An articulated transit bus has two steering axles — a front steer axle and an articulation steering axle. Both axles are equipped with air disc brakes. During braking on wet pavement, the driver notices that the ABS activates much more aggressively on the rear section of the bus. What is the most likely cause?

A. The ABS module is programmed to apply more aggressive modulation to the rear section for stability control purposes

B. The rear section tires have less tread depth or a different tread compound than the front section, providing less traction on wet surfaces and causing the wheels to approach lockup more readily

C. The front section disc brakes are more powerful than the rear section and absorb more kinetic energy before ABS activation is needed

D. The ABS wheel speed sensors on the rear section are out of calibration, triggering premature ABS activation

40. A truck driver reports hearing a loud "bang" from under the truck followed by the loss of all air pressure in the primary circuit. The secondary circuit holds pressure normally. All brakes appear to function on the secondary circuit. What is the most likely cause?

A. The governor has catastrophically failed and vented all primary circuit air through its exhaust port

B. The primary circuit relay valve has failed internally and is continuously exhausting primary circuit air to atmosphere

C. The air compressor has seized and the drive gear has broken, which would affect both circuits equally

D. A primary circuit air line or component has failed catastrophically (burst hose, cracked fitting, or blown chamber diaphragm), rapidly venting the entire primary reservoir to atmosphere while the secondary circuit remains intact due to the dual-circuit protection design

41. What is the correct method for measuring brake drum inside diameter?

A. Place a drum gauge or inside micrometer at the open end of the drum and measure the diameter across the widest point, recording the measurement at multiple positions to check for out-of-round — compare to the maximum allowable diameter stamped on the drum

B. Measure the outside circumference of the drum with a tape measure and calculate the inside diameter using π

C. Use an outside micrometer to measure the drum wall thickness and subtract from the known outside diameter

D. Place a feeler gauge between the brake shoe and drum at the widest point and add the feeler gauge thickness to the shoe diameter

42. A truck equipped with air brakes experiences a condition where the front brakes release normally but the rear brakes release slowly — taking 3 to 4 seconds to fully release after the brake pedal is released. What is the most likely cause?

A. The rear brake chambers have a larger volume than the front chambers, which is normal and accounts for the release delay

B. The ABS modulator valves on the rear axle are holding residual pressure after the brake application cycle

C. A restricted air line, a sticking relay valve, or a partially blocked quick release valve on the rear circuit is slowing the exhaust of application air from the rear brake chambers

D. The rear brake return springs are weak and cannot retract the shoes quickly enough to keep pace with the air release rate

43. During a brake test, a technician measures the applied pushrod stroke at all wheel positions. The measurements are as follows: left front 1.5", right front 1.5", left rear outer 1.75", right rear outer 1.75", left rear inner 2.25", right rear inner 2.25". The maximum allowable stroke for all chambers is 2.0". Which positions require attention?

A. All positions require adjustment because none are at the optimal stroke of 1.0"

B. Only the left and right rear inner positions at 2.25", as they exceed the 2.0" maximum allowable stroke and the automatic slack adjusters must be diagnosed for the root cause of the over-stroke condition

C. All rear positions, both outer and inner, because they are closer to the maximum than the front positions

D. None of the positions require attention because all measurements are within an acceptable range

44. A hydraulic brake system on a medium-duty truck has a spongy pedal that improves after pumping the pedal several times. The fluid level is correct and no external leaks are found. What is the most likely cause?

A. The brake pads are contaminated with oil that is compressing under pressure and causing the spongy feel

B. The brake calipers are sticking on their slide pins, preventing full pad-to-rotor contact on the first application

C. The master cylinder bore is scored, allowing fluid to bypass the primary piston during the first application

D. Air is trapped in the hydraulic brake circuit — the air compresses during the first application (causing the spongy feel), and repeated pumping forces the air bubble to a location where it has less effect

45. A fifth-wheel-equipped tractor is in for service. The driver reports a loud clunk from the coupling area during acceleration and braking transitions. The fifth wheel jaws are verified as locked around the king pin. What is the most likely cause?

A. The fifth wheel top plate, jaws, or king pin are worn, creating excessive free play that allows the coupling to shift during torque reversals between acceleration and braking

B. The trailer's upper coupler plate is bent from a previous docking impact and is sitting unevenly on the fifth wheel surface

C. The fifth wheel mounting bolts are loose, allowing the entire fifth wheel assembly to shift on the frame

D. The king pin retaining bolts on the trailer have loosened, allowing the king pin to move within its mounting plate

46. A transit bus equipped with drum brakes on all axles has a condition where the brakes pull strongly to the right during moderate to heavy braking. The tires are matched and properly inflated. What is the most likely cause?

A. The right front brake is operating normally while the left front brake has a malfunction — a restricted air supply, an out-of-adjustment slack adjuster, or contaminated linings on the left front are reducing braking force on that side

B. The right front wheel bearing is loose, allowing the drum to shift and contact the shoes unevenly

C. A malfunctioning left side brake creates unequal braking force — the right side generates more force, pulling the vehicle toward the stronger-braking right side during application

D. The steering alignment is out of specification and the pull only becomes apparent during braking because the deceleration forces amplify the alignment deviation

47. A technician is testing a circuit with a known 12-volt source and a 24-watt bulb. Using Watt's Law ($P = V \times I$), what current does the bulb draw?

A. 288 amps

B. 2 amps — calculated by dividing the wattage by the voltage ($24W \div 12V = 2A$)

C. 0.5 amps

D. 12 amps

48. A heavy-duty truck's charging system is tested and the alternator output voltage reads 12.2 volts at the battery terminals with the engine running at 1,500 RPM and no loads applied. What does this indicate?

A. The battery is fully charged and the voltage regulator has reduced output to match the battery's state of charge

B. The alternator is producing adequate voltage for a 12-volt system since the reading exceeds 12.0 volts

C. The voltage regulator is operating in a fuel-economy mode that reduces charging voltage during highway driving

D. The alternator is not charging the battery — the 12.2-volt reading is the battery's own voltage, not the alternator's output, which should be 13.8 to 14.4 volts when the charging system is functioning

49. In a parallel electrical circuit, what happens to the total circuit current when an additional load (such as another light bulb) is connected in parallel?

A. The total circuit current increases because the additional load provides another path for current flow, reducing total circuit resistance

B. The total circuit current decreases because the additional load shares the existing current with the original load

C. The total circuit current remains the same because the voltage source cannot provide additional energy

D. The total circuit current doubles regardless of the resistance of the additional load

50. A technician is diagnosing a truck that has frequent battery failure — the batteries are being replaced every four to six months. The alternator output and battery loads have been tested and are within specification. What additional test should be performed?

A. A coolant conductivity test to check for stray current paths through the cooling system that are draining the batteries

B. A charging circuit voltage drop test to verify the alternator output is reaching the batteries without excessive loss

C. A parasitic draw (key-off drain) test to identify an electrical load that remains active when the vehicle is shut down, slowly draining the batteries during periods of non-use

D. A battery acid specific gravity test at multiple ambient temperatures to create a temperature compensation curve

51. A heavy-duty truck has a complete no-start condition. When the ignition key is turned to the start position, nothing happens — no click, no cranking, no dash lights. Battery voltage across the posts reads 12.6 volts. What should the technician check first?

A. The battery cable connections and the master disconnect switch — clean, tight connections and a closed disconnect are required for any current to flow from the battery to the vehicle's electrical system

B. The starter motor for a seized armature that is preventing any electrical draw from the battery

C. The alternator for a shorted diode that is creating a dead short on the battery's output

D. The engine ECM for a fault code that has disabled the starting circuit as a protective measure

52. A truck's auxiliary battery disconnect switch (master cutoff switch) is located on the frame rail near the battery box. What is the primary purpose of this switch?

A. To disconnect the batteries from the charging system during extended storage to prevent the alternator from overcharging

B. To provide a second ignition switch location for emergency engine shutdown from outside the cab

C. To reduce parasitic battery drain during extended parking by disconnecting all electrical loads from the batteries

D. To provide a single-point battery disconnection for safety during maintenance, emergency situations, or extended storage — isolating all vehicle electrical systems from the battery in one action

53. A technician is measuring the voltage at each battery in a four-battery bank (two pairs of 12-volt batteries in series-parallel for a 24-volt system). Three batteries read 12.5 to 12.6 volts, but one reads 10.8 volts. What is the correct action?

A. Replace only the weak battery with a new battery of the same size, type, and CCA rating

B. The weak battery at 10.8 volts must be load-tested — if it fails, it should be replaced, and its series partner should also be replaced to maintain a matched pair, since a mismatched pair accelerates the failure of the stronger battery

C. Charge all four batteries simultaneously for 24 hours and retest — the weak battery may recover to normal voltage

D. Swap the weak battery's position with one of the stronger batteries to see if the low voltage reading follows the battery or stays at the position

54. A truck's marker lights, tail lights, and clearance lights all operate on the same circuit. The fuse for this circuit blows repeatedly. The technician inspects the wiring and finds no visible damage. What diagnostic technique should be used to locate the fault?

A. Disconnect each lamp fixture one at a time and replace the fuse after each disconnection — when the fuse stops blowing, the last disconnected fixture or its wiring is the location of the short circuit

B. Replace the fuse with a higher amperage fuse to overcome the temporary overload condition

C. Measure the voltage at each lamp socket while the circuit is de-energized to find the socket with the lowest reading

D. Replace all lamp fixtures simultaneously since the short could be in any of them and individual testing is unreliable

55. A technician is tracing a circuit using a wiring diagram. The diagram shows a component symbol consisting of a coil winding connected to a set of switch contacts that are mechanically linked. What component does this symbol represent?

A. A circuit breaker with a bimetallic trip element that opens under overcurrent conditions

B. A solenoid that converts electrical energy into linear mechanical motion through electromagnetic force

C. A relay — the coil winding creates a magnetic field that moves the mechanically linked switch contacts to open or close a separate circuit

D. A transformer that converts voltage between different levels in the vehicle's electrical distribution system

56. A truck's left headlight is inoperative on low beam but works on high beam. The right headlight works on both beams. The fuse for the low-beam circuit is intact. What is the most likely cause?

A. The left headlight low-beam filament has burned out — in a dual-filament bulb, the high-beam and low-beam filaments are independent, and one can fail while the other continues to function

B. The dimmer switch is not completing the circuit to the left low-beam position due to a worn internal contact

C. The left headlight ground connection is intermittent and only makes contact when the high-beam circuit is energized

D. The body controller module has detected a voltage fault on the left low-beam circuit and has disabled that output

57. A technician connects a scan tool to a heavy-duty truck's diagnostic connector and retrieves a fault code from the engine ECM for "Throttle Position Sensor — Signal Voltage Above Normal Range." What is the most likely fault?

A. The accelerator pedal assembly has a worn potentiometer that is no longer providing the correct signal

B. The throttle position sensor wiring has a damaged insulation allowing the signal wire to contact the reference voltage wire

C. The ECM's internal analog-to-digital converter is malfunctioning and reading the sensor signal incorrectly

D. The TPS signal wire has an open circuit or a short to the voltage reference (typically 5 volts), causing the ECM to see a voltage higher than the sensor should produce at any pedal position

58. A truck's electric fuel pump (low-pressure transfer pump) runs continuously when the ignition is on, even when the engine is not running. On this system, the fuel pump should only run when the engine is cranking or running. What is the most likely cause?

A. The fuel pump relay has failed in a manner that grounds the pump circuit regardless of engine operation

B. The fuel pump relay contacts have welded closed, providing continuous power to the pump regardless of the control signal from the ECM — the relay must be replaced

C. The fuel pump check valve is stuck open, causing the pump to run continuously to maintain fuel line pressure

D. The ECM is commanding the pump to run because it detects low fuel pressure from a leaking fuel rail

59. A heavy-duty truck has an intermittent electrical problem — the dash lights flicker, the radio resets, and the engine occasionally stumbles simultaneously. The problem occurs randomly and cannot be reproduced on command. What is the most likely common cause?

A. A loose or corroded main battery cable connection or ground connection that intermittently loses contact, momentarily interrupting power to all vehicle systems simultaneously

B. An alternator with a failing voltage regulator that produces intermittent voltage spikes affecting all circuits

C. A faulty ignition switch that intermittently loses contact in the RUN position during vibration or bumps

D. A CAN bus fault that disrupts communication to the instrument cluster, radio, and engine ECM simultaneously

60. A truck equipped with daytime running lights (DRLs) has a condition where the DRLs remain on even when the headlight switch is turned to the full-on position. The headlights illuminate normally but the DRLs do not extinguish. What is the most likely cause?

A. The headlight switch is faulty and is not sending the correct signal to the DRL module to deactivate the DRLs

B. The DRL fuse is oversized, preventing the DRL circuit from responding to the headlight switch command

C. The DRL module or the body controller's DRL circuit is not receiving the headlight-on signal that should command the DRLs to deactivate when the headlights are switched on

D. The alternator output is higher than normal, providing sufficient voltage to keep both the DRLs and headlights illuminated simultaneously

61. A technician is testing the starter solenoid on a heavy-duty truck. With the key in the START position, the technician measures 12.4 volts at the solenoid's S (signal) terminal and 0.2 volts at the solenoid's M (motor) terminal. The battery voltage is 12.5 volts. What is the diagnosis?

A. The ignition switch and control circuit are delivering adequate voltage to the solenoid coil (12.4V at S terminal), but the solenoid is not closing its internal contacts — the 0.2V at the M terminal confirms that battery current is not passing through the solenoid to the motor

B. The solenoid is functioning correctly because both terminals show voltage, confirming current flow to the motor

C. The starter motor has failed internally and the low voltage at the M terminal is the result of the motor's high resistance

D. The battery is too weak to supply both the solenoid coil current and the motor starting current simultaneously

62. A truck's electronic instrument cluster is displaying a "No CAN Communication" message. All gauges read zero and no data is displayed. What physical layer test should the technician perform first?

A. Replace the instrument cluster with a known-good unit to determine if the cluster is the source of the communication failure

B. Measure the amperage draw of the CAN bus to determine if excessive current is overloading the data link

C. Test the diagnostic connector pins for battery voltage to verify the scan tool is receiving power from the vehicle

D. Measure the termination resistance between CAN H (Pin C) and CAN L (Pin D) at the diagnostic connector — the reading should be approximately 60 ohms for a properly terminated bus with two 120-ohm resistors in parallel

63. A truck's license plate lamp is operating but is very dim. The technician measures 8.5 volts at the lamp socket. Battery voltage is 12.6 volts. What is consuming the missing 4.1 volts?

A. Unwanted resistance in the circuit — corroded connectors, deteriorated wiring, or a high-resistance ground connection is creating voltage drops that consume 4.1 volts before the current reaches the lamp

B. The lamp bulb is drawing excessive current that exceeds the circuit's capacity, causing a voltage reduction

C. The fuse for the license plate circuit is partially blown, creating a resistance that drops voltage across the fuse

D. The alternator is not maintaining consistent voltage to all circuits and the license plate circuit is at the end of the longest wire run

64. A technician is verifying the function of a temperature sender for a mechanical (non-electronic) gauge. The sender is a variable resistor that changes resistance with temperature. What happens to the gauge reading if the sender wire is disconnected while the ignition is on?

A. The gauge will read maximum temperature because the circuit sees infinite resistance with the sender disconnected

B. The gauge will default to a mid-range reading that represents the sender's normal operating temperature

C. The gauge reading depends on whether the gauge is a grounded-sender or powered-sender type — on most heavy-duty systems, a disconnected sender (open circuit) drives the gauge to one extreme of its scale, typically cold/low on grounded-sender systems

D. The gauge will read normally because the sender continues to provide its signal through the vehicle's chassis ground

65. A technician finds that the battery charging rate on a heavy-duty truck is consistently low — the alternator output is 13.2 volts at the alternator output terminal but only 12.4 volts at the battery terminals. What is the most likely cause?

A. The voltage regulator is set too low and needs to be adjusted to increase the alternator's output voltage

B. Excessive voltage drop in the charging circuit wiring between the alternator and the battery — 0.8 volts is being consumed by resistance in the output cable, connections, or fusible link

C. The battery has a shorted cell that is pulling the voltage down despite adequate alternator output

D. The alternator's field winding is partially open, reducing the magnetic field strength and limiting output

66. A truck's J1939 CAN bus is experiencing intermittent communication dropouts. The technician measures the DC voltage on CAN H at the diagnostic connector and reads 0.5 volts with the ignition on. The expected voltage is 2.5 to 3.5 volts. What does this indicate?

A. The CAN bus is functioning normally at a reduced data rate that produces lower voltage levels during light communication traffic

B. The 9-pin diagnostic connector has internal corrosion that is attenuating the CAN signal before it reaches the measurement point

C. The CAN bus termination resistors are both missing, which would produce higher voltage readings, not lower

D. CAN H is shorted to ground or there is a wiring fault on the CAN H line that is pulling the voltage below its normal operating range, disrupting communication for all modules on the bus

67. A technician is diagnosing a truck that blows the fuse for the power window circuit every time the driver's window is lowered approximately halfway. The window operates smoothly through the first half of its travel. What is the most likely cause?

A. At the halfway point of travel, the window wiring harness in the door has a damaged section where the insulation has worn through and the conductor contacts the door frame metal, creating a short to ground that draws current exceeding the fuse rating

B. The window motor develops a temporary stall condition at the halfway point due to the regulator mechanism binding

C. The window glass is chipped at the midpoint and the sharp edge cuts through the window channel seal, grounding the circuit

D. The power window switch has an internal contact fault that creates a short circuit only when the switch is in the down position past the halfway point

68. A heavy-duty truck has a condition where the ABS warning lamp comes on intermittently during highway driving but extinguishes when the vehicle slows down for city driving. The wheel speed sensors, reluctor rings, and wiring have been inspected and appear in good condition. What should the technician investigate?

A. The ABS module's power supply and ground connections for intermittent contact that occurs during highway vibration conditions

B. The vehicle's alternator for an overvoltage condition at highway RPM that causes the ABS module to fault

C. The wheel speed sensor air gaps, which may be slightly out of specification — the sensor signal at highway wheel speed may be marginally out of the ECU's expected frequency range, triggering the fault during high-speed operation

D. The tire sizes, which may be slightly different on different axle positions, producing speed signals that diverge at highway speed but remain within tolerance at lower speeds

69. A heavy-duty truck with a manual transmission and a dual-disc clutch is experiencing clutch chatter during engagement from a standstill. The clutch was not recently serviced. What is the most likely cause?

A. Excessive clutch free play that delays engagement until the engine RPM is too high for smooth takeoff

B. Oil contamination on the clutch disc facing from a leaking rear main engine seal, a leaking transmission input shaft seal, or over-lubrication of the release bearing, causing the disc to alternately grip and slip during engagement

C. A broken torsional damper spring inside the clutch disc hub that is failing to absorb engagement shock

D. An excessively worn pilot bearing allowing the transmission input shaft to wobble, causing the disc to contact the flywheel and pressure plate unevenly

70. A truck equipped with a 13-speed non-synchronized manual transmission is experiencing a condition where the driver cannot get the transmission into any gear from neutral with the engine running, but can shift into all gears with the engine off. What does this indicate?

A. The transmission's main shaft pilot bearing has seized, locking the input shaft to the mainshaft

B. The shift mechanism linkage has disconnected from the shift tower on top of the transmission

C. The synchronizer blocking rings are worn beyond their effective range and cannot slow the input shaft

D. The clutch is not fully releasing — the input shaft continues to spin when the clutch pedal is depressed, preventing the non-synchronized gears from meshing without gear clash

71. An Allison automatic transmission equipped with a torque converter has a condition called "stall speed." What does the stall speed measurement indicate?

A. The maximum RPM the engine reaches before the electronic speed governor intervenes and cuts fuel

B. The RPM at which the engine stalls due to excessive load from the torque converter under heavy hauling conditions

C. The maximum engine RPM achieved with the transmission in gear and the brakes applied to hold the vehicle stationary — this measurement verifies the condition of both the engine's power output and the torque converter's stall torque capacity

D. The minimum RPM required to engage the lockup clutch for fuel-efficient highway cruising

72. A technician is inspecting a driveshaft and finds that one U-joint has bright, rust-colored staining around the bearing caps and the grease fitting is missing. The joint is tight with no perceptible play. What is the correct action?

A. Replace the U-joint — the rust staining indicates that moisture has entered the bearing caps through the missing grease fitting, and the needle bearings are beginning to corrode even though play is not yet detectable; the joint will fail soon if left in service

B. Install a new grease fitting and lubricate the joint with a high-pressure grease gun to flush the contamination

C. Monitor the joint at the next scheduled service interval since there is no measurable play yet

D. Apply a rust inhibitor to the bearing caps and grease fitting location to arrest the corrosion progression

73. A truck's automatic transmission is slipping in 3rd gear only — the engine RPM flares momentarily during the 2-3 upshift, then the gear engages. All other shift points are normal. What is the most likely cause?

A. The torque converter lockup clutch is slipping because it engages in 3rd gear for the first time during the shift sequence

B. The transmission fluid is overheated and has lost viscosity, but only affects 3rd gear because it is the most torque-demanding gear

C. The governor pressure is incorrect, causing the transmission to shift too early into 3rd before the clutch pack is fully charged

D. The 3rd gear clutch pack is worn or has a leaking clutch piston seal that cannot maintain adequate clamping pressure, causing the clutch to slip momentarily during the shift until the apply pressure catches up

74. A technician replaces a center carrier bearing on a two-piece driveshaft. After the repair, a vibration is present that was not there before the repair. The U-joints are in good condition. What is the most likely cause of the new vibration?

A. The replacement carrier bearing is a different part number with different stiffness characteristics than the original

B. The driveshaft sections were separated during the repair and reassembled with the phasing marks misaligned, creating an out-of-phase condition that introduces a vibration at twice per driveshaft revolution

C. The carrier bearing crossmember bolts were not torqued to specification, allowing the bearing to shift under load

D. The new carrier bearing's rubber isolator is too stiff for the application, transmitting vibration that the original softer isolator absorbed

75. A heavy-duty truck with a tandem drive axle has the inter-axle differential lock engaged. What is the effect on the differential action within each individual drive axle?

A. The inter-axle lock only affects the torque split between the front and rear drive axles — each axle's own wheel-end differential continues to function normally, allowing the left and right wheels on each axle to turn at different speeds during turns

B. Both the inter-axle differential and the individual axle differentials lock simultaneously when the inter-axle lock is engaged

C. The individual axle differentials reverse their function when the inter-axle lock is engaged, causing the inside wheel to drive faster than the outside wheel during turns

D. The inter-axle lock disengages the individual axle differentials entirely, sending all torque to one wheel per axle

76. A truck equipped with a PTO-driven hydraulic system has a condition where the PTO engages but the hydraulic pump does not turn. The PTO output shaft rotates when checked manually with the PTO disengaged. What is the most likely cause?

A. The PTO shift mechanism is only partially engaging the PTO gear, causing it to spin without transmitting torque

B. The hydraulic pump is seized internally and cannot be driven by the PTO

C. The driveshaft or coupling between the PTO output shaft and the hydraulic pump input has failed — a broken driveshaft, a stripped spline coupling, or a sheared coupler pin allows the PTO to turn without transmitting torque to the pump

D. The transmission oil level is too low to lubricate the PTO gear mesh, causing the gear to slip under load

77. A technician is adjusting the ring and pinion backlash in a drive axle. The backlash measurement is 0.005 inches. The specification calls for 0.008 to 0.012 inches. What adjustment is needed?

A. Decrease the pinion depth by adding shims to move the pinion away from the ring gear centerline

B. Move the ring gear away from the pinion by adjusting the side bearing adjusters to increase the backlash to within specification — the current measurement of 0.005 inches indicates the ring gear is too close to the pinion

C. Replace the ring and pinion gear set because backlash below specification indicates the gears are worn beyond their service limit

D. No adjustment is needed because 0.005 inches is within the acceptable tolerance for heavy-duty drive axles

78. A heavy-duty truck has a humming noise from the rear axle that is present at all speeds and increases in pitch with vehicle speed. The noise is constant during acceleration, deceleration, and coasting. What is the most likely cause?

A. The ring and pinion gear set has a wear pattern that generates noise on both the drive and coast sides of the teeth

B. A worn differential side bearing is allowing the carrier to move, creating a constant-pitch noise at all load conditions

C. The axle shaft splines are worn and producing a humming sound as they rotate inside the side gear

D. A damaged wheel bearing on the drive axle is generating a constant speed-dependent noise regardless of torque load — wheel bearings produce noise based on rotational speed, not on whether the vehicle is accelerating or decelerating

79. A fleet technician is comparing two identical trucks with different final drive ratios: Truck A has a 3.08:1 ratio and Truck B has a 4.11:1 ratio. Assuming both trucks have the same engine, transmission, and tire size, which truck will have higher engine RPM at a given highway speed?

A. Truck B with the 4.11:1 ratio will have higher engine RPM at any given road speed because the higher numerical ratio means the driveshaft (and therefore the engine) must turn more revolutions per wheel revolution

B. Truck A with the 3.08:1 ratio will have higher RPM because the lower ratio means less torque multiplication and the engine must work harder

C. Both trucks will have the same engine RPM because the transmission ratios compensate for the axle ratio difference

D. The axle ratio has no effect on engine RPM at highway speed — only the transmission's top gear ratio determines engine speed

80. An automated manual transmission (AMT) displays a fault code for "Clutch Wear Beyond Learn Limit." The transmission shifts normally but the technician notices that engagement from a stop is rough and occasionally the engine stalls during takeoff. What does this code indicate?

A. The AMT's shift forks are worn and the transmission needs a complete rebuild to correct the engagement issues

B. The engine's idle speed is set too low for the AMT's engagement algorithm and must be increased by 100 RPM

C. The clutch disc friction material has worn beyond the point where the TCU's clutch actuator can compensate — the actuator has reached its maximum travel and can no longer achieve the precise engagement point, requiring clutch replacement and a TCU relearn procedure

D. The TCU software has not been updated to the latest version and needs to be reflashed to accommodate the current clutch condition

81. What is the function of the synchronizer assembly in a synchronized manual transmission?

A. It locks the output shaft to the mainshaft during high-speed operation to prevent the transmission from jumping out of gear

B. It equalizes the speed of the selected gear and the mainshaft before the sliding clutch sleeve engages, allowing smooth, clash-free gear changes without requiring the driver to double-clutch

C. It provides additional gear ratios between the main ratios by partially engaging two gears simultaneously

D. It prevents the driver from accidentally shifting into reverse while the vehicle is moving forward

82. A technician is diagnosing a vibration complaint on a single-piece driveshaft. The vibration occurs at highway speed and increases with speed. The technician rotates the driveshaft 180 degrees on the rear axle companion flange (unbolting it, rotating it half a turn, and re-bolting it). The vibration changes character but does not disappear. What does this indicate?

A. The vibration source is likely the driveshaft itself (imbalance or runout) rather than the companion flange — rotating the shaft changes the imbalance position relative to the flange but does not eliminate it because the imbalance travels with the shaft

B. The companion flange is the source of the vibration and the driveshaft is in good condition

C. The rear axle pinion bearing is the vibration source and the driveshaft rotation test is inconclusive

D. The vibration is caused by the transmission output shaft and cannot be affected by driveshaft repositioning

83. A driver reports difficulty engaging reverse gear on a heavy-duty manual transmission. All forward gears shift normally. The clutch is fully releasing. What is the most likely cause?

A. The reverse idler gear is not fully disengaging from the forward gear train before the reverse shift is attempted

B. The reverse gear synchronizer is worn and cannot match the speed of the reverse idler gear to the mainshaft

C. The clutch brake is worn or missing — on a heavy-duty transmission, the clutch brake stops the input shaft rotation when the clutch pedal is fully depressed, allowing clash-free engagement of reverse and low gears from a standstill

D. The reverse light switch on the transmission is malfunctioning and sending a signal that blocks reverse engagement through the TCM

84. A truck equipped with a hydraulic retarder on the Allison automatic transmission experiences reduced retarder effectiveness after the transmission oil is changed. The correct oil type and quantity were used. What is the most likely cause?

A. The new transmission oil is at a lower temperature than the old oil, which temporarily reduces the retarder's fluid coupling efficiency

B. Air was introduced into the retarder circuit during the oil change, reducing the fluid density in the retarder housing and decreasing the resistance that creates the retarding force — the air must be bled from the system

C. The retarder solenoid valve was disturbed during the service and is no longer fully opening to fill the retarder housing

D. The transmission filter replacement restricted flow to the retarder circuit due to a higher-efficiency filter element

85. What determines whether a manual transmission gear change requires a range shift, a splitter shift, or a main-box shift on an 18-speed transmission?

A. The driver's preference for RPM drop determines which shift type is used for each gear change

B. The ECM automatically selects the shift type based on vehicle speed and engine load through the CAN bus

C. The position change within the shift pattern determines the type — main-box shifts move the shift lever to a different gate position, splitter shifts toggle the splitter button for a small ratio step within the same gate position, and range shifts flip the range selector for a large ratio step between the upper and lower halves of the pattern

D. All shifts on an 18-speed are main-box shifts — the "range" and "splitter" descriptions refer to the gear ratios, not the shift method

86. A heavy-duty truck has a condition where the steering wheel oscillates rapidly from side to side at speeds between 70 and 90 km/h. The oscillation stops above and below this speed range. What is this condition called?

A. Steering wander, caused by worn steering linkage components that allow the wheels to drift randomly

B. Steering pull, caused by unequal caster angles that bias the steering to one side at specific speed ranges

C. Power steering cavitation, caused by a low fluid level that allows air into the system at specific engine RPM ranges

D. Steering shimmy (speed-sensitive oscillation), caused by an out-of-balance front tire, a worn steering damper, worn king pins, worn tie rod ends, or a worn wheel bearing that allows the steer axle to oscillate at the natural frequency excited by the specific road speed

87. A technician is inspecting the power steering system on a heavy-duty truck. The fluid in the reservoir is foamy and has a light brown color instead of the normal red. What does this indicate?

A. The fluid has been cross-contaminated with engine oil during a previous service event

B. Air is being drawn into the power steering system — likely through a loose suction line fitting, a low fluid level, or a cracked reservoir — causing the fluid to aerate and appear foamy

C. The power steering pump has failed internally and is generating metallic particles that change the fluid color

D. The steering gear has an internal coolant leak from a damaged heat exchanger that is mixing coolant with the power steering fluid

88. A truck's steer axle has a measured caster angle of +2 degrees on the left side and +4 degrees on the right side. What steering symptom will this condition produce?

A. The vehicle will pull to the left during straight-line driving because the side with less positive caster (+2 degrees) has less directional stability and less self-centering force, causing the steering to drift toward that side

B. The vehicle will pull to the right because the higher caster angle on the right side generates more self-centering force

C. The vehicle will wander at highway speed but track straight at low speed due to the caster differential

D. The caster difference will cause inside edge tire wear on the right steer tire and outside edge wear on the left

89. During a frame inspection on a concrete mixer truck, a technician finds a crack in the top flange of the right frame rail at a location where an auxiliary engine mount bracket is welded. What is the most likely contributing factor to this crack?

A. The concrete mixer's vibration has caused resonant fatigue at the bracket attachment point

B. Road salt corrosion has weakened the frame rail at the weld location to the point of cracking

C. The weld that attaches the bracket to the frame has created a heat-affected zone in the frame steel that is weaker and less fatigue-resistant than the surrounding base metal, and the cyclic loading from the mixer operation has initiated a fatigue crack at this weakened area

D. The frame rail was improperly heat-treated during manufacturing and has developed a latent defect

90. A truck with air ride suspension on the drive axles is exhibiting a condition where the vehicle's ride height drops noticeably when the engine is shut off for extended periods, then returns to normal within a minute of engine restart. What is the most likely cause?

A. A height control valve that is venting air while the vehicle is parked, allowing gradual pressure loss from the air springs

B. A slow air leak in the air spring system (at an air spring, a fitting, or a line) that allows the springs to gradually deflate during extended parking — the leak is slow enough that the compressor replenishes the lost air quickly when the engine is restarted

C. The air springs are losing their structural integrity and sagging under the vehicle's weight without continuous air pressure support

D. The air tank drain valves are leaking, reducing system pressure that feeds the air ride circuit during extended shutdowns

91. A transit bus has a damaged frame crossmember that has been bent in a collision. The crossmember connects the two frame rails at the midpoint of the bus. What is the consequence of operating the bus with this damaged crossmember?

A. Reduced fuel economy from the additional aerodynamic drag created by the bent crossmember protruding below the frame rail profile

B. No significant consequence since the frame rails carry all longitudinal loads and the crossmember is only a mounting point for accessories

C. Accelerated tire wear on the rear axle due to the crossmember's interference with the suspension geometry

D. Reduced torsional rigidity of the frame, which can cause the frame to twist under cornering and uneven loading forces — this can lead to misalignment of mounted components, cracking at other stress points, and compromised vehicle handling

92. A truck equipped with leaf spring suspension on the steer axle has a condition where the front of the vehicle sways excessively during lane changes and cornering. The shock absorbers have been replaced with no improvement. What additional component should be inspected?

A. The front stabilizer bar (anti-roll bar) and its mounting links and bushings — a disconnected, broken, or worn stabilizer bar allows excessive body roll during cornering because the bar can no longer transfer load between the left and right sides of the suspension

B. The leaf spring shackle pins, which if tight would increase body roll by preventing the springs from deflecting properly

C. The steer axle alignment, which if incorrect would cause swaying during directional changes

D. The cab mounting bushings, which if worn would allow the cab to sway on the frame independently of the chassis

93. A technician is inspecting tires on a long-haul tractor and finds that the drive tires show wear only on the inside and outside edges (both shoulders) while the center tread is in good condition. What is the most likely cause?

A. The tires have been run consistently overinflated, concentrating wear in the center and lifting the shoulders off the road

B. The drive axle alignment is causing both tires to toe excessively, scrubbing both edges during straight-line driving

C. The tires have been run consistently underinflated, causing the sidewalls to flex excessively and load the shoulder areas while the center of the tread lifts away from the road surface under the reduced inflation pressure

D. The shock absorbers are worn, causing the tires to bounce and wear the edges from intermittent contact

94. A heavy-duty truck has a broken leaf in the spring pack on the right rear suspension — not the main leaf, but the third leaf from the top. The leaf is cracked through its full width. Is this an out-of-service condition?

A. Yes — any broken leaf in a spring pack is an automatic out-of-service condition regardless of which leaf is broken

B. While a broken main leaf is an automatic out-of-service condition, a broken non-main leaf is a defect that must be monitored and repaired at the next scheduled service — it is not automatically out-of-service unless the spring's load-carrying capacity is visibly compromised (sagging, shifted axle, contact with frame)

C. No — only the main leaf is structurally critical, and broken non-main leaves have no effect on the spring's function

D. The determination depends on whether the broken leaf is on the tension side or the compression side of the spring pack

95. A trailer equipped with a slider tandem axle suspension has a condition where one of the slider locking pins will not fully engage after the axle position is adjusted. The pin appears undamaged. What should the technician investigate?

A. The air supply pressure to the slider release mechanism, which may be insufficient to fully retract and then release the pin

B. The trailer frame rail slider channel, which may be misaligned with the axle mounting bracket after the position change

C. The slider rail, which may be worn or corroded at the pin hole locations, preventing the locking pin from engaging

D. The slider pin engagement holes in the slider rail for corrosion buildup, debris, or damage that is physically preventing the pin from fully seating — also inspect the pin mechanism for a worn or broken return spring that cannot drive the pin fully into the engagement hole

96. A truck driver reports that the vehicle requires more steering effort than usual, particularly at low speeds during parking lot maneuvering. The power steering fluid level is full and the belt tension is correct. What should the technician check next?

A. The power steering pump output pressure and flow rate using a power steering analyzer to verify the pump is delivering adequate pressure and volume to the steering gear

B. The steer axle king pins, which if tight would resist steering movement and increase the effort required

C. The tire pressures on the steer axle, which if significantly underinflated would increase the contact patch area and require more force to turn

D. The steering column U-joints, which if binding would add mechanical resistance to the steering input

97. A tractor-trailer combination is being loaded and the trailer's tandem axles need to be repositioned to distribute the load for legal axle weight compliance. The slider lock pins are released but the axles will not slide. What is the most likely cause?

A. The trailer air suspension is over-pressurized and has lifted the slider axles off the slider rails

B. The slider rails are corroded and the friction between the rails and the trailer frame prevents the axles from sliding

C. The trailer's weight is resting on the slider lock pins because they were not fully retracted before attempting to move the axles — the trailer must be lifted slightly using the tractor's fifth wheel or a dock to unload the pins before sliding

D. The trailer ABS system is applying the brakes and preventing the axles from moving

98. A technician is performing a wheel bearing adjustment on a trailer hub with adjustable tapered roller bearings. After following the manufacturer's adjustment procedure, the technician spins the hub and notices a slight grinding feel. What does this indicate?

A. Normal bearing operation — all new or freshly adjusted bearings have a slight grinding feel during the initial break-in period

B. The bearing is contaminated with debris, damaged from a previous failure, or the adjustment is too tight — the bearing must be disassembled, inspected, and either cleaned and readjusted or replaced if damage is found

C. The bearing grease is too thick and will smooth out after the hub reaches operating temperature

D. The hub seal is dragging against the spindle and creating the grinding sensation that feels like a bearing problem

99. What is the primary purpose of a tire's speed rating?

A. To indicate the maximum speed at which the tire can be legally operated in any Canadian province

B. To specify the minimum inflation pressure required for the tire to maintain structural integrity at highway speed

C. To define the maximum load the tire can carry at any speed without risk of structural failure

D. To indicate the maximum sustained speed the tire can safely handle under specified load and inflation conditions — exceeding the speed rating causes excessive heat buildup that can lead to tread separation and structural failure

100. A truck has a wheel that is vibrating at highway speed. The tire has been balanced and the balance is confirmed as correct. The tire has no visible defects. What should the technician check next?

A. The wheel itself for excessive lateral runout or radial runout, and the hub mounting surface for debris, corrosion, or damage that prevents the wheel from seating true — a wheel that does not sit flat and centered on the hub will vibrate regardless of tire balance

B. The tire pressure, which if slightly below specification could cause a harmonic vibration at highway speed

C. The brake rotor or drum, which may be causing the vibration through brake pulsation rather than wheel imbalance

D. The shock absorber on that corner, which if worn would amplify tire vibration that balance correction cannot eliminate

101. A truck has both steer tires wearing rapidly and evenly across the entire tread surface. Tire pressure is correct, alignment has been verified as within specification, and no mechanical defects are found. What other factor could explain the accelerated wear?

A. The steer tires are a rib-pattern design that inherently wears faster than a lug-pattern drive tire regardless of conditions

B. The tires are installed in the wrong rotational direction, which reverses the self-cleaning tread design and accelerates wear

C. The vehicle's steer axle load exceeds the tires' rated load capacity, causing the tires to operate under excessive stress and wear faster than their designed rate

D. The driver's steering habits include holding the steering wheel at full lock during parking maneuvers, which scrubs the tread during stationary turning

102. A fifth wheel grease is specified as a lithium-complex EP (extreme pressure) grease. A technician substitutes a general-purpose lithium grease because the EP grease is not available. What is the potential consequence?

A. No consequence — all lithium-based greases are interchangeable for fifth wheel applications regardless of EP rating

B. The general-purpose grease may not withstand the extreme pressure and sliding loads between the fifth wheel top plate and the trailer king pin plate, leading to metal-to-metal contact, accelerated wear, and potential coupling noise and damage

C. The general-purpose grease will attract more dirt and debris to the fifth wheel surface than EP grease

D. The general-purpose grease has a different color that will make it difficult to distinguish from the EP grease during future inspections

103. A truck equipped with hub-piloted wheels has a recurring problem of wheel studs breaking on one particular wheel position. The technician replaces the studs and re-torques the nuts correctly, but the studs break again within 10,000 km. What should the technician investigate?

A. The hub bore, which may be oversized from wear and causing the wheel to sit off-center, creating uneven loading on the studs

B. The wheel nut type, which may be the wrong configuration (stud-piloted nuts used on a hub-piloted system) creating incorrect seating forces

C. The axle shaft, which may be transmitting torsional vibrations from the differential that are fatiguing the studs

D. The hub pilot pad surface and the wheel's mating surface for corrosion, damage, or debris that is preventing the wheel from seating flush — an improperly seated wheel creates bending loads on the studs with every revolution that cause fatigue failure

104. A truck driver reports that the cab shakes noticeably at idle speed. The engine mounts are in good condition. What other cab-related component could cause this vibration at idle?

A. Deteriorated cab mounts (the rubber isolators between the cab and the frame) that have hardened or collapsed, losing their vibration-isolating properties and transmitting engine vibration directly from the frame to the cab structure

B. A loose windshield that has separated from its adhesive bond and vibrates independently at the engine's idle frequency

C. A worn driver's seat suspension that amplifies engine vibration through resonance at idle RPM

D. A clogged cabin air filter that creates a pressure differential inside the HVAC housing, generating a low-frequency vibration

105. A transit bus has power-operated entry doors that fail to open when the door control switch is activated. The air system pressure is adequate and all other air-operated systems function normally. What should the technician check first?

A. The tire pressure, which if low could affect the door's proximity sensor and prevent door opening

B. The bus's brake interlock system, which on many transit buses requires the parking brake to be applied before the doors can be opened for passenger safety

C. The door control switch, the door actuator air valve, and the air supply line to the door mechanism for a fault that is preventing air from reaching the door cylinder

D. The bus's transmission, which must be in neutral before the door safety interlock permits door opening

106. During a cab inspection on a conventional truck, the technician notices that the right door does not close flush with the cab body — the bottom of the door gaps outward by approximately 10 mm. What is the most likely cause?

A. The door weather strip has swollen from UV exposure and is pushing the door outward at the bottom

B. The door hinge pins and bushings are worn, allowing the door to sag and swing outward at the bottom — the misalignment prevents the door from closing flush against the cab body

C. The door latch striker is adjusted too far outward on the cab pillar, preventing the door from pulling fully closed

D. The cab body itself has flexed from a twisted frame, moving the door opening out of its original alignment

107. A truck's windshield develops a crack that starts from the bottom edge and extends upward across the driver's primary viewing area. What factors determine whether the windshield can be repaired or must be replaced?

A. Only the length of the crack matters — cracks shorter than 15 cm can always be repaired regardless of location

B. Only the width of the crack matters — narrow cracks can be filled with resin while wide cracks require replacement

C. The crack must be replaced since any crack that extends from the edge of the windshield cannot be repaired by resin injection

D. The crack's location, length, and depth determine the repair decision — a crack in the driver's primary viewing area that exceeds the province's maximum allowable size must be addressed by windshield replacement rather than repair, as the crack affects both visibility and structural integrity

108. A heavy-duty truck's HVAC system produces adequate heat and cooling but the airflow from the dashboard vents is significantly weaker than the airflow from the floor and defrost vents. What is the most likely cause?

A. A mode door actuator malfunction or a physically obstructed mode door that is restricting airflow to the dashboard vent duct while allowing airflow to the floor and defrost ducts

B. The evaporator core is partially blocked with debris, restricting airflow to the upper vents while the lower vents receive unobstructed air from a different section of the evaporator

C. The blower motor is failing and producing reduced airflow that only reaches the nearest vent positions

D. The cabin air filter is installed backward, directing airflow away from the dashboard ducts and toward the floor

109. A technician is inspecting a trailer's air brake system and discovers that the relay valve on the trailer is leaking air from its exhaust port continuously. The service brakes are released and no brake application is being made. What does this indicate?

A. The relay valve exhaust port is designed to vent a small amount of air continuously to prevent moisture from accumulating in the valve body

B. The foot valve on the tractor has a residual pressure leak on the trailer circuit that is sending a small signal to the relay valve

C. The relay valve has an internal seal failure that is allowing supply air to pass through to the exhaust port — the valve must be replaced to prevent continuous air loss from the trailer's reservoir

D. The trailer's ABS modulator is commanding a small amount of brake application to compensate for a detected wheel speed sensor imbalance

110. A flatbed trailer is being inspected and the technician finds that several of the trailer's crossmembers are visibly rusted with significant material loss. The main frame rails appear to be in acceptable condition. What is the concern?

A. The weakened crossmembers reduce the trailer floor's load-carrying capacity, potentially allowing the floor to sag or fail under concentrated loads such as forklift traffic or heavy cargo placed between the rails

B. The rusted crossmembers are only cosmetic and do not affect the trailer's structural integrity since the frame rails carry all loads

C. The crossmembers only support the electrical wiring and air lines and their condition does not affect structural capacity

D. The crossmembers will need paint touch-up at the next annual inspection but do not require structural repair

111. A refrigerated trailer's TRU (transport refrigeration unit) is producing frost or ice on the exterior of the refrigerant lines at the TRU's evaporator outlet. The TRU is running and the cargo space temperature is warmer than the setpoint. What does the frost on the refrigerant lines indicate?

A. Normal operation — frost on the evaporator outlet line indicates the system is running at maximum capacity and will reach setpoint soon

B. The TRU compressor is oversized for the trailer and is cooling the refrigerant excessively in the evaporator

C. The refrigerant charge is correct but the condenser fan has failed, preventing heat rejection and causing the low-pressure side to get colder than normal

D. The system likely has a low refrigerant charge — insufficient refrigerant causes the evaporator pressure and temperature to drop below normal, and the frost on the outlet line indicates refrigerant is still evaporating past the point where it should have fully vaporized inside the evaporator

112. A trailer's ABS ECU is mounted on the frame rail near the front of the trailer. The technician notices that the ECU's wiring connector has visible corrosion on several pins. What effect could this corrosion have?

A. No effect — the ABS ECU is sealed and the connector corrosion cannot affect the internal electronics

B. The corrosion creates high-resistance connections that can produce intermittent or erratic signals between the ECU and the wheel speed sensors or modulator valves, causing false ABS activations, failure to activate when needed, or persistent fault codes

C. The corrosion only affects the ECU's ground connection and will cause the ABS warning lamp to illuminate without affecting actual ABS function

D. The corrosion protects the pins from further oxidation by forming a stable oxide layer and does not affect electrical conductivity

113. A trailer equipped with a lift axle (auto-deploying type) deploys the lift axle whenever the trailer is loaded, but the axle immediately lifts back up after deployment. The air supply pressure is adequate. What is the most likely cause?

A. The lift axle air spring is leaking and cannot maintain the pressure needed to hold the axle down against the road surface under the trailer's loaded weight

B. The lift axle deploy valve has a faulty sensor that detects load but then immediately commands retraction

C. The trailer's main suspension air springs are overinflated, physically pushing the lift axle back up

D. The lift axle brake chambers are applying brake force that lifts the axle through the reaction torque of the braking action

114. A trailer's conspicuity tape (retroreflective tape) specification requires alternating red and white segments. A technician notices that a section of the tape has been replaced with solid white tape. Is this acceptable?

A. Yes — any retroreflective tape provides adequate nighttime visibility regardless of color pattern

B. Solid white tape is acceptable on the upper rear of the trailer but not on the sides or lower rear

C. The alternating red and white pattern is specifically required by CMVSS 108 for maximum nighttime conspicuity — solid white tape does not meet the standard and must be replaced with the correct alternating pattern

D. Solid white tape is actually preferred over the alternating pattern because it reflects more light

115. A technician discovers that a trailer's landing gear cross shaft is bent. The landing gear still operates but the legs extend and retract unevenly — one leg moves faster than the other. What is the consequence of operating the trailer with this condition?

A. No significant consequence as long as both legs touch the ground when fully extended

B. Cosmetic damage to the landing gear shoes that will need replacement at the next service interval

C. The uneven extension will cause the trailer to sit at an angle when disconnected, potentially causing cargo shift

D. The bent cross shaft creates uneven loading on the gearbox and leg tubes, and the uneven extension can cause the trailer to tilt when disconnected, potentially leading to landing gear collapse under load — the cross shaft must be replaced

116. A trailer brake chamber has a cracked pushrod clevis. The crack is visible but the clevis is still attached to the pushrod and the slack adjuster pin. What is the correct assessment?

A. The clevis can be welded to close the crack and returned to service after the weld is inspected

B. The cracked clevis is an immediate safety hazard — if the clevis fails completely during a brake application, the brake on that wheel will be inoperative, and the clevis must be replaced before the trailer operates

C. The crack is cosmetic and will not progress because the clevis is made from ductile iron that resists crack propagation

D. The entire brake chamber must be replaced because the pushrod and clevis are not available as separate replacement parts

117. A truck's cab HVAC system provides strong airflow from all vents but the temperature of the air does not change regardless of the temperature control setting — the air is always warm. The engine is at operating temperature and the A/C compressor is not engaged. What is the most likely cause?

A. The blend door (temperature door) is stuck in the full-heat position, directing all airflow through the heater core regardless of the temperature control input — the actuator cable, vacuum motor, or electric actuator that controls the blend door has failed or disconnected

B. The heater control valve is stuck open, continuously supplying hot coolant to the heater core

C. The evaporator is plugged with debris, preventing cold air from reaching the vents even when the A/C is selected

D. The thermostat is stuck closed, causing the engine to overheat and the heater core to produce maximum heat at all times

118. A truck's A/C system manifold gauge readings show: low side at 45 psi and high side at 135 psi. Normal readings for the ambient temperature should be low side 25-35 psi and high side 180-250 psi. Both the high and low side pressures are closer together than normal. What is the most likely diagnosis?

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

B. The A/C compressor clutch is slipping, reducing the compressor's effective speed and pumping capacity

C. The compressor is not compressing effectively — worn valves, pistons, or scroll mechanism are failing to create the normal pressure differential between the high and low sides

D. The expansion valve is stuck open, flooding the evaporator and equalizing the pressures across both sides

119. A fuel-fired coolant heater (Webasto/Espar type) starts normally but shuts down after approximately 60 seconds of operation. The control module stores a "flame failure" code. What is the most likely cause?

A. The exhaust outlet pipe is restricted, causing combustion gases to back up into the combustion chamber and extinguish the flame

B. The flame sensor (flame detector) is dirty, damaged, or has failed — it cannot confirm that combustion is occurring, so the control module shuts the heater down as a safety precaution after the startup period expires without flame confirmation

C. The fuel supply is intermittent — the heater starts on residual fuel in the combustion chamber but the fuel pump or fuel line cannot maintain a continuous fuel supply, and the flame dies after the residual fuel is consumed

D. The combustion air blower is running at excessive speed, blowing the flame out after the initial ignition period

120. What is the purpose of evacuating (pulling a vacuum on) an A/C system before charging it with refrigerant?

A. To test the compressor's ability to create suction and verify it has not seized from the previous failure

B. To collapse any air bubbles trapped in the condenser tubes for improved heat transfer efficiency

C. To remove any remaining refrigerant that the recovery machine could not extract from the system

D. To remove all air and moisture from the system — air is a non-condensable gas that raises operating pressure, and moisture can form ice at the expansion device and create corrosive acids that damage internal components

121. A truck's heater core is leaking coolant inside the cab. The driver reports a sweet smell in the cab, the windows fog persistently, and the carpet on the passenger side is wet. Beyond replacing the heater core, what additional action is necessary?

A. The cooling system must be pressure-tested after the repair to verify that no other leaks exist, the coolant must be refilled with the correct type and concentration, and the system must be bled of air

B. The engine thermostat must be replaced because the heater core failure was caused by excessive coolant temperature

C. The HVAC blower motor must be replaced because coolant contamination from the leak has damaged the motor windings

D. The A/C compressor must be replaced because liquid coolant may have entered the evaporator and contaminated the refrigerant circuit

122. An A/C system has been repaired and recharged. The system cools adequately at highway speed but provides insufficient cooling during stop-and-go driving or at idle. What is the most likely cause?

A. The expansion valve is opening too wide at low compressor speeds, flooding the evaporator with liquid refrigerant

B. The refrigerant charge is slightly low, but the deficit is only apparent when the compressor is turning at low RPM during idle operation

C. The condenser fan or cooling fan is not operating properly — at highway speed, ram airflow through the condenser provides adequate heat rejection, but at idle or low speed there is insufficient airflow to cool the condenser without the fan

D. The A/C compressor clutch is engaging and disengaging too frequently at idle, preventing the system from maintaining a consistent evaporator temperature

123. A truck's HVAC system is switched to the defrost mode but the air coming from the defrost vents is not warm enough to clear the windshield fog. The engine is at operating temperature. The blower works on all speeds. What should the technician check?

A. The A/C compressor engagement, since the defroster mode on many HVAC systems automatically activates the A/C compressor to dehumidify the air, and a non-functioning compressor means the air is not being dehumidified before it reaches the windshield

B. The blend door position, which may not be fully directing airflow through the heater core in defrost mode, delivering air that is insufficiently warm

C. The cabin air filter, which if clogged reduces airflow velocity at the windshield surface and slows the defog process

D. The engine thermostat, which may be stuck open and preventing the coolant from reaching full operating temperature

124. A hydraulic system's relief valve is set to 2,500 psi. A technician connects a pressure gauge to the test port and operates the system under load. The gauge reads a maximum of 1,800 psi even when the cylinder stalls at end of stroke. What is the most likely cause?

A. The pressure gauge is faulty and reading 700 psi lower than the actual system pressure

B. The hydraulic pump cannot reach 2,500 psi due to excessive internal leakage from wear — the pump's maximum pressure output is limited by its internal bypass rate

C. The directional control valve is partially restricting flow, creating a pressure drop between the pump and the cylinder

D. The relief valve spring has weakened or the valve seat is worn, allowing the valve to crack open at 1,800 psi instead of holding to the 2,500 psi setting

125. A hydraulic cylinder on a refuse truck packer blade must produce 40,000 pounds of force. The system operates at 3,000 psi. Using the formula $F = P \times A$, what minimum piston area is required?

A. Approximately 13.3 square inches — calculated by dividing the required force by the system pressure (40,000 lb ÷ 3,000 psi = 13.33 in^2)

B. 120,000,000 square inches

C. Approximately 7.5 square inches

D. 40 square inches

126. A hydraulic system equipped with a return line filter has a filter condition indicator showing the filter is in bypass. The technician replaces the filter element. What additional action should be taken?

A. Drain and refill the hydraulic reservoir with fresh fluid since the bypassing filter has allowed contaminated fluid to circulate

B. Flush the entire hydraulic circuit with clean solvent before refilling with new hydraulic oil

C. Take an oil sample from the reservoir and send it for analysis to determine whether the period of unfiltered operation has introduced contamination levels that require further action beyond the filter change

D. No additional action is needed — replacing the filter element restores filtration and the system will gradually clean itself

127. A mobile crane's hydraulic boom cylinder drifts downward under load even though the directional control valve is in the hold (neutral) position. The counterbalance valve is functioning and the directional valve spool shows no internal leakage. What is the most likely cause?

A. The relief valve is set too low and is allowing pressure to bleed off from the cap side of the cylinder

B. The cylinder's internal piston seal has failed, allowing pressurized fluid to bypass from the cap end to the rod end within the cylinder, causing the load to drift downward

C. The hydraulic reservoir fluid level is low, reducing the volume of fluid available to maintain the cylinder in position

D. The boom's mechanical pivot pin is worn, allowing the boom to settle under load independently of the hydraulic system

128. A technician is diagnosing a hydraulic system that overheats during continuous operation. The reservoir level is correct and the fluid is the correct type and viscosity. The system has an oil cooler. What should be checked first?

A. The hydraulic cylinders for oversized bore diameters that require more fluid flow than the system was designed to deliver

B. The pump's displacement setting, which may be set too high for the application's duty cycle

C. The directional control valve for an internal leakage condition that is converting hydraulic energy to heat

D. The oil cooler for restrictions, adequate airflow, and proper function — a blocked cooler core, a failed cooling fan, or a restricted cooler line prevents the system from dissipating the heat generated during normal operation

129. What is the primary safety concern when replacing a hydraulic accumulator on a truck-mounted hydraulic system?

A. The accumulator must be pre-charged with hydraulic fluid before installation to prevent pump cavitation during initial startup

B. The accumulator's electrical connections must be de-energized before removal to prevent an arc that could ignite hydraulic fluid vapors

C. The accumulator is not a safety concern during replacement because it only stores a small volume of fluid at low pressure

D. The accumulator contains pressurized nitrogen gas and may also contain trapped hydraulic fluid under system pressure — both the gas pre-charge and the hydraulic pressure must be fully relieved before the accumulator is disconnected to prevent uncontrolled release of stored energy

130. A hydraulic system uses JIC (37-degree flare) fittings throughout. A technician notices a small leak at one fitting connection. What is the correct repair procedure?

A. Apply thread sealant tape (Teflon tape) to the JIC fitting threads to seal the leak at the thread interface

B. Tighten the fitting an additional half-turn beyond the original torque to compress the flare tighter against the seat

C. Disassemble the connection, inspect the flare surface and the mating seat for damage (nicks, scratches, deformation), replace any damaged component, and reassemble to the manufacturer's torque specification — JIC fittings seal on the 37-degree flare-to-seat contact, and damage to either surface prevents a proper seal

D. Replace the JIC fitting with an NPT (pipe thread) fitting since NPT provides a more reliable seal through thread engagement

131. A truck-mounted hydraulic system has a condition where the hydraulic oil appears dark and smells burnt. The system is overheating frequently despite a functioning oil cooler. What does the fluid condition indicate?

A. The hydraulic oil has simply oxidized from age and needs to be replaced with fresh fluid of the same type

B. The hydraulic oil has been severely overheated and thermally degraded — the dark color and burnt smell indicate that the oil's molecular structure has broken down, reducing its lubricating properties, viscosity stability, and anti-wear additive effectiveness — the root cause of the overheating must be identified and corrected before refilling with new fluid

C. The hydraulic oil has been contaminated with engine oil from a cross-connected line and the color change is from the engine oil's darker pigmentation

D. The hydraulic oil has absorbed excessive moisture from condensation and the dark color is from the water's interaction with the oil's additive package

132. A battery electric transit bus has a diagnostic fault code for "Battery Cell Voltage Imbalance — Module 7." The BMS has opened the high-voltage contactors and the bus will not enter the ready state. What does this fault indicate?

A. The charging station delivered an incorrect voltage to the bus during the last charge session, overcharging Module 7

B. The traction motor is drawing excessive current from one section of the battery, causing localized voltage depression

C. The BMS software needs to be updated to correctly read the voltage signals from the newer cell chemistry in Module 7

D. One or more cells in Module 7 have degraded or failed, causing their voltage to diverge significantly from the pack average — the BMS has opened the contactors to protect the pack from further damage, and Module 7 must be inspected and the affected cells or module replaced

133. A hybrid electric vehicle's regenerative braking system is not recovering energy during deceleration. The friction brakes are functioning normally. The battery state of charge is at 40%. What should the technician investigate?

A. The traction motor, the power inverter, and the vehicle control unit for faults that are preventing the motor from operating in generator mode — a motor fault, an inverter fault, or a VCU communication error can all disable regenerative braking while leaving friction braking unaffected

B. The foundation brake pads, which may be contaminated with a material that interferes with the regenerative sensor

C. The 12-volt battery, which must be at full charge for the regenerative system to activate

D. The tire pressure, which if incorrect could reduce the friction needed for the motor to generate electricity during braking

134. What class of insulating gloves is required as a minimum for working on a commercial hybrid vehicle high-voltage system that operates at 600 VDC?

A. Class 00 gloves rated to 500 VAC / 750 VDC — sufficient for systems up to 750 VDC

B. Standard leather work gloves with rubber palm pads for grip and basic insulation

C. Class 0 gloves rated to 1,000 VAC / 1,500 VDC — providing adequate voltage protection with safety margin above the system's 600 VDC operating level

D. Class 1 gloves rated to 7,500 VAC / 11,250 VDC — required for any voltage above 500 VDC

135. A battery electric truck's range has decreased by approximately 30% compared to when it was new. The vehicle has 150,000 km on the odometer. The BMS reports no active fault codes. What is the most likely cause of the reduced range?

A. The traction motor efficiency has degraded by 30%, requiring more energy per kilometer than when new

B. Normal battery capacity degradation — lithium-ion batteries lose capacity over time and charge cycles, and a 30% reduction at 150,000 km is within the expected degradation curve for commercial vehicle battery packs, which is tracked by the BMS as "state of health" (SOH)

C. The DC-DC converter is drawing excessive power from the high-voltage battery to maintain the 12-volt system

D. The regenerative braking system has become less efficient, recovering only 70% of the energy it captured when new

Practice Exam 3: Answer Key and Explanations

1. D — Lockout/tagout exists to prevent exactly this scenario — an energy source being activated while a worker is exposed to the hazard. The first technician should have disconnected the battery, applied a personal lock to the battery disconnect and the ignition, and attached a tag identifying who locked it out and why. Without lockout, any person can unknowingly start the engine while a technician is working under the hood, on the electrical system, or in any position where an unexpected startup could cause injury or death.

2. B — All workplace injuries, regardless of severity, must be reported to the supervisor and documented. Even minor injuries create a legal record that protects the worker if the injury worsens later, and the documentation triggers a hazard investigation that can prevent recurrence. Under the OHSA, employers are required to maintain injury records, and failure to report even minor incidents creates gaps in the workplace's safety data that can mask systemic hazards.

3. C — The flame pictogram inside a red diamond-shaped border is the WHMIS 2015 / GHS symbol for flammable materials — products that can ignite when exposed to heat, sparks, open flames, or other ignition sources. This is one of the most commonly encountered pictograms in a truck repair shop, appearing on brake cleaners, carburetor cleaners, many aerosol products, solvents, gasoline, and certain lubricants. The pictogram tells the technician to keep the product away from all ignition sources and use it with adequate ventilation.

4. A — Before any lift, the operator must verify three things: the crane's rated capacity exceeds the weight of the load (overloading a crane can cause structural failure), the rigging (slings, chains, shackles) is appropriate for the load's weight, shape, and center of gravity, and all safety devices are functional — particularly the hook safety latch that prevents the load from accidentally slipping off the hook. Operating a crane without verifying these items creates a dropped-load hazard that can crush and kill personnel below.

5. C — Multi-piece rim assemblies can fail explosively during inflation — the lock ring, side ring, or rim base can separate with lethal force if any component is damaged, corroded, or misassembled. A tire safety cage contains these components if a failure occurs. The technician must stand outside the cage during inflation, using a clip-on chuck with a remote hose to inflate from a safe position. This procedure is mandated because multi-piece rim failures have caused numerous fatalities in the tire service industry.

6. B — Steering components are safety-critical — an incorrectly torqued steering fastener can loosen during driving, causing loss of steering control. Estimating torque from general charts or relying on feel

introduces a risk of undertorquing (component loosens) or overtorquing (fastener stretches, cracks, or strips). The only acceptable approach is to obtain the manufacturer's specific torque specification for that exact component and application, then apply it with a calibrated torque wrench.

7. D — Compressed air at shop pressure (typically 100-120 psi) can penetrate the skin and introduce air into the bloodstream, causing an air embolism that can be fatal. It can also propel particles into the eyes, ears, and mucous membranes at velocities high enough to cause serious injury. Additionally, if the air is directed at the body, it can rupture eardrums and cause internal injuries. OSHA and equivalent Canadian regulations prohibit using compressed air for cleaning purposes on the body.

8. A — A discharged fire extinguisher is a life-safety emergency — if a fire occurs in the work area, the nearest extinguisher is the first response tool, and a discharged unit provides no protection. The technician must report the condition immediately to the supervisor so the extinguisher can be recharged or replaced before any further work is performed. Continuing to work without fire suppression capability violates basic workplace safety requirements and puts all personnel in the area at risk.

9. C — In the common inline six-cylinder firing order 1-5-3-6-2-4, the companion cylinder pairs are 1-6, 2-5, and 3-4. When cylinder 1 is at TDC on its compression stroke (both valves closed, ready for the power stroke), its companion cylinder 6 is at TDC on its exhaust stroke (exhaust valve closing, intake valve opening). This relationship allows the technician to adjust valves on both companion cylinders at each crankshaft position, because both cylinders have predictable cam lobe positions relative to TDC.

10. A — Cavitation erosion is a well-documented failure mode specific to wet cylinder liners. During combustion, the liner wall vibrates at high frequency due to the sudden pressure increase. This vibration creates microscopic vapor bubbles in the coolant on the outer liner surface. When these bubbles collapse, they release concentrated energy that progressively pits and erodes the liner material. The damage is most severe on the thrust side where combustion forces push the piston hardest against the liner. Supplemental coolant additive (SCA) provides a protective barrier that reduces cavitation damage.

11. D — Total Base Number measures the oil's remaining capacity to neutralize acids produced during combustion — primarily sulfuric and nitric acids from fuel combustion byproducts. A TBN drop from 8.2 to 2.1 indicates the oil's acid-neutralizing additives are nearly exhausted. Once TBN reaches approximately 1.0 to 2.0, the oil can no longer protect internal engine surfaces from acid attack, and corrosion of bearings, cylinder walls, and other components accelerates. The oil must be changed immediately, and the rapid depletion rate should be investigated for root cause.

12. B — A cracked exhaust manifold leaks exhaust gas through the crack at each exhaust pulse, producing a ticking or hissing sound that corresponds to engine firing frequency. The noise is louder when the engine is cold because the crack is wider — cast iron contracts when cold, opening the crack. As the manifold heats and expands, thermal expansion partially closes the crack, reducing the leak rate and the noise intensity. This temperature-dependent noise characteristic is a classic diagnostic indicator of an exhaust manifold crack.

13. C — Magnetic particle inspection works by magnetizing the cast iron head and then applying fine iron particles (either dry powder or suspended in a liquid) to the surface. At the location of a crack, the magnetic field is disrupted — flux leaks from the crack — and the iron particles are attracted to and collect along the flux leakage line, creating a visible indication of the crack's location and extent. MPI is effective only on ferromagnetic materials (cast iron, steel) and cannot be used on aluminum heads, which require dye penetrant or pressure testing.

14. A — A piston ring end gap of 0.008 inches is below the manufacturer's minimum of 0.015 inches. The ring must be carefully filed at the gap to enlarge it to within specification. Insufficient end gap is a critical condition — as the engine heats up, the ring expands thermally. If the gap is too small, the ring ends will butt together before the engine reaches operating temperature, forcing the ring outward against the cylinder wall with uncontrolled force. This causes ring breakage, cylinder wall scoring, and potential piston seizure.

15. D — Pressurizing the cooling system raises the boiling point of the coolant beyond its atmospheric boiling point. At atmospheric pressure, a 50/50 coolant mixture boils at approximately 108°C. At 15 psi system pressure, the boiling point rises to approximately 129°C. This higher boiling point prevents localized boiling at hot spots within the engine — particularly near the exhaust valve seats and the combustion chamber surfaces — where temperatures can exceed the atmospheric boiling point during heavy-load operation.

16. B — The engine has adequate boost pressure (the turbocharger and air intake system are delivering sufficient air) and elevated exhaust gas temperature (indicating the combustion process is running hotter than normal for the amount of work being produced). This combination points to a fuel delivery deficiency — one or more injectors are not delivering their full commanded fuel quantity. The engine is burning the fuel it receives efficiently (hence the high EGT) but simply isn't getting enough total fuel across all cylinders to produce rated power.

17. A — Oil level measurement accuracy depends on three conditions: the vehicle must be on a level surface (a tilted vehicle causes the oil to pool to one side of the pan, producing a false reading), the engine must be off (the oil pump must not be circulating oil, which would lower the pan level), and

sufficient time must elapse for oil to drain back from the upper engine components to the pan (the manufacturer specifies a wait time, typically 5 to 15 minutes). Reading the dipstick under these conditions provides the most accurate representation of the total oil volume in the system.

18. D — Air filter service life is directly determined by the particulate concentration in the operating environment. A filter designed for 50,000 km of highway operation may reach maximum restriction in 5,000 km or less when operating in a high-dust environment — construction sites, unpaved roads, mining operations, or agricultural areas produce orders of magnitude more airborne particulate than paved highway driving. The restriction indicator activates based on the actual pressure drop across the filter, not on mileage, so it provides an accurate indication regardless of the operating environment.

19. C — A deep, dull knock from the lower end of the engine that is most prominent at idle and diminishes under load is the classic symptom of a worn main or connecting rod bearing. At idle, oil pressure is at its lowest and the oil film between the bearing and journal is thinnest — the worn bearing clearance allows the journal to impact the bearing shell with each power stroke, producing the knock. At higher RPM, increased oil pump output builds a thicker oil film that partially cushions the impact, reducing the noise intensity even though the wear condition has not changed.

20. B — The HEUI system's defining characteristic is its use of high-pressure engine oil (500 to 3,600 psi, generated by a dedicated high-pressure oil pump) to power an intensifier piston inside each injector. The intensifier multiplies the oil pressure to create injection pressures up to 21,000 psi at the nozzle. This means that engine oil pressure and oil condition directly affect injection performance — low oil pressure, worn oil pump, or degraded oil viscosity can cause injection faults. Common rail systems, by contrast, use a dedicated high-pressure fuel pump to maintain constant fuel pressure in a shared rail.

21. A — Combustion gases leaking into the cooling system through a cracked head, liner, or blown head gasket pressurize the coolant with exhaust gas. This elevated pressure forces coolant past the pressure cap and into the overflow tank. The combustion byproducts contaminate the coolant with hydrocarbons (the oily residue on the surface) and carbon dioxide (which forms carbonic acid, lowering coolant pH). A combustion gas leak test — using a block tester or gas analyzer at the radiator fill neck — confirms this condition.

22. D — The timing gear train must maintain a precise angular relationship between the crankshaft and camshaft. Excessive backlash between the gears introduces a variable error in this relationship — the camshaft position oscillates slightly relative to the crankshaft as the gears alternate between driving and coasting. This timing variation affects valve events and injection timing (on engines with gear-driven injection pumps), causes audible gear noise, and accelerates gear tooth wear from the repeated impact loading as the gears take up the backlash during each torque reversal.

23. B — Biodiesel has mild solvent properties that can dissolve and dislodge deposits (varnish, sediment, microbial growth) that have accumulated inside the fuel tank, fuel lines, and fuel system components during years of petroleum diesel use. These loosened deposits migrate to the fuel filters, loading them more rapidly than normal. During the initial transition to biodiesel, fuel filter change intervals may need to be shortened until the fuel system is clean. After the transition period, normal filter change intervals can usually be resumed.

24. C — The exhaust backpressure sensor measures the pressure differential across the DPF. When the DPF is heavily loaded with soot or ash, the resistance to exhaust flow increases, and the sensor reading rises above the expected value for the current engine speed and load. The ECM interprets this as a DPF that needs regeneration (if soot) or cleaning (if ash). If the loading exceeds the threshold for active regeneration or if regeneration attempts have failed, the ECM initiates a power derate to limit further soot accumulation and protect the DPF from damage.

25. A — The water pump impeller's vanes are the active pumping elements that create the centrifugal force driving coolant through the engine. With nearly half of each vane eroded away, the pump's ability to move coolant is severely compromised. At idle and light load, the reduced flow may barely maintain adequate cooling because heat production is low. Under heavy load, the engine produces heat faster than the crippled pump can circulate coolant to the radiator, causing localized overheating at the hottest points in the engine — near the exhaust valves and combustion chambers — even though the coolant level and thermostat are functioning normally.

26. D — Valve overlap is a brief period near TDC between the exhaust and intake strokes when both valves are open simultaneously. The kinetic energy of the outgoing exhaust gas stream creates a low-pressure wake that helps draw fresh air into the cylinder through the open intake valve. On turbocharged engines, the intake manifold boost pressure further assists this scavenging by pushing fresh air into the cylinder while the exhaust is still flowing out. This overlap effect improves volumetric efficiency — the cylinder captures a greater mass of fresh air than it would without the scavenging assistance.

27. A — The cooling system holds pressure (no leaks) and the coolant level is correct, so the system is sealed and full. The persistent overheating under load must be caused by a component that is limiting the system's ability to reject heat at the rate the engine produces it. A thermostat that opens at too high a temperature delays the onset of coolant flow to the radiator — the engine heats faster than the thermostat responds, particularly under heavy load where heat production is highest. Testing the thermostat's opening temperature in a heated water bath confirms whether it opens at the correct specification.

28. B — The VGT vanes control the exhaust gas flow across the turbine wheel. When the vanes are stuck in the closed or partially closed position, the exhaust must pass through a smaller opening at high

velocity. At high engine RPM where exhaust volume is large, forcing all that exhaust through the restricted opening over-speeds the turbine — the concentrated exhaust energy spins the wheel faster than its design limit. The high-pitched whine is the turbocharger operating at excessive speed, and the excess boost pressure is the compressor's response to the over-speed condition.

29. C — Two identical trucks on the same route with the same driver should achieve similar fuel economy. A consistent difference points to a mechanical condition on the lower-economy truck that is wasting energy. Dragging brakes convert fuel energy directly to heat at the wheels. Low tire pressure increases rolling resistance. A fan clutch that runs continuously consumes 30-50 hp that a properly functioning clutch would save. A thermostat stuck open keeps the engine cold, reducing combustion efficiency. Misaligned axles cause tire scrub. Each of these conditions is measurable, correctable, and directly impacts fuel consumption.

30. A — The compressor's piston rings seal the compression chamber from the crankcase — similar to engine piston rings. When these rings wear, engine oil from the compressor's crankcase (which is lubricated by the engine oil system) leaks past the rings into the compression chamber. This oil is then pumped into the air system along with the compressed air. The excessive heat is also explained by the oil pass-by — oil combustion residue builds up on the discharge valves, reducing their efficiency and causing the compressor to work harder and run hotter.

31. D — The grease on the brake shoes came from somewhere — and the most likely source on a drive axle is the hub seal. If the wheel bearing hub seal has failed, axle lubricant (gear oil) migrates outward along the axle shaft and spindle, past the seal, and onto the brake components inside the drum. Replacing the shoes without replacing the failed hub seal will result in the new shoes being contaminated in the same way. The seal must be inspected and replaced, and the hub must be cleaned before the new shoes are installed.

32. B — If all mechanical adjustments are correct and the air system is functioning, but stopping distance has increased, the friction material itself is the suspect. Glazed brake linings have a hardened, polished surface created by overheating — the friction material's binder resin has melted and resolidified into a glassy layer that has a much lower coefficient of friction than the original material. The linings may appear to have adequate thickness, but their friction performance is severely degraded. The shoes must be replaced with new linings, and the cause of the overheating must be identified and corrected.

33. A — The governor should signal the compressor to unload at 120-125 psi, preventing pressure from rising further. If the safety valve pops at 145 psi, the system pressure has risen well beyond the cut-out

point — meaning the governor failed to unload the compressor. The compressor continued pumping past its normal cut-out pressure until the safety valve (set at approximately 150 psi on most systems) opened to prevent dangerous over-pressurization. The governor must be inspected for a stuck or malfunctioning unloader signal circuit.

34. C — The spring brakes apply mechanical force through the same foundation brake components — pushrod, slack adjuster, S-cam, shoes, and drum — as the service brakes. If the brake shoes are severely worn (reduced friction surface) or the slack adjusters are far out of adjustment (the spring's force must take up excessive free play before the shoes contact the drum), the spring brake force that reaches the drum is insufficient to hold the vehicle on a grade. The spring mechanisms themselves may be delivering full rated force, but that force is wasted on taking up mechanical slack rather than generating friction against the drum.

35. B — The "30/30" designation refers to the effective diaphragm area — 30 square inches on each section. Force equals pressure times area ($F = P \times A$), so a 30-square-inch diaphragm at 100 psi produces 3,000 pounds of output force on the pushrod. The designation tells the technician exactly how much force each section of the chamber produces at any given air pressure, which is essential for verifying that the replacement chamber matches the vehicle manufacturer's specifications for brake force balance.

36. D — An ABS modulator valve that leaks air continuously from its exhaust port when the brakes are not applied has an internal seal failure. The valve should be completely sealed when the ABS is inactive — no air should pass through the modulator in any direction. Continuous leakage indicates that the internal seals have deteriorated, allowing supply air to pass through the valve body and exit the exhaust port. This leak consumes system air and may reduce the air available for brake application on that wheel. The modulator must be replaced.

37. A — Both standard-stroke and long-stroke Type 30 chambers have the same 30-square-inch diaphragm area (producing the same force at any given pressure). The difference is the depth of the housing — the long-stroke chamber allows the pushrod to travel approximately 25% farther before reaching its maximum effective stroke. This additional travel provides a greater adjustment reserve — as the linings wear and the distance between shoes and drum increases, the long-stroke chamber can accommodate more wear before the pushrod reaches its maximum stroke, providing more consistent braking force over a wider lining wear range.

38. C — Blue discoloration on a brake drum's friction surface is evidence of severe overheating — the heat has been intense enough to change the metallurgical structure of the cast iron. Heat-damaged drums lose hardness, become more prone to cracking, may develop hard spots that cause uneven braking, and

may have dimensional distortion that cannot be corrected by machining. A heat-blued drum must be replaced regardless of whether its diameter measurement is within specification, because the metallurgical damage compromises its structural integrity and friction characteristics.

39. B — ABS activates more aggressively when wheels approach lockup more readily — which occurs when the tires have less available traction. If the rear section tires have less tread depth or a different (less grippy) tread compound, they reach the traction limit sooner than the front tires during braking on wet pavement. The ABS modulates more frequently and more aggressively on the rear section to prevent these lower-traction tires from locking up. Inspecting and matching the tread condition and tire specifications across both sections would reduce the disparity.

40. D — A loud bang followed by rapid pressure loss in one circuit while the other circuit retains pressure is the hallmark of a catastrophic component failure in the affected circuit. The bang is the sound of a burst hose, a cracked fitting, or a blown chamber diaphragm — components that fail suddenly and release stored air explosively. The dual-circuit protection system is performing exactly as designed — the primary circuit has lost all pressure, but the secondary circuit is isolated and intact, providing partial braking capability through its independent reservoirs and brake channels.

41. A — Brake drum inside diameter is measured using a drum gauge (a specialized tool calibrated for drum dimensions) or an inside micrometer. Measurements must be taken at multiple positions around the circumference and at multiple depths within the drum to check for out-of-round and taper. The measured diameter is compared to the maximum allowable diameter stamped on the drum casting. A drum that exceeds the maximum has walls that are too thin for safe heat absorption and must be replaced.

42. C — When the brakes are released, the application air in the rear chambers must exhaust to atmosphere through the return path — either back through the relay valve's exhaust port or through a quick release valve. If any component in this exhaust path is restricted (a relay valve with a sticking exhaust piston, a partially blocked quick release valve, or a kinked exhaust line), the air cannot escape quickly and the chamber diaphragm retracts slowly. The front brakes release normally because their exhaust path is unobstructed, confirming the restriction is isolated to the rear circuit.

43. B — The maximum allowable applied pushrod stroke for all chambers in this scenario is 2.0 inches. The left and right rear inner positions at 2.25 inches exceed this limit. The front positions (1.5") and outer rear positions (1.75") are within specification. The over-stroked inner rear positions indicate that the automatic slack adjusters on those wheels are not maintaining proper adjustment, and the root cause must be diagnosed — defective ASA, worn anchor pins, oversized drums, or severely worn linings — before the vehicle is returned to service.

44. D — A spongy brake pedal that improves with pumping is the classic symptom of air in a hydraulic brake circuit. Air is compressible — when the pedal is pressed, the trapped air bubble compresses before the incompressible fluid can transmit force to the calipers. Pumping the pedal repeatedly pushes the air bubble to a location where it has less effect on pedal feel (such as a high point in the circuit or back toward the reservoir). The permanent fix is to bleed the hydraulic system to remove all trapped air, restoring a firm pedal on the first application.

45. A — A clunk during acceleration-to-deceleration transitions at the fifth wheel indicates mechanical free play in the coupling that allows the trailer to shift forward and backward relative to the tractor. Worn fifth wheel jaw faces, a worn king pin, or a worn king pin pocket all create clearance that allows this movement. During acceleration, the trailer resists and pushes backward against the jaws; during braking, the trailer pushes forward. The transition between these two states takes up the free play with an audible clunk. The worn components must be inspected and replaced.

46. C — A vehicle that pulls to the right during braking has more braking force on the right side than the left. However, diagnostically, the cause is usually a deficiency on the opposite side — the left brakes are not generating their full share of braking force, making the right side dominant by comparison. A restricted air supply to the left front, an out-of-adjustment left front slack adjuster, or contaminated left front linings all reduce left-side braking force. The vehicle pulls toward the side with more braking force — the right side — because the asymmetric braking creates a yaw moment toward the stronger-braking side.

47. B — Watt's Law states $P = V \times I$. Rearranging to solve for current: $I = P / V = 24W / 12V = 2$ amps. This calculation is fundamental for sizing wires and fuses — a 24-watt bulb on a 12-volt circuit draws 2 amps, so the wire must be rated for at least 2 amps and the fuse must be rated above 2 amps but below the wire's maximum current capacity to protect the wire from overheating if a short circuit occurs.

48. D — A healthy charging system produces 13.8 to 14.4 volts at the battery terminals with the engine running. A reading of 12.2 volts is the battery's own resting voltage — the alternator is not adding any charging voltage above the battery's existing charge. This means the alternator is not charging — possible causes include a failed voltage regulator, worn brushes that cannot deliver field current to the rotor, a blown fusible link in the alternator output circuit, a broken drive belt, or a faulty alternator internal component.

49. A — Adding a load in parallel provides an additional current path from the voltage source. The new path draws its own current based on the source voltage and the new load's resistance ($I = V/R$). This additional current adds to the current already flowing through the original loads. The total circuit current increases, and the total resistance of the parallel combination decreases (more paths = less overall

resistance). The voltage across each parallel path remains the same because all parallel loads share the same voltage source.

50. C — A parasitic draw test measures the current that flows from the battery when the vehicle is completely shut down — ignition off, all loads supposedly off, all doors closed. A normal parasitic draw for a modern heavy-duty truck is typically 50 to 85 milliamps (for modules that remain powered in sleep mode). A draw significantly above this level indicates an electrical component that remains active when it should be off — a stuck relay, a module that won't enter sleep mode, a short circuit in an accessory circuit, or an aftermarket device drawing power continuously. This persistent drain depletes the batteries during parking periods.

51. A — A completely dead electrical system (no lights, no dash, no cranking) with a fully charged battery means no current is flowing from the battery to any vehicle circuit. The break must be at the single point where all vehicle current passes — the main battery cables, the battery disconnect switch, or the main fusible link. These are the only components where a single open circuit can disable every electrical function simultaneously. A loose or corroded cable terminal, an open disconnect switch, or a blown fusible link at this point stops all current flow despite the battery being fully charged.

52. D — The master battery disconnect switch serves as a single-point isolation device that disconnects all vehicle electrical systems from the battery with one action. This is essential for safety during maintenance (preventing accidental electrical activation while working on the vehicle), emergencies (quickly isolating the electrical system in case of a fire or collision), and extended storage (eliminating all parasitic draws that would drain the batteries over time). Its location on the frame rail near the battery box allows access from outside the cab in emergency situations.

53. B — A battery reading 10.8 volts has at least one failed or severely degraded cell (each cell contributes approximately 2.1 volts, so the missing voltage represents a cell producing less than 1 volt). This battery must be load-tested or conductance-tested to confirm failure. In a series pair, the weak battery limits the total voltage available and causes the stronger battery to be overworked during charging and discharging — the charger tries to push current through the weak cell, and the discharge load depletes the strong battery faster because the weak battery cannot carry its share. Replacing both batteries in the series pair ensures matched performance.

54. A — Systematically disconnecting loads one at a time while replacing the fuse after each disconnection isolates the short circuit to a specific segment of the wiring. When the fuse stops blowing, the most recently disconnected load or its wiring contains the short. This method is efficient because it tests each segment under actual operating conditions rather than relying on resistance measurements that may not reveal a fault that only manifests under voltage. Never increase the fuse size to "overcome" a short — the fuse protects the wire from overheating and starting a fire.

55. C — The wiring diagram symbol described — a coil winding mechanically linked to a set of switch contacts — is the standard symbol for a relay. The coil creates a magnetic field when energized by a low-current control circuit, which moves the mechanically linked contacts to open or close a separate high-current load circuit. This allows a small switch to control a large load without passing the load current through the switch itself. Relays are found throughout the vehicle's electrical system controlling headlights, fans, fuel pumps, and many other loads.

56. A — A dual-filament headlight bulb contains two separate filaments — one for low beam and one for high beam. Each filament can fail independently. When the low-beam filament burns out, the high-beam filament continues to function because it is a separate electrical element within the same bulb. Since the right headlight works on both beams and the fuse is intact, the circuit is delivering power correctly — the fault is isolated to the left bulb's low-beam filament. Replacing the bulb resolves the issue.

57. D — A "signal voltage above normal range" code means the ECM is seeing a voltage on the TPS signal wire that exceeds the maximum value the sensor should produce at any pedal position. The most common cause is the signal wire shorted to the 5-volt reference wire (which would drive the signal to approximately 5 volts) or an open signal wire that allows the ECM's internal pull-up to drive the voltage high. Either condition sends the ECM a false "wide-open throttle" signal that does not match the actual pedal position.

58. B — A relay with welded contacts has its internal switch permanently stuck in the closed position — the contacts have fused together from the heat of repeated switching cycles or from a momentary high-current event. With the contacts welded closed, the load circuit (the fuel pump) is permanently connected to battery power regardless of whether the relay coil is energized by the ECM. The relay must be replaced. Welded contacts are a common relay failure mode, particularly in circuits that switch high-current loads frequently.

59. B — Intermittent voltage at the battery terminals (fluctuation at the common power source) simultaneously affects every circuit connected to that source — lights flicker because voltage fluctuates, the radio resets because its supply momentarily drops below the minimum hold voltage, and the engine stumbles because the ECM's supply momentarily dips. The most common cause is a loose or corroded connection at the battery terminals, the main ground cable, or the battery disconnect switch — these are the single-point connections where an intermittent contact affects everything downstream simultaneously.

60. C — Daytime running lights are designed to deactivate when the headlights are turned on (since the headlights provide greater visibility and the DRLs become redundant). The DRL module or BCM must

receive a signal from the headlight switch or the headlight circuit confirming that the headlights are on. If this signal is not received — due to a faulty switch signal, a broken feedback wire, or a BCM programming fault — the DRL module continues to operate the DRLs because it has no information that the headlights have been activated.

61. B — The solenoid's S terminal receives 12.4 volts (nearly full battery voltage), confirming the control circuit is complete and the coil should be energizing — the click confirms it is. However, the M terminal reads only 0.2 volts, which means virtually no battery voltage is passing through the solenoid to the motor. The solenoid's heavy-duty contacts — which must close when the plunger pulls in to connect battery power to the motor — are not making adequate contact. Worn, pitted, or burned contacts create such high resistance that almost no voltage passes through, despite the plunger mechanically engaging.

62. D — The first physical layer test for a CAN bus communication fault is termination resistance measurement. With the ignition off and all modules connected, measuring between CAN H (Pin C) and CAN L (Pin D) should yield approximately 60 ohms — the parallel combination of two 120-ohm terminating resistors, one at each end of the bus backbone. A reading of 120 ohms indicates one missing terminator. An open reading indicates a completely broken bus. A near-zero reading indicates a short between CAN H and CAN L. This single measurement immediately classifies the fault type.

63. A — The missing 4.1 volts is being consumed by unwanted resistance somewhere between the battery and the lamp socket. Voltage drop testing along the circuit — measuring across each connector, wire segment, switch, and ground connection while the circuit is energized — will reveal where the 4.1 volts is being lost. Common culprits include corroded connectors, deteriorated trailer wiring junction boxes, a corroded ground bolt, or a wire with reduced cross-section from internal corrosion or damage. Every volt consumed by unwanted resistance is a volt not available to the lamp.

64. C — The behavior of a gauge when its sender is disconnected depends on the gauge's design — whether it uses a grounded sender (where the sender's variable resistance completes the circuit to ground) or a powered sender configuration. On most heavy-duty grounded-sender systems, disconnecting the sender creates an open circuit that drives the gauge to one extreme of its scale — typically the cold/low reading because no current flows through the gauge winding. Understanding this behavior helps diagnose sender versus gauge faults: if disconnecting the sender drives the gauge to one extreme, the gauge circuit is functional and the fault is in the sender or its wiring.

65. B — A 0.8-volt difference between the alternator output terminal (13.2V) and the battery terminals (12.4V) means the charging circuit wiring is consuming 0.8 volts of the alternator's output. The maximum allowable voltage drop for the entire charging circuit (output cable, connections, and fusible link) is typically 0.5 volts. The excessive drop means the alternator must produce higher voltage to

overcome the circuit resistance and still deliver adequate charging voltage to the battery. Voltage drop testing along the charging circuit will identify the specific high-resistance connection or component.

66. D — CAN H should read approximately 2.5 to 3.5 volts with the ignition on. A reading of 0.5 volts indicates that the CAN H line is being pulled toward ground — either by a direct short to the chassis/ground wire, a damaged CAN H wire contacting a grounded metal surface, or a failed module that is pulling the CAN H line low. This low voltage prevents the CAN bus from achieving the differential signal levels needed for communication, explaining the intermittent dropouts as the damaged point makes and breaks contact with ground during driving.

67. A — A fuse that blows at a specific point in the window's travel indicates that the short circuit exists at a location in the wiring that is only exposed when the window reaches that position. The door wiring harness flexes and repositions as the window moves — at the halfway point, a section of wire with damaged insulation contacts the metal door frame, creating a dead short to ground. The short only occurs at that specific window position because the wire only contacts the door frame when the harness is pulled to that point by the window mechanism's movement.

68. C — The wheel speed sensors generate a signal by reading the teeth on a reluctor ring as they pass the sensor tip. The signal strength (AC voltage output) is determined by three factors: the speed of the teeth passing the sensor (higher speed = stronger signal), the air gap between the sensor and the ring (smaller gap = stronger signal), and the sensor's magnetic strength. If the air gap is slightly out of specification — close enough to generate an adequate signal at low city speeds but too large to produce a clean signal at the higher frequencies of highway wheel speed — the ABS ECU may intermittently detect signal quality issues at highway speed only.

69. B — Clutch chatter during engagement is caused by the clutch disc alternating rapidly between gripping and slipping rather than engaging smoothly. Oil contamination on the friction facing is the most common cause of this pattern — the oil creates localized areas where the friction coefficient is reduced, and as the disc rotates, these contaminated areas alternately grip (where the facing is clean) and slip (where oil is present). The three most likely contamination sources are a leaking rear engine seal, a leaking transmission input shaft seal, or excessive grease from over-lubrication of the release bearing.

70. D — A non-synchronized transmission requires the input shaft to be completely stopped before gears can mesh without clashing. The clutch is the only mechanism for stopping the input shaft — when fully released, it disconnects the engine from the input shaft, and internal friction plus the clutch brake (at full pedal travel) bring the shaft to a stop. If the clutch is not fully releasing, the input shaft continues to spin at some speed, and no amount of double-clutching can compensate because the input shaft never stops between gear selections. The fact that gears shift normally with the engine off confirms the transmission's internal components are intact.

71. C — Stall speed testing is a diagnostic measurement performed with the transmission in gear, the service brakes fully applied to hold the vehicle stationary, and the throttle applied to full. The engine RPM climbs to a point where the torque converter's impeller (driven by the engine) and turbine (held stationary by the brakes) reach equilibrium. This maximum RPM is the stall speed. It verifies both the engine's power output (a weak engine will stall at a lower RPM) and the torque converter's capacity (a worn converter stalls at a different RPM than specified). The actual stall RPM is compared to the manufacturer's specification.

72. A — Rust-colored staining around U-joint bearing caps is evidence that moisture has entered the bearing. Even though the joint currently has no detectable play, the needle bearings inside the caps are corroding, and failure is imminent. U-joint failure often progresses rapidly once moisture contamination begins — the corroded needle bearings develop flat spots, the cross trunnion surfaces wear, and the joint develops play that quickly progresses to catastrophic failure (a broken cross or a cap that spins in its bore). Replacing the joint now prevents a driveline failure on the road.

73. D — A slip in only one gear indicates that the clutch pack responsible for that specific gear ratio is not holding under torque. Each gear in an Allison automatic transmission is engaged by a specific combination of clutch packs. If the 3rd gear clutch pack linings are worn or the clutch piston seal is leaking, the pack cannot maintain adequate clamping force during the 2-3 shift. The engine RPM flares as the clutch slips, then catches as the apply pressure eventually overcomes the reduced clamping force. All other clutch packs are healthy, so other shifts are unaffected.

74. B — A vibration that did not exist before the carrier bearing replacement points to something that was changed during the repair. When the driveshaft sections were separated to install the new bearing, they may have been reassembled with the phasing marks misaligned. Driveshaft phasing requires the yoke ears at both ends of each section to be in the same plane. Misaligned phasing introduces a vibration at twice per driveshaft revolution because the U-joints' inherent speed fluctuations no longer cancel properly. Verifying and correcting the phase alignment eliminates the vibration.

75. A — The inter-axle differential lock only affects the torque split between the forward and rear drive axles — it forces both axles to rotate at the same speed. However, each individual axle still has its own internal wheel-end differential that continues to function normally. The left and right wheels on each axle can still turn at different speeds during turns, because the inter-axle lock does not engage the individual axle differential locks (those are separate controls, if equipped).

76. C — The PTO output shaft rotates (confirming the PTO is engaged and mechanically functional), but the hydraulic pump does not turn (confirming the pump is not receiving the PTO's rotational input). The connection between the PTO and the pump — whether it's a driveshaft, a spline coupler, or a direct

coupling — has failed. A broken driveshaft, a stripped coupling spline, or a sheared coupler pin allows the PTO to rotate freely without transmitting any torque to the pump's input shaft.

77. B — Backlash of 0.005 inches is below the specification range of 0.008 to 0.012 inches — the ring gear is positioned too close to the pinion. Insufficient backlash causes tight meshing, noise, heat generation, and accelerated gear wear. The ring gear must be moved away from the pinion by adjusting the side bearing adjusters, increasing the backlash to within the specified range. Moving the ring gear away from the pinion shifts both the backlash measurement and the gear tooth contact pattern (from toe toward heel).

78. D — A humming noise that is constant during acceleration, deceleration, and coasting — and increases in pitch with speed — is characteristic of a wheel bearing fault rather than a ring and pinion fault. Ring and pinion noise typically changes between acceleration (drive side) and deceleration (coast side) because the loaded tooth surface changes. A wheel bearing produces noise based solely on rotational speed, unaffected by torque direction. The constant, speed-proportional nature of the noise points directly to a damaged bearing race or roller.

79. A — The final drive ratio determines how many driveshaft revolutions occur per wheel revolution. A 4.11:1 ratio means the driveshaft turns 4.11 times for every one wheel revolution, while a 3.08:1 ratio requires only 3.08 driveshaft turns per wheel revolution. Since the engine speed is directly linked to driveshaft speed through the transmission, Truck B's engine must turn more revolutions per wheel revolution at any given road speed. At highway speed, this translates to higher engine RPM, which typically means higher fuel consumption but more torque multiplication at the wheels.

80. C — The "Clutch Wear Beyond Learn Limit" code means the AMT's clutch actuator has reached the end of its mechanical travel range — it can no longer compensate for the clutch disc thickness that has worn away. The TCU continuously learns the clutch engagement point and adjusts the actuator position as the disc wears. When the disc wears to the point where the actuator cannot extend far enough to reach the correct engagement position, the TCU can no longer control engagement precisely, causing rough engagement and stalling. The clutch assembly must be replaced and the TCU must relearn the new engagement point.

81. B — The synchronizer assembly is a friction device that matches the rotational speed of the selected gear to the mainshaft speed before the sliding clutch sleeve engages. Without synchronizers (as in non-synchronized transmissions), the driver must manually match speeds through double-clutching. The synchronizer's friction ring contacts the gear's cone surface as the driver moves the shift lever, using friction to slow down or speed up the gear until its speed matches the mainshaft. Only when the speeds are equalized does the blocker ring allow the sleeve to slide forward and lock the gear to the shaft.

82. A — Rotating the driveshaft 180 degrees on the companion flange changes the position of any driveshaft imbalance relative to the flange. If the vibration changes character (changes its phase or frequency pattern) but does not disappear, the imbalance is traveling with the driveshaft — confirming it is in the shaft itself rather than in the companion flange. If the vibration remained exactly the same after rotation, the flange would be the suspect. If the vibration disappeared, the problem was likely a combination of shaft and flange imbalance that cancelled in the new position.

83. A — On heavy-duty non-synchronized transmissions, a clutch brake is installed on the transmission input shaft between the release bearing and the transmission front bearing retainer. When the clutch pedal is pressed to the floor (the last 1 to 2 inches of pedal travel), the release bearing contacts the clutch brake and applies friction to stop the input shaft's rotation completely. This is necessary for clash-free engagement of reverse and first gear from a standstill. A worn or missing clutch brake allows the input shaft to continue spinning, making reverse engagement difficult or impossible without clashing.

84. A — Air in the retarder circuit reduces the density of the fluid inside the retarder housing. The retarder generates braking force through the resistance of fluid being pumped between the rotor and stator — denser fluid creates more resistance and more braking force. Air bubbles in the circuit reduce the effective fluid density, and the aerated fluid compresses under the pumping action rather than transmitting resistance. Bleeding the air from the retarder circuit after the oil change restores full fluid density and retarder effectiveness.

85. C — An 18-speed transmission uses three types of shifts to access all ratios. Main-box shifts move the shift lever between different gate positions, selecting different physical gear pairs. Splitter shifts toggle a button on the shift lever, changing the auxiliary splitter section for a small ratio step within the same main-box position. Range shifts flip a switch on the shift lever, changing the auxiliary range section for a large ratio step that transitions between the lower and upper halves of the total range. The driver must know which type of shift to make for each gear change — a range shift at the wrong time would skip multiple ratios.

86. D — Speed-sensitive steering shimmy is a resonant oscillation of the front wheels that occurs within a specific speed range where the excitation frequency (from a tire imbalance, a road surface, or a mechanical disturbance) matches the natural frequency of the steer axle/steering linkage system. An out-of-balance front tire provides the excitation, and worn components (steering damper, king pins, tie rod ends, wheel bearings) that should dampen the oscillation instead allow it to build. Correcting all contributing factors — balancing the tires, replacing the worn damper, and replacing worn steering and suspension components — resolves the shimmy.

87. B — Foamy power steering fluid indicates air entrainment — air is being drawn into the system and mixed with the fluid by the pump's action. The most common entry points are a low fluid level (the

pump draws air along with fluid when the level drops below the pickup), a loose suction line fitting (air is pulled in through the loose connection under the pump's suction), or a cracked reservoir (air enters through the crack). The brownish color comes from the air oxidizing the fluid and from the fluid's visual appearance changing when it's mixed with air bubbles.

88. A — Unequal caster side-to-side causes the vehicle to pull toward the side with less positive caster. The side with higher caster (+4 degrees on the right) has stronger directional stability and self-centering force, while the side with lower caster (+2 degrees on the left) has weaker stability. The net effect is that the steering drifts toward the weaker side — the left. The standard diagnostic rule is: the vehicle pulls toward the side with less positive caster. Correcting the caster to equal values on both sides eliminates the pull.

89. C — Welding a bracket to the frame created a heat-affected zone in the high-strength frame steel surrounding the weld. The HAZ has altered metallurgical properties — typically reduced hardness, changed grain structure, and lower fatigue resistance than the original base metal. Under the cyclic loading from the concrete mixer's operation (continuous vibration, dynamic load shifts during mixing and pouring), the weakened HAZ developed a fatigue crack at the stress concentration point where the weld meets the base metal. This is a well-documented failure pattern in welded frame modifications.

90. B — A gradual ride height drop during extended parking that recovers quickly upon engine restart indicates a slow air leak in the suspension circuit. The leak rate is low enough that the drop occurs over hours of parking, but the compressor and height control valve can replenish the lost air within a minute of restart. Common leak points include deteriorating air spring rubber, a slow leak at an air line fitting, a height control valve that seeps when static, or a small leak at the air supply connection. A soap-solution leak test with the system pressurized identifies the leak location.

91. D — A damaged crossmember compromises the frame's torsional rigidity — its resistance to twisting. Without adequate torsional stiffness, the frame twists under cornering loads, uneven terrain, and asymmetric loading conditions. This twisting can cause misalignment of body-mounted components, cracking at other frame attachment points from the redistributed stress, and degraded vehicle handling as the frame allows the axles to shift relative to each other. The crossmember must be repaired or replaced to restore the frame's designed structural integrity.

92. A — The front stabilizer bar (anti-roll bar) connects the left and right sides of the suspension through torsion. During cornering, the bar transfers load from the lightly loaded inside suspension to the heavily loaded outside suspension, reducing body roll. A broken bar, disconnected links, or worn link bushings eliminate this load transfer, allowing the body to roll excessively during lane changes and

cornering. Shock absorbers dampen oscillation but do not resist body roll — that is the stabilizer bar's specific function.

93. C — Both-shoulder tire wear with good center tread is the classic pattern of chronic underinflation. An underinflated tire's sidewalls flex excessively, causing the tread to bow upward in the center. The center of the tread lifts slightly away from the road surface while the shoulders bear the full contact load. Over thousands of kilometers, this uneven loading wears the shoulders prematurely while the unloaded center retains its tread depth. Correcting the inflation pressure to specification restores a flat contact patch and stops the shoulder wear.

94. B — Regulatory standards distinguish between a broken main leaf (the primary structural leaf that contains the spring eyes and carries the greatest load, which is automatically out-of-service) and a broken non-main leaf. A broken non-main leaf reduces the spring's total load capacity and stiffness but does not necessarily compromise the spring's structural attachment to the vehicle. The severity is assessed by looking at secondary indicators — whether the spring has sagged, whether the axle has shifted, or whether the remaining leaves are contacting the frame during normal travel. If none of these conditions exist, the defect requires repair but is not automatically out-of-service.

95. D — The slider locking pins must fully engage the holes in the slider rail to secure the axle position. If the pin holes are corroded, filled with debris, or physically damaged, the pin cannot seat fully — it may enter the hole partially but not lock. Additionally, the pin mechanism itself may have a worn or broken return spring that cannot drive the pin with enough force to seat through the obstruction. Cleaning the pin holes, inspecting for rail damage, and verifying the pin spring and mechanism function addresses the root cause.

96. A — The power steering pump's primary diagnostic test is a pressure and flow analysis performed with a power steering analyzer (a tool that measures both pressure and flow simultaneously). If the pump is not delivering adequate pressure (the steering gear doesn't receive enough force assist) or adequate flow (the assist is delayed or inconsistent), the steering effort increases. Testing the pump output isolates whether the fault is the pump, the steering gear, or the circuit between them.

97. C — The slider axles are supporting a significant portion of the trailer's loaded weight. The slider locking pins bear the shear load of this weight, and they cannot be retracted while the weight is resting on them. The friction between the slider rails and the trailer frame (increased by the weight pressing the rails together) also prevents sliding. The trailer must be lifted slightly — either by using the tractor's fifth wheel height or a dock's height differential — to unload the pins and reduce the rail friction before the axles can be repositioned.

98. B — A properly adjusted bearing should spin smoothly with no roughness, grinding, or notchy sensation. Any grinding feel indicates contamination (debris between the rollers and races), bearing damage (pitting, spalling, or brinelling of the roller or race surfaces from a previous failure or overload), or an adjustment that is too tight (preloading the bearing beyond its design clearance). The bearing must be disassembled and inspected — if damage is found, the bearing and race must be replaced; if contamination is the cause, thorough cleaning and fresh grease may be sufficient if the surfaces are undamaged.

99. D — The tire speed rating indicates the maximum sustained speed the tire can safely handle under specified load and inflation conditions. At speeds above the rating, the tire's internal structure generates heat faster than it can dissipate, leading to thermal degradation of the rubber and reinforcement materials. Prolonged operation above the speed rating causes the tire's structural integrity to deteriorate progressively, potentially resulting in tread separation, sidewall failure, or blowout. Commercial vehicle tires must be rated for the vehicle's maximum operating speed.

100. A — If the tire is balanced correctly and has no defects but the wheel still vibrates, the issue is either the wheel itself or the interface between the wheel and the hub. Wheel runout (lateral or radial) causes the tire and wheel assembly to wobble as it rotates, creating a vibration that balance correction cannot address because the vibration is caused by the wheel's shape, not its mass distribution. Corrosion, debris, or damage on the hub mounting surface prevents the wheel from seating flat, causing it to cock at an angle that produces runout.

101. C — If tire pressure, alignment, and mechanical condition are all verified as correct, the remaining variable that determines tire wear rate is the load on the tire relative to its rated capacity. A tire carrying more weight than its design load rating flexes more per revolution, generates more heat, and wears faster — even with perfect alignment and correct inflation. Steer axle overloading commonly results from heavy front-mounted accessories, forward-shifted fifth wheel positions, or improperly distributed cargo weight.

102. B — Fifth wheel EP (extreme pressure) grease is formulated with additives that form a protective boundary film under the extreme sliding loads between the fifth wheel top plate and the trailer king pin plate. General-purpose lithium grease lacks these EP additives and cannot maintain a lubricating film under the same extreme pressure conditions. Metal-to-metal contact occurs, accelerating wear on both the fifth wheel plate and the king pin plate surfaces. The resulting wear creates free play in the coupling that causes noise, accelerated jaw wear, and potentially compromises coupling security.

103. D — Recurring wheel stud failure at one position indicates a systematic cause — not a random fastener defect. The most common cause is an improperly seated wheel that creates a bending load on

the studs with every revolution. Corrosion ridges, debris, or damage on the hub pilot pad surface prevents the wheel from seating flush and centered against the hub. The cocked wheel pivots slightly on the imperfection with each rotation, bending the studs back and forth thousands of times per minute. This cyclic bending load causes fatigue failure of the studs within a relatively short distance.

104. A — Cab mounts (rubber isolators between the cab and the frame) are the primary vibration isolation pathway between the chassis and the cab. When these mounts harden from age, heat cycling, and oil contamination, or when they collapse from compression set, they lose their ability to absorb and isolate vibration. Engine vibration at idle — which is always present but normally absorbed by compliant mounts — transmits directly through hardened or collapsed mounts into the cab structure, producing a noticeable shake. The engine mounts isolate the engine from the frame; the cab mounts isolate the cab from the frame. Both must be functional for a vibration-free cab.

105. C — A transit bus's power-operated entry doors often have a brake interlock that requires the parking brake to be applied (or the service brakes to be applied, or the vehicle to be below a certain speed) before the doors can be opened. This safety interlock prevents passengers from being exposed to open doors while the bus is in motion. If the interlock condition is not satisfied (parking brake not fully applied, brake switch not sensing the applied condition), the door control signal is blocked by the interlock logic and the doors will not open even though air pressure and the door mechanism are functional.

106. B — A door that does not close flush at the bottom — with the bottom gapping outward — has sagged on its hinges. The door's weight is carried by the hinge pins, and as the pins and bushings wear, the door drops at the latch side. The bottom of the door swings outward because the top hinge allows the door to tilt. Worn hinge pins and bushings must be replaced to restore the door to its correct position and alignment. Continued operation with sagging hinges worsens the misalignment, damages the latch striker, and compromises the door seal.

107. D — Windshield repair versus replacement decisions consider multiple factors: the crack's location (damage in the driver's direct line of sight is held to stricter standards than peripheral damage), length (longer cracks are more likely to propagate and affect structural integrity), and depth (cracks through both glass layers of the laminated windshield compromise its structural contribution to the cab). A crack extending from the edge across the driver's viewing area typically requires replacement rather than repair because edge cracks propagate readily and the location directly impairs the driver's ability to see the road.

108. A — The HVAC system uses mode doors to direct airflow to different vent locations — dashboard (panel), floor, and defrost. If the mode door that controls airflow to the dashboard vents is stuck partially closed, physically obstructed, or has a failed actuator, air cannot reach the dashboard vents at full

volume. The floor and defrost ducts may have separate or differently routed paths that are unobstructed, receiving full airflow while the dashboard path is restricted. Inspecting the mode door position and actuator function resolves the discrepancy.

109. C — A trailer relay valve that leaks continuously from its exhaust port when no brake application is being made has an internal fault. The relay valve should be sealed in the released position — no air should pass from the supply port to the exhaust. An internal seal failure allows pressurized supply air to bypass through the valve body and escape through the exhaust port. This continuous leak depletes the trailer's air reservoir, reducing the air available for brake applications and potentially triggering the tractor's low-air-pressure warning.

110. A — Crossmembers support the trailer floor between the main frame rails. Corrosion that significantly reduces their cross-sectional area weakens their load-bearing capacity. The floor must support concentrated loads from cargo weight, forklift traffic during loading and unloading, and the dynamic forces of cargo shifting during driving. Weakened crossmembers can allow the floor to sag, buckle, or fail under these loads, potentially causing cargo damage, cargo shift hazards, and structural failure of the trailer floor assembly.

111. D — Frost on the evaporator outlet line indicates that the refrigerant is still in a liquid/vapor state as it exits the evaporator — it has not fully vaporized inside the evaporator as it should. In a properly charged system, the refrigerant absorbs enough heat inside the evaporator to fully vaporize before reaching the outlet. A low refrigerant charge means less refrigerant enters the evaporator, and the reduced volume drops the evaporator pressure and temperature below normal — cold enough to frost the outlet line. The cargo space remains warm because the undercharged evaporator cannot absorb enough heat despite running cold.

112. B — Corroded connector pins create high-resistance connections that degrade the electrical signals between the ABS ECU and its sensors and modulators. A wheel speed sensor signal that passes through a corroded pin may be attenuated, delayed, or intermittently lost, causing the ECU to misinterpret wheel speed data. This can produce false ABS activations (the ECU thinks a wheel is locking when it is not), failure to activate when needed (the ECU misses a genuine lockup signal), or persistent fault codes that disable the ABS function.

113. A — An auto-deploying lift axle uses air springs to push the axle down into contact with the road. If the air spring on the lift axle is leaking, it cannot maintain the pressure needed to hold the axle down against the weight of the loaded trailer pushing upward through the suspension. The axle deploys momentarily when the control valve sends air to the spring, but the air immediately leaks out and the

spring collapses, allowing the axle to retract back up. The air spring must be inspected for cracks, tears, or mounting seal failures and replaced.

114. C — CMVSS 108 specifically requires the alternating red and white pattern for trailer conspicuity tape. The alternating pattern is designed to provide maximum visibility under varied lighting conditions — the red segments are visible against light backgrounds and the white segments are visible against dark backgrounds. Solid white tape does not provide the same conspicuity performance as the alternating pattern and does not meet the regulatory standard. The solid white section must be replaced with the correct alternating red and white tape.

115. D — The cross shaft synchronizes both landing gear legs — when the crank handle turns, the cross shaft rotates and drives both legs equally through their respective gearboxes. A bent cross shaft transmits unequal rotational input to the two legs, causing one to extend or retract faster than the other. When disconnected from the tractor, the uneven extension causes the trailer to sit at an angle, which shifts the weight asymmetrically onto the shorter leg. Under heavy load, this asymmetric loading can exceed the shorter leg's capacity, leading to landing gear collapse.

116. B — A cracked pushrod clevis is an immediate safety hazard because the clevis is the structural link between the brake chamber's pushrod and the slack adjuster. During a brake application, the full force of the chamber's air pressure is transmitted through the clevis to the slack adjuster and S-cam. If the cracked clevis fails completely during a brake application, the pushrod disconnects from the slack adjuster and the brake on that wheel becomes completely inoperative. The vehicle loses braking force at that wheel position, potentially causing a pull to one side during braking or increasing overall stopping distance.

117. A — The blend door (temperature door) is the component that regulates how much airflow passes through the heater core versus bypassing it. When the blend door is stuck in the full-heat position, all airflow is directed through the heater core regardless of the temperature control setting. The driver selects cooler temperatures, but the door does not move to redirect air around the core. The actuator (cable, vacuum motor, or electric motor) that controls the blend door position has failed, disconnected, or the door itself is mechanically stuck.

118. C — Normal A/C operation produces a significant pressure differential between the high side and low side — the compressor creates this differential by pumping refrigerant from the low side to the high side. When both pressures are closer together than normal (low side too high, high side too low), the compressor is not creating adequate pressure differential. This indicates the compressor is worn internally — the pistons, valves, or scroll mechanism can no longer compress effectively, and refrigerant leaks back through the worn internal clearances. The compressor must be replaced.

119. B — The heater starts (confirming fuel, combustion air, and ignition are present for initial light-off) but shuts down after 60 seconds with a flame failure code. The flame sensor's job is to confirm that combustion is ongoing after the startup period. If the sensor is dirty (coated with carbon deposits), damaged, or has failed, it cannot detect the flame even though combustion may be occurring normally. The control module interprets the absence of a flame signal as a failed ignition and shuts down the heater as a safety precaution to prevent raw fuel from accumulating.

120. D — Evacuation removes two contaminants that would cause system damage if left inside: air and moisture. Air is a non-condensable gas — it does not change state with the refrigerant and occupies space in the condenser that should be available for refrigerant condensation, raising high-side pressure and reducing system efficiency. Moisture forms ice at the expansion device (blocking refrigerant flow and causing intermittent cooling loss) and combines with refrigerant to form hydrochloric and hydrofluoric acids that corrode the system's internal metal surfaces. The deep vacuum boils the moisture at the low temperature inside the evacuated system, converting it to vapor that the vacuum pump removes.

121. A — Replacing the heater core addresses the immediate leak, but the repair is not complete until the cooling system is verified leak-free, properly filled, and bled of air. A pressure test after the repair confirms that the new heater core and all connections are sealed. The coolant must be refilled with the correct type and concentration (50/50 ratio for freeze and corrosion protection). Air must be bled from the heater core and its supply/return hoses — air pockets in the heater circuit cause reduced heating performance and can cause localized overheating in the engine if the air pocket blocks coolant flow.

122. C — At highway speed, ram air (the forward movement of the vehicle pushing air through the condenser) provides substantial airflow for heat rejection, regardless of whether the condenser fan is operating. At idle or low speed, there is minimal ram air, and the condenser relies entirely on its fan for airflow. If the fan is not operating (failed motor, faulty clutch, blown fuse, disconnected wiring), the condenser cannot reject heat at low speeds, and the high-side pressure rises while cooling performance drops. The system works at highway speed because ram air substitutes for the failed fan.

123. B — Defrost mode should deliver the hottest air possible to the windshield to warm the glass surface above the dew point and clear condensation. If the air arriving at the windshield is not warm enough, the blend door may not be fully directing airflow through the heater core. A blend door that is stuck partially open to the bypass path mixes unheated air with heated air, reducing the delivered temperature below what is needed to effectively defog the windshield. The blend door position, its actuator, and the control signal must be checked.

124. D — The relief valve is supposed to hold system pressure at 2,500 psi, but the gauge reads only 1,800 psi when the system is deadheaded (stalled at end of stroke). This means something is limiting the maximum pressure below the intended relief setting. The relief valve spring may have weakened from fatigue or heat, reducing the force holding the valve closed. Alternatively, the valve seat may be worn or contaminated, allowing fluid to bypass at a lower pressure than the spring setting. The relief valve must be inspected, cleaned, adjusted, or replaced to restore the correct maximum pressure.

125. A — Using $F = P \times A$ rearranged to $A = F / P$: $A = 40{,}000 \text{ lb} \div 3{,}000 \text{ psi} = 13.33 \text{ in}^2$. This means the cylinder must have a piston area of at least 13.33 square inches (corresponding to a piston diameter of approximately 4.12 inches) to produce 40,000 pounds of force at 3,000 psi system pressure. If the piston area is smaller, the cylinder cannot produce the required force at the available pressure.

126. C — A filter that has been in bypass was allowing unfiltered fluid to circulate through the system for an unknown period. While replacing the filter element restores filtration going forward, the unfiltered operation may have introduced contamination levels that could damage downstream components. Taking an oil sample and sending it for particle count analysis determines whether the contamination level exceeds the system's cleanliness requirements. If contamination is elevated, additional action such as system flushing or extended filtration may be needed.

127. B — The counterbalance valve is functioning (holding the load against external forces) and the directional valve is not leaking internally (no cross-port leakage). The remaining leak path is inside the cylinder itself — the piston seal allows fluid to bypass from the cap end (pressurized by the load) to the rod end (connected to the return line through the counterbalance valve). As fluid slowly bypasses the worn seal, the effective volume on the cap side decreases and the boom drifts downward. Isolating the cylinder and pressurizing it confirms the internal bypass.

128. D — The oil cooler is the system's primary heat rejection component. If the cooler core is blocked (by external debris or internal contamination), the cooling fan has failed (on fan-cooled coolers), or the cooler lines are restricted, the system cannot dissipate the heat generated during normal operation. The fluid temperature rises progressively because heat is generated continuously by the normal inefficiencies of the pump, valves, and actuators, but the cooler cannot remove it at an adequate rate. Verifying cooler function is the first step because it is the most common overheating cause when fluid level and type are correct.

129. D — Hydraulic accumulators contain pressurized nitrogen gas (typically 1,000 to 3,000 psi pre-charge) and may also contain hydraulic fluid trapped under system pressure. Both energy sources must be fully relieved before the accumulator is disconnected. The nitrogen pre-charge is relieved through the gas valve on top of the accumulator, and the hydraulic pressure is relieved by cycling the system

controls to exhaust stored pressure. An accumulator that is disconnected while still charged can release its stored energy explosively, propelling the accumulator, fittings, or fluid at lethal velocity.

130. C — JIC fittings seal on the contact between the 37-degree flare and the mating seat — not on the threads. Thread sealant tape on JIC fittings is incorrect and can actually interfere with proper seating. If the flare or seat surface has a nick, scratch, or deformation, the metal-to-metal seal cannot form properly and the connection leaks. The correct repair is to disassemble the connection, inspect both sealing surfaces, replace any damaged component, and reassemble to the correct torque. A properly prepared JIC flare-to-seat connection provides a reliable, leak-free seal without sealant.

131. B — Dark, burnt-smelling hydraulic fluid indicates severe thermal degradation. The oil has been subjected to temperatures exceeding its thermal stability limit, causing the molecular chains in the base oil to break down (a process called oxidation or thermal cracking). Thermally degraded oil has reduced viscosity (thinner film = less protection), depleted additives (anti-wear, anti-oxidant, and anti-foam additives break down at high temperatures), and may contain varnish and sludge deposits that can block filters and orifices. The root cause of the overheating must be identified and corrected before refilling — adding fresh fluid to a system that overheats will simply destroy the new fluid.

132. D — A cell voltage imbalance fault means the BMS has detected that one or more cells in Module 7 have diverged significantly from the pack's average voltage. This divergence indicates cell degradation — a cell with reduced capacity charges and discharges faster than healthy cells, reaching higher voltage during charging and lower voltage during discharging. The BMS opens the contactors to prevent the degraded cell from being further damaged (overcharged or overdischarged), which could trigger thermal runaway. Module 7 must be inspected, the affected cells identified through individual cell testing, and the module or cells replaced.

133. A — Regenerative braking requires the traction motor to operate as a generator, the inverter to convert the motor's AC output back to DC, and the VCU to coordinate the transition from motoring to generating mode. A fault in any of these components — a motor winding fault, an inverter switching device failure, or a VCU communication error — can disable the regenerative function while leaving the friction brakes completely unaffected (since friction brakes are mechanical/hydraulic/pneumatic systems independent of the high-voltage drive system). The battery SOC at 40% confirms the battery can accept charge, ruling out a full-battery rejection.

134. C — Class 0 insulating gloves are rated to 1,000 VAC / 1,500 VDC, providing adequate protection with a significant safety margin above the system's 600 VDC operating level. Class 00 gloves (rated to 500 VAC / 750 VDC) would technically cover 600 VDC, but the safety margin is minimal and does not account for voltage spikes or transient conditions. Class 0 is the standard minimum for most commercial

HEV/BEV work. The gloves must be visually inspected and air-tested before each use and electrically tested every six months by a certified testing laboratory.

135. B — Lithium-ion batteries experience gradual capacity degradation over time and charge cycles — this is a normal electrochemical aging process, not a fault condition. The BMS tracks this degradation as "state of health" (SOH), which decreases from 100% (new) as the battery ages. A 30% range reduction at 150,000 km falls within the expected degradation curve for commercial vehicle battery packs. The BMS reports no fault codes because the degradation is within its monitored parameters — the battery is functioning as expected for its age and usage, just with reduced capacity. Battery replacement or capacity planning should be based on the SOH trend.