PRACTICE EXAM 10: RED SEAL 310T SIMULATION (135 QUESTIONS)

1. A technician is replacing a spring-loaded belt tensioner on a heavy-duty diesel engine. The tensioner must be rotated against its spring pressure to release the belt. What is the primary safety concern during this procedure?

A. The belt may snap during removal and strike the technician in the face or hands

B. The spring-loaded tensioner stores significant mechanical energy — if the tool slips off the tensioner bolt during rotation, the tensioner arm snaps back with enough force to fracture a hand or finger; the technician must use a properly fitting wrench or tensioner tool and keep hands and body clear of the tensioner's snap-back path

C. The belt tensioner spring may break during rotation and the fragments can project from the housing

D. The belt may wrap around the technician's hand and pull it into the pulley as the tensioner is released

2. A technician is tasked with draining and disposing of used diesel exhaust fluid (DEF) during a DEF tank replacement. Where should the used DEF be disposed of?

A. Down the shop's floor drain because DEF is a water-based solution that is safe for the municipal sewer system

B. In the shop's waste oil collection tank where it will be recycled with the used engine oil

C. Poured onto the shop's gravel parking lot where it will evaporate and decompose harmlessly

D. In a dedicated waste container for proper disposal according to local regulations — although DEF (urea solution) is non-toxic and non-hazardous in small quantities, large volumes should not be discharged to drains without verification of local wastewater regulations, and the container that held the DEF may be contaminated with other substances

3. A technician is grinding a weld on a truck frame. Sparks and grinding debris are flying in all directions. What minimum personal protective equipment is required for this operation?

A. Safety glasses with side shields, a face shield over the safety glasses, hearing protection, leather gloves, and a long-sleeved shirt or leather welding jacket — grinding produces high-velocity metal particles that can penetrate eyes from any angle, sparks that burn exposed skin, and noise levels that exceed safe exposure limits

B. Safety glasses and leather gloves are sufficient because the grinding operation produces only low-velocity particles

C. A full-face welding helmet with a shade 10 lens and flame-resistant coveralls appropriate for welding operations

D. Safety glasses with side shields and latex gloves to protect the hands from the heat of the grinding disc

4. A shop has a policy requiring all technicians to perform a daily inspection of their personal hand tools before use. What specific defect in a standard combination wrench would require removing the wrench from service?

A. Surface rust on the handle that does not affect the jaw dimensions or structural integrity of the wrench

B. A worn chrome finish on the box end that exposes the underlying steel but does not affect the dimensions

C. A spread or worn jaw on the open end that no longer grips the fastener's flats securely — a worn jaw rounds fastener heads, and a spread jaw can slip off a fastener under force, sending the technician's hand into adjacent components or causing a loss of balance

D. A slight bend in the handle that was caused by using the wrench on a previously stuck fastener

5. A technician is draining the fuel tank on a diesel truck that is being decommissioned. The tank will be removed from the vehicle. What safety precaution is essential when working with diesel fuel in an enclosed shop?

A. Diesel fuel is non-flammable under normal conditions and no special precautions are needed beyond standard PPE

B. The technician should wear a supplied-air respirator because diesel fuel vapors displace oxygen in enclosed spaces

C. The shop ventilation system should be turned off to prevent the fan from spreading diesel vapors to other work areas

D. Adequate ventilation must be provided, ignition sources in the immediate area must be eliminated, and a fire extinguisher must be accessible — although diesel fuel has a higher flash point than gasoline, the atomized fuel spray during draining, spills on hot surfaces, and accumulated vapors in enclosed spaces can create fire and health hazards

6. A technician discovers that a coworker has left an open container of parts cleaning solvent on the workbench overnight. The solvent has been evaporating for approximately 12 hours. What is the primary concern?

A. The solvent has lost its cleaning effectiveness from the 12 hours of evaporation and must be replaced

B. The evaporating solvent has been releasing flammable and potentially toxic vapors into the shop air for 12 hours — the accumulated vapor concentration may approach the lower explosive limit near the container, and the chronic inhalation exposure poses a health risk to all shop personnel; the container must be covered immediately, the area ventilated, and the incident reported

C. The solvent container's label has been degraded by the evaporation and is no longer legible for WHMIS compliance

D. The solvent residue on the workbench surface has created a slippery surface that is a fall hazard

7. A technician is using a hydraulic press to remove a bearing from a shaft. The bearing suddenly shatters during pressing, sending fragments across the shop. What safety measure should have been in place to prevent this hazard?

A. A press safety shield or cage must be installed around the pressing area to contain fragments if a component shatters under the pressing force — bearings, bushings, and other hardened steel components can shatter explosively when pressed, and the shield prevents fragments from striking personnel or equipment in the shop

B. The technician should have heated the bearing with a torch before pressing to soften the metal and prevent shattering

C. The press should have been operated at a slower speed to reduce the instantaneous force that caused the bearing to shatter

D. The technician should have used a plastic drift between the press ram and the bearing to absorb the impact force

8. A shop technician is asked to top up the battery electrolyte on a set of conventional (flooded) lead-acid batteries. What specific fluid must be used to top up the electrolyte level?

A. A dilute sulfuric acid solution matching the battery's original specific gravity concentration

B. Tap water that has been allowed to sit for 24 hours to allow chlorine to dissipate before adding to the cells

C. A commercially available battery acid product from the auto parts store labeled "battery electrolyte refill"

D. Distilled water only — adding anything other than distilled water introduces minerals and impurities that contaminate the electrolyte, coat the battery plates, and accelerate plate sulfation; tap water contains dissolved minerals and chlorine that are harmful to battery chemistry; acid should never be added unless the electrolyte was physically spilled from the battery

9. A heavy-duty diesel engine has a condition where the exhaust produces visible black smoke only during rapid throttle application from idle to full load. The smoke clears within 2 seconds and the engine runs clean at steady full load. What is the most likely cause?

A. The turbocharger wastegate is sticking momentarily during rapid throttle changes, causing a brief boost lag

B. The fuel injection timing is retarded, causing late combustion that produces black smoke under all load conditions

C. Turbocharger lag — during rapid throttle application, the ECM commands full fuel delivery immediately, but the turbocharger requires 1-2 seconds to spool up and deliver the corresponding air volume; during this brief mismatch, the engine has more fuel than air (rich condition), producing black smoke until the turbo catches up and the air-fuel ratio normalizes

D. The DPF is releasing stored soot during the pressure spike created by the sudden increase in exhaust gas flow

10. A technician is diagnosing a heavy-duty diesel engine that has a coolant leak from the exhaust manifold area. Coolant is dripping from between the exhaust manifold and the cylinder head. What internal engine condition could cause coolant to appear at this external location?

A. The exhaust manifold gasket has eroded and no longer seals the coolant passage that runs through the cylinder head adjacent to the exhaust ports

B. A cracked cylinder head at a location where a coolant passage runs between two exhaust ports — the crack connects the internal coolant passage to the exhaust manifold gasket surface, and the pressurized coolant seeps through the crack and exits externally between the manifold and head

C. The exhaust manifold bolts have been over-torqued, crushing the gasket and opening a coolant passage to the exterior

D. The water pump is producing excessive pressure that forces coolant past the head gasket at the exhaust manifold mounting surface

11. A heavy-duty diesel engine has a condition where oil consumption has increased from 0.5 litres per 1,000 km to 2.0 litres per 1,000 km over the past 50,000 km. There are no external oil leaks, no blue smoke, and the crankcase pressure is within specification. Where is the oil going?

A. The oil is being consumed through the turbocharger's compressor-side seal — the oil enters the intake tract and is burned in the cylinders; the small quantity per combustion event is insufficient to produce visible blue smoke but accumulates to 2.0 litres per 1,000 km; the crankcase pressure is within specification because the turbo seal leak does not affect the ring-to-liner seal

B. The oil is leaking internally into the cooling system through a failed oil cooler and raising the coolant level

C. The oil is being consumed by the air compressor through worn piston rings and passing into the air system

D. The oil is being absorbed by the engine's carbon deposits and will be released during the next DPF regeneration

12. A diesel engine equipped with a variable geometry turbocharger has a condition where the engine produces adequate boost pressure but the VGT response to commanded position changes is delayed by approximately 3 seconds. What is the most likely cause?

A. The VGT electronic actuator has a worn internal motor that cannot respond to position commands quickly

B. The VGT vanes are properly clean but the actuator linkage has excessive free play from worn pins or bushings

C. The ECM's VGT control algorithm has been corrupted and is sending delayed position commands

D. The VGT vane mechanism has carbon and soot buildup that restricts the vanes' freedom of movement — the actuator commands the correct position, but the contaminated vanes resist movement through the carbon deposits, creating a delay between the command and the actual vane position change; the vanes eventually reach the commanded position (producing adequate boost) but the lag in response reduces the engine's transient performance

13. A technician discovers that a heavy-duty diesel engine's coolant has turned from its original orange (OAT) color to a murky brown. The coolant was changed 100,000 km ago with the correct OAT formulation. Oil contamination has been ruled out. What is the most likely cause of the discoloration?

A. The coolant has been contaminated with a different coolant chemistry (such as an IAT green coolant) during a top-up — mixing OAT and IAT chemistry causes the inhibitor packages to react and precipitate, forming the murky brown discoloration

B. The engine's cast iron liner surfaces have corroded from depleted SCA protection, and the iron oxide (rust) particles have discolored the coolant

C. The OAT coolant has changed color from the normal chemical reaction between the organic acid inhibitors and the metal surfaces inside the engine — this color change is expected and does not indicate degradation

D. The engine's aluminum components have corroded from the OAT coolant's acid content, releasing aluminum oxides into the coolant

14. A heavy-duty diesel engine has a condition where the engine produces a noticeable vibration at idle that smooths out above 1,000 RPM. The engine has six cylinders. A cylinder contribution test reveals

that cylinder 2 is contributing 40% less than the average of the other five. What does the reduced contribution indicate?

A. Cylinder 2 is not producing its proportional share of power at idle — the cylinder's power deficiency creates an imbalance in the engine's firing impulses that produces the idle vibration; the cause could be a faulty injector (poor spray, low flow), low compression (worn rings, leaking valve), or incorrect valve lash; above 1,000 RPM, the increased rotational inertia of the flywheel masks the imbalance

B. The engine's harmonic balancer has failed and the vibration coincidentally appears to come from cylinder 2's contribution deficiency

C. The fuel rail pressure regulator is not maintaining stable pressure at idle, causing random cylinder-to-cylinder fuel delivery variations

D. The engine mount on the cylinder 2 side has failed, transmitting that cylinder's firing impulse directly to the chassis

15. A diesel engine's DPF regeneration process has failed to complete during a parked regeneration attempt. The technician initiates a second parked regeneration and the exhaust temperature reaches only 450°C. The required temperature for soot oxidation is 550-600°C. What is preventing the system from reaching the required temperature?

A. The DOC has degraded and cannot produce the exothermic reaction needed to raise the exhaust temperature from the engine-out temperature to the DPF regeneration threshold

B. The engine oil level is too high, and the excess oil vapors in the exhaust are absorbing heat from the regeneration process

C. The ambient temperature is too cold for the aftertreatment system to overcome the heat loss from the exhaust components

D. The diesel oxidation catalyst (DOC) upstream of the DPF has lost its catalytic efficiency — the DOC's exothermic oxidation of hydrocarbons and CO is the primary heat source for active DPF regeneration; a degraded or contaminated DOC cannot generate adequate heat from the post-injected fuel, preventing the exhaust temperature from reaching the 550-600°C threshold needed for soot oxidation

16. A heavy-duty diesel engine has a condition where the engine oil appears to gain volume between oil changes — the oil level on the dipstick rises above the full mark even though no oil has been added. The oil has a distinct fuel odor and the viscosity is noticeably thinner than fresh oil. What is occurring?

A. The oil is absorbing moisture from the crankcase ventilation system and the water is increasing the volume

B. Fuel is leaking into the crankcase and mixing with the engine oil — the most common cause on modern engines is excessive post-injection fuel events during DPF regeneration, where the late-injected fuel washes past the piston rings and dilutes the oil; alternatively, a leaking injector o-ring, a cracked injector body, or a failed fuel pump seal can introduce raw fuel into the oil

C. The dipstick tube has shifted position during engine thermal cycling, making the oil level appear higher than it actually is

D. The oil filter bypass valve is stuck open, allowing unfiltered oil to recirculate without passing through the filter, creating turbulence that foams the oil and raises the apparent level

17. A diesel engine's cooling system uses a coolant filter with supplemental coolant additive (SCA) built into the filter element. The engine has wet cylinder liners. What specific type of damage does the SCA in the filter protect against?

A. Corrosion of the aluminum cylinder head from the acidic byproducts of coolant degradation over time

B. Scale buildup inside the radiator tubes from dissolved minerals in the water portion of the coolant mixture

C. Cavitation erosion of the wet cylinder liners — during combustion, the liner walls vibrate at high frequency, creating and collapsing microscopic vapor bubbles in the coolant that erode the liner's outer surface; the SCA chemicals form a protective barrier on the liner surface that resists the erosive force of the collapsing bubbles

D. Electrolytic corrosion between dissimilar metals in the cooling system from stray electrical currents

18. A technician is performing an intake manifold boost leak test on a turbocharged diesel engine. The technician pressurizes the intake system to 20 psi with shop air and listens for leaks. A hissing sound is detected at the turbocharger compressor housing. What does this indicate?

A. The turbocharger compressor housing has a crack, a failed gasket at the compressor outlet, or the compressor housing-to-backplate seal is leaking — any of these conditions allow pressurized boost air to escape before it reaches the intake manifold, reducing the effective boost pressure and causing power loss

B. The turbocharger wastegate is stuck open and the pressurized air is escaping through the wastegate opening

C. The turbocharger bearing is worn and the pressurized air is leaking past the compressor wheel into the center housing

D. The sound is normal — the compressor housing allows controlled air recirculation during boost testing

19. A heavy-duty diesel engine equipped with a fuel-water separator has a condition where the water-in-fuel warning light illuminates frequently — every 2-3 days of operation. The separator is drained each time the light activates, and significant water is present. What is the root cause that should be investigated?

A. The fuel-water separator element has degraded and is no longer effectively separating water from the fuel

B. The engine's fuel return system is creating condensation inside the fuel tank from the temperature differential between the hot return fuel and the cooler tank fuel

C. The fuel filter downstream of the separator has a restriction that creates backpressure, pushing water past the separator element

D. The fuel source (the fueling station or bulk tank) is contaminated with water — consistent water accumulation every 2-3 days indicates a chronic water source rather than normal condensation; the fuel supply tank's sump, the fueling station's underground tank, or the delivery process is introducing water into the fuel; alternatively, the truck's fuel tank has a failed vent check valve or a cap seal that allows rainwater ingress

20. A diesel engine has a condition where the engine's power gradually decreases over a period of 3 months. No fault codes are present. The turbocharger boost is slightly below specification, and the intake manifold temperature is slightly above specification. What single component failure could produce both of these symptoms simultaneously?

A. The EGR cooler has a restriction that is reducing EGR flow and causing the ECM to derate power as a compensating strategy

B. The charge air cooler (intercooler) has developed a partial internal restriction — reduced airflow through the cooler raises the intake manifold temperature (because less heat is rejected) and reduces the effective boost reaching the cylinders (because the restriction limits the volume of air that passes through), producing both symptoms from a single component

C. The fuel injection pump has worn internally and is delivering less fuel than commanded at full load

D. The crankcase ventilation system is restricted, causing elevated crankcase pressure that interferes with ring sealing

21. A heavy-duty diesel engine has a condition where the engine starts normally but the idle speed fluctuates between 600 and 750 RPM in a rhythmic pattern. The fluctuation repeats every 3-4 seconds. No fault codes are present. What is the most likely cause?

A. A vacuum leak in the intake system that introduces unmetered air intermittently as the engine's vibration opens and closes the leak

B. The fuel supply has a periodic restriction — air bubbles in the fuel supply line, a partially clogged fuel filter that alternately blocks and passes fuel, or a fuel transfer pump that pulses create an intermittent fuel supply variation that the ECM compensates for by adjusting idle speed

C. The idle speed control is hunting — the ECM's idle control algorithm is receiving an input signal that oscillates (such as an unstable coolant temperature sensor, a fluctuating fuel pressure signal, or an erratic throttle position signal) and the ECM chases the varying input, producing the rhythmic speed fluctuation

D. The engine's drive belt is slipping on the alternator pulley at idle, causing a load variation that the ECM compensates for with speed changes

22. A diesel engine has been diagnosed with a failed EGR valve — the valve is stuck fully open. What symptoms would a stuck-open EGR valve produce?

A. Excessive EGR flow at all engine operating conditions — at idle, the excess exhaust gas displaces fresh air in the intake manifold, reducing oxygen available for combustion and causing rough idle, misfiring, and excessive smoke; at low load, the engine may stall; the ECM may detect the excessive

EGR flow and set a fault code, but if the valve position sensor still reports the commanded position, the ECM may not detect the mechanical failure

B. The engine will overheat because the exhaust gas bypasses the EGR cooler when the valve is stuck open

C. The engine will produce excessive NOx emissions because the stuck-open valve prevents the exhaust gas from being cooled

D. The engine will experience no noticeable performance changes because the ECM compensates for the stuck-open condition automatically

23. A diesel engine's oil analysis shows a steadily increasing trend in sodium content over three consecutive samples: 8 ppm, 15 ppm, 25 ppm. No other contaminant metals show significant changes. What is the most likely source of the increasing sodium?

A. Sodium-based fuel additive buildup from a biodiesel blend that the engine has been using

B. Bearing overlay material containing sodium that is wearing into the oil at an increasing rate

C. Atmospheric sodium from road salt exposure entering through the crankcase ventilation system

D. A slow, progressively worsening coolant leak into the oil — sodium is a component of coolant additive packages (particularly SCA and OAT formulations); the steadily increasing trend confirms a leak that is getting worse over time, introducing more coolant into the oil with each successive sample; the leak source (oil cooler, head gasket, EGR cooler, or cracked component) must be identified

24. A heavy-duty diesel engine has a condition where the engine starts and runs normally but the oil pressure gauge reads zero at all times. A mechanical test gauge installed at the engine's oil gallery reads 55 psi at operating RPM and 18 psi at idle — both within specification. What is the most likely cause?

A. The oil pressure relief valve is bypassing all oil away from the sender's port, providing pressure to the gallery but not to the sender

B. The oil pressure sender or its electrical circuit has failed — the sender itself may have an open circuit, a shorted circuit, or a stuck internal element, or the wire between the sender and the gauge has an open or short; the mechanical gauge confirms adequate oil pressure, isolating the fault to the electronic reporting circuit

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

D. The ECM is receiving the correct oil pressure data but is not broadcasting it to the instrument cluster on the CAN bus

25. A diesel engine's fuel system has a condition where the engine runs normally at idle and light load but surges and hesitates at moderate to heavy loads. The fuel filter has been recently replaced with the correct specification filter. What should be investigated?

A. The fuel injector return line restriction, which may be blocking the return flow and building excessive backpressure on the injectors

B. The fuel tank vent, which may be plugged and creating a vacuum in the tank as fuel is drawn out faster than air can replace it

C. The fuel supply system between the tank and the high-pressure pump — a suction-side restriction (collapsed pickup tube, kinked line, restricted check valve, or air leak that allows air ingestion under the higher suction demand of heavy load) limits the fuel volume reaching the high-pressure pump; at idle and light load, the demand is low enough that the restricted supply keeps up, but at heavier loads the demand exceeds the restricted supply's capacity

D. The high-pressure fuel pump's metering valve, which may be sticking at specific fuel delivery positions

26. A heavy-duty diesel engine has a condition where the engine's oil level rises steadily and the oil has a strong diesel fuel odor. The engine has no DPF and does not use post-injection for regeneration. What is the most likely fuel source entering the crankcase?

A. Biodiesel fuel has a natural tendency to seep past piston rings more easily than petroleum diesel due to its different molecular structure

B. The fuel transfer pump has a diaphragm leak that allows fuel to enter the crankcase through the engine-mounted pump's mounting gasket

C. The engine's fuel return line has a pinhole leak inside the valve cover that drips fuel onto the head and into the crankcase

D. One or more fuel injectors are leaking fuel into the cylinders during the engine-off period — the leaking fuel accumulates on the piston tops and washes past the rings into the crankcase; alternatively, a fuel injector with a severely degraded spray pattern is injecting fuel onto the cylinder wall instead of into the combustion chamber, where it washes past the rings during operation

27. A diesel engine equipped with a common rail fuel system has been accidentally run with the fuel tank completely empty until the engine stalled. After refueling, the engine cranks but will not restart. What procedure is required?

A. The high-pressure fuel system must be bled of air — running the tank empty introduced air into the entire fuel circuit including the high-pressure pump, fuel rail, and injectors; the air must be purged from the system using the manufacturer's specified bleed procedure, which may involve cranking with the bleed screw open, using the electric priming pump, or cycling the ignition to activate the transfer pump

B. The high-pressure fuel pump must be replaced because running dry has damaged the internal components from lack of lubrication

C. The fuel injectors must be removed and individually primed before the engine will restart after running out of fuel

D. The ECM must be reset using the scan tool before it will allow the engine to restart after a fuel starvation event

28. A diesel engine's exhaust gas temperature readings from the scan tool show that all six cylinders read within 30°C of each other during a loaded road test, except cylinder 5, which reads 80°C lower than the average. What does a significantly lower EGT on one cylinder indicate?

A. Cylinder 5 is not firing or is firing with significantly reduced combustion — the low EGT confirms that less heat is being generated in that cylinder; the cause could be a failed injector (not injecting fuel), a compression loss (not compressing the charge adequately for ignition), or an intake valve that is not closing (not trapping the charge for compression)

B. Cylinder 5's exhaust gas temperature sensor has developed a calibration offset and is reading lower than the actual temperature

C. The exhaust manifold runner for cylinder 5 has an internal restriction that is absorbing heat before it reaches the sensor

D. Cylinder 5's intake valve is opening too early, pre-releasing the exhaust gas before the sensor can measure its temperature

29. A heavy-duty diesel engine has been overhauled and the technician is performing the first oil and filter change at 500 km. During the filter change, the technician cuts open the used filter and examines the media. Fine metallic particles are visible but no large fragments or unusual debris is found. What is the assessment?

A. The fine metallic particles indicate the overhaul was performed incorrectly and the engine should be torn down for inspection

B. The particles indicate the oil specification is incorrect and is not providing adequate film strength for the new components

C. Fine metallic particles in the first post-overhaul oil filter are normal break-in debris — new components (bearings, rings, liners, gears) produce fine wear particles as their surfaces mate and polish during the initial operating period; the absence of large fragments or unusual debris confirms normal break-in; the 500 km oil change is specifically scheduled to remove this debris before it can cause abrasive damage

D. The particles are from the filter element itself and are not indicative of any engine wear condition

30. A heavy-duty truck's air brake system has a condition where the driver notices that the brake pedal effort required to stop the vehicle has gradually increased over the past month. The air system pressure is normal, the brake adjustment is correct on all wheels, and the linings have adequate thickness. What should be investigated?

A. The tire pressures, which if gradually decreasing over the month would require more braking force to decelerate

B. The relay valves for internal wear that progressively reduces their delivery efficiency

C. The air dryer for a gradual loss of drying capacity that is introducing moisture into the system and corroding valve internals

D. The brake linings' coefficient of friction — the linings may be progressively glazing from sustained heat exposure, or they may have been contaminated with oil from a gradually worsening compressor oil

pass-by problem; in either case, the friction coefficient decreases gradually, requiring more pedal effort (higher application pressure) to generate the same braking force

31. A tractor-trailer combination is performing a pre-trip inspection. The driver builds system pressure to cut-out, shuts the engine off, and monitors the gauges. The primary gauge drops 1 psi per minute with brakes released, and the secondary gauge holds steady. The driver then makes a full brake application and holds the pedal down. The primary gauge drops 4 psi per minute and the secondary drops 3 psi per minute. What is the assessment?

A. Both readings are within the allowable limits — with brakes released, 1 psi/minute on the primary is within the 2 psi/minute maximum for a single vehicle, and the secondary at zero is ideal; with brakes applied, 4 psi/minute on a combination is above the 4 psi/minute maximum by zero margin, so it technically passes but should be investigated for the source of the primary circuit leak

B. The applied test fails because the combined rate exceeds the 4 psi/minute maximum for a combination vehicle

C. The primary circuit has a leak that exceeds the standard and the vehicle should not be operated until the leak is repaired

D. The secondary circuit is abnormally tight (zero loss) which indicates a blocked check valve that is not allowing the secondary to equalize properly

32. A heavy-duty truck equipped with S-cam drum brakes has a condition where one wheel produces a loud "clunk" sound during the initial brake application. The noise occurs once per application and does not repeat during the remainder of the stop. What is the most likely cause?

A. The brake drum has a flat spot that contacts the shoe at one specific point during the initial application

B. The ABS modulator on that wheel is cycling once during the initial application from a faulty wheel speed sensor signal

C. Excessive clearance in the S-cam bushing, the slack adjuster clevis pin, or the anchor pin — the free play in these worn components is taken up with a clunk when the brake application force initially loads the slack in the system; once the slack is taken up, the components are loaded and the noise does not repeat during the remainder of the application

D. The brake return spring on that wheel has weakened and the shoe is not fully retracted, causing it to contact the drum abruptly during application

33. A technician is performing a static pressure test on a tractor-trailer combination's air system. With the engine off, system fully charged, and all brakes released, the technician observes that both gauges drop exactly 2 psi over 5 minutes. What is the assessment for this vehicle?

A. The vehicle passes the static leak test — for a tractor-trailer combination with brakes released, the maximum allowable loss rate is 2 psi per minute; the observed rate is 2 psi over 5 minutes (0.4 psi per minute), which is well within the specification and indicates a tight air system

B. The vehicle fails because any measurable pressure drop with brakes released indicates a leak that must be corrected

C. The test must be repeated after waiting an additional 1 minute because the first minute of the test is an equalization period that should not be counted

D. The vehicle passes but is at the boundary of acceptable and should have the leaks identified and repaired preventively

34. A transit bus equipped with air disc brakes has had its brake pads replaced on the front axle. After the pad replacement, the driver reports a spongy brake pedal feel. The air system pressure is normal and no air leaks are detected. What is the most likely cause?

A. The new brake pads are a different compound that compresses more under application force than the original specification

B. The brake caliper pistons were not fully retracted before the new pads were installed, and the pistons are now at an incorrect position

C. Air was introduced into the hydraulic portion of the air-over-hydraulic brake system during the pad change

D. The caliper pistons need to be reset and the automatic wear adjusters need to cycle through several brake applications to take up the excess clearance between the new (thinner at the contact point) pads and the rotor — the first several applications feel spongy because the pistons must advance further to contact the rotor with the new pads; the self-adjusting mechanism compensates after a few applications

35. A heavy-duty truck's air governor has been replaced. After installation, the compressor builds pressure to 145 psi before the governor unloads the compressor. The correct cut-out pressure is 120-125 psi. What is the concern with this over-pressure condition?

A. The air dryer purge cycle activates at the incorrect time, preventing proper desiccant regeneration

B. The elevated pressure exceeds the design rating of the system's hoses, fittings, valves, reservoirs, and brake chambers — components rated for the standard 120-125 psi operating range may fail at 145 psi; additionally, the safety valve (set at approximately 150 psi) should have opened before reaching 145 psi, and its failure to do so indicates both the governor and the safety valve need attention

C. The compressor will overheat from the extended pumping cycle needed to reach 145 psi

D. The brake chambers will apply with excessive force, potentially locking the wheels during moderate brake applications

36. A trailer's air system has been disconnected from the tractor for an extended period. When the trailer is reconnected, the technician notices that the trailer reservoir drain valve releases a significant quantity of liquid water when opened. What does this water accumulation indicate?

A. The trailer's air system has no air dryer and relies entirely on the tractor's dryer for moisture removal

B. Normal condensation — atmospheric air contains moisture, and when compressed, the moisture condenses; without the tractor's compressor running to charge the system and the air dryer to remove moisture, any residual moisture in the trailer's air system condensed as the system cooled during the storage period

C. The trailer reservoirs must be drained of water during the pre-trip inspection on every trip — draining is a mandatory part of the daily pre-trip procedure for trailers that do not have automatic drain valves

D. The tractor's air dryer failed before the trailer was disconnected, and the moisture accumulated in the trailer's reservoir during the last trip

37. A heavy-duty truck has a condition where the parking brakes drag when the vehicle is first driven after sitting overnight in freezing temperatures. The dragging diminishes after approximately 5 minutes of driving. What is the most likely cause?

A. Moisture has frozen inside the spring brake chambers or in the spring brake hold-off air lines — the ice prevents the hold-off air from fully compressing the springs, leaving the brakes partially applied; as the vehicle drives and heat from the friction and exhaust thaw the ice, the springs fully compress and the drag disappears

B. The parking brake valve in the cab has a slow-acting return spring that takes 5 minutes to fully release at cold temperatures

C. The brake shoes have developed a rust bond to the drums from overnight moisture and the friction breaks the bond during the first few stops

D. The spring brake power springs lose tension in cold weather and gradually warm up to their designed force after 5 minutes of operation

38. A technician is inspecting a truck's brake system and finds that one automatic slack adjuster has been manually adjusted by a previous technician — the adjuster has been backed off (loosened) to shorten the pushrod stroke. Why is manually backing off an ASA a potentially dangerous practice?

A. Manual adjustment damages the ASA's internal worm gear mechanism and accelerates its wear

B. The manual adjustment will cause the ASA to over-adjust during the next brake application and lock the wheel

C. Manual adjustment voids the brake system warranty and creates a liability issue for the repair facility

D. Backing off the ASA masks the root cause of the excessive stroke — the ASA was designed to automatically maintain the correct adjustment, and if it cannot do so, there is an underlying problem (worn shoes, oversized drum, worn anchor pins, worn S-cam bushings, or a defective ASA); manually shortening the stroke makes the pushrod measurement appear correct while the root cause remains and the brake will quickly return to the over-stroke condition

39. A heavy-duty truck equipped with ABS has a condition where the ABS warning lamp illuminates after the vehicle has been driving for approximately 30 minutes and the brakes have been used multiple times. The lamp is off at startup and passes the self-test. What could cause this delayed-onset ABS fault?

A. A temperature-sensitive component is failing — a wheel speed sensor, a modulator valve coil, or a wiring connection that functions correctly when cold develops a fault as it heats from proximity to the

brake drum; the resistance of a sensor coil increases with temperature, and a marginal coil that passes the cold self-test may exceed the module's resistance specification when hot

B. The ABS module's internal memory fills up after 30 minutes of data logging and triggers the warning lamp

C. The brake fluid (on air-over-hydraulic systems) overheats after 30 minutes and activates a thermal protection in the ABS module

D. The ABS module's power supply voltage drops after 30 minutes due to increased electrical load from the HVAC system

40. A transit bus has a condition where the foundation brakes lock up when the spring brakes are released quickly. The lockup occurs on the rear axle wheels only and releases within seconds. What is occurring?

A. When the spring brakes are released rapidly, the hold-off air enters the spring brake chamber and pushes against the spring side diaphragm — on a properly functioning system, this air compresses the spring; however, if the spring brake relay valve delivers hold-off air too quickly, the volume of air rushing into the spring side can momentarily push through the service side diaphragm's internal passage, briefly applying the service brake before the air equalizes

B. The spring brake chambers have a manufacturing defect that allows the hold-off air to cross into the service side

C. The ABS system interprets the rapid spring brake release as wheel spin and applies the foundation brakes as a traction control response

D. The rear brake shoes are adjusted too tightly and the thermal expansion from the spring brake drag creates enough friction to lock the wheels when the springs release

41. A heavy-duty truck has a condition where the air system's safety valve (pop-off valve) opens and vents air periodically during normal driving. The governor appears to function normally, cutting out at 125 psi. The safety valve is set at 150 psi. What is the most likely cause?

A. The safety valve's spring has weakened from age and fatigue, allowing the valve to open at a pressure below its rated 150 psi setting — the valve is opening at or near the governor's cut-out pressure (125 psi)

rather than waiting for a true overpressure event; the safety valve must be replaced with a new unit set to the correct 150 psi threshold

B. The governor is overshooting the cut-out pressure by 25+ psi before the compressor responds to the unload signal

C. A pressure spike occurs in the system during each brake application that momentarily exceeds 150 psi

D. The compressor discharge check valve is stuck closed, causing the compressor to continue building pressure against the closed valve and exceeding the safety valve threshold

42. A technician is diagnosing a tractor-trailer combination where the trailer brakes seem to apply harder than the tractor brakes during every stop. The driver describes the trailer as "pushing" the tractor during stops. What is the most likely cause?

A. The tractor's foundation brakes are worn and have reduced friction compared to the trailer's newer linings

B. The trailer's automatic slack adjusters have over-adjusted, causing the trailer brakes to apply more aggressively

C. The tractor's foot valve secondary circuit output pressure is lower than normal due to internal wear

D. The trailer's relay valve has a lower-than-specified crack pressure, causing it to deliver full system pressure to the trailer brake chambers with minimal signal pressure from the foot valve — the trailer brakes apply disproportionately strong relative to the tractor's brake application, creating the pushing sensation

43. A heavy-duty truck has a condition where the front brakes on the steer axle produce inadequate stopping force, while the rear brakes produce normal force. The air pressure delivered to the front chambers is correct, and the pushrod strokes are within specification. What should the technician investigate?

A. The front brake drums for an out-of-round condition that reduces the effective contact area between the shoes and the drum

B. The front brake lining material — if the linings have been replaced with a non-OEM specification that has a lower coefficient of friction than the original, or if the linings have become contaminated (oil, grease, or brake fluid), the reduced friction produces inadequate stopping force despite correct adjustment, adequate pressure, and correct stroke

C. The front brake chambers for internal diaphragm leakage that reduces the effective force applied to the pushrod

D. The ABS modulator valves on the front axle for a restriction that limits the volume of air delivered to the chambers during application

44. A school bus's air brake system has a condition where the low-air-pressure warning buzzer sounds briefly during each brake application, then silences when the pedal is released. System pressure reads 110 psi on both gauges. What is the most likely cause?

A. The brake application is momentarily dropping the system pressure below the warning switch's threshold at the switch location

B. The low-pressure warning switch itself is faulty — it is activating from the pressure fluctuation during each brake application rather than from an actual low-pressure condition; the switch may be installed in a location where it is sensitive to the application-induced pressure drop, or the switch has developed a marginal calibration that triggers at a pressure above its intended threshold

C. The warning buzzer has an internal fault that causes it to sound briefly whenever the brake light circuit is activated

D. The governor is cutting in during each brake application, and the electrical load of the compressor engaging causes a voltage drop that activates the warning circuit

45. A technician is replacing the air compressor on a heavy-duty diesel engine. After installation, the compressor builds pressure normally but the technician notices oil dripping from the air dryer's purge valve. What is the most likely cause?

A. The new compressor is passing excessive oil past its piston rings — a new compressor should pass minimal oil during normal operation; excessive oil in the discharge indicates the compressor may be defective, the wrong oil fill level was used, or the compressor's intake is connected to a source of oil-laden air (such as the engine's crankcase ventilation system instead of the clean air intake)

B. The air dryer desiccant is saturated from the previous compressor's oil contamination and is releasing the stored oil during the new compressor's purge cycles

C. The new compressor has a higher discharge temperature that is liquefying the oil residue in the discharge line from the previous compressor

D. Residual oil from the old compressor that was left in the discharge line and fittings is being purged through the system by the new compressor's output

46. A heavy-duty truck's brake system has been recently serviced with new brake shoes on all drive axle positions. After the service, the vehicle pulls to the right during braking. All pushrod strokes are equal and within specification. What is the most likely cause?

A. The replacement brake shoes on the left side have a different friction coefficient than those on the right side — mixed lining brands or formulations create an imbalance in braking force between the left and right sides even though the adjustment, stroke, and air pressure are identical

B. The brake drums on the right side were turned during the service while the left side drums were not

C. The relay valve delivering air to the left-side chambers has a marginally higher crack pressure than the right-side relay valve

D. The left-side brake shoe arc length does not match the drum radius as precisely as the right side, reducing contact area

47. A heavy-duty truck has a condition where the batteries discharge overnight when the vehicle is parked with the ignition off. The parasitic draw test shows 3.5 amps — significantly above the 50-85 milliamp specification. The technician begins pulling fuses to isolate the draw. When the fuse for the inverter circuit is pulled, the draw drops to 60 milliamps. What does this confirm?

A. The 3.5-amp draw could be the inverter's normal standby consumption, which some inverters maintain for their internal circuitry

B. The inverter circuit contains the parasitic draw source — the draw may be from the inverter itself (stuck in standby or active mode), a device plugged into the inverter, or a wiring fault in the inverter circuit between the fuse and the inverter

C. The inverter fuse is the wrong amperage and is leaking current to the inverter circuit even in the off state

D. The inverter must be replaced immediately because any draw above 2 amps on a single circuit indicates a component failure

48. A truck's scan tool shows that the engine ECM is broadcasting the correct coolant temperature on the J1939 data link (92°C), but the instrument cluster displays 120°C. What is the most likely cause of the discrepancy?

A. The CAN bus has a data corruption issue that is modifying the temperature value between the ECM and the cluster

B. The ECM uses a different temperature sensor than the cluster — some vehicles have separate coolant temperature sensors for the ECM and the gauge, and the gauge sensor may have a different calibration or fault

C. The instrument cluster has a thermal protection mode that adds 28°C to the displayed temperature when the cluster's internal temperature exceeds its operating range

D. The instrument cluster is receiving the correct data from the ECM but is interpreting it incorrectly — the cluster may have a gauge calibration error, an internal scaling fault, or a software version mismatch that applies incorrect conversion factors to the raw CAN data; alternatively, if the cluster has its own dedicated sensor, that sensor may be reading differently from the ECM's sensor

49. A heavy-duty truck has a condition where the starter motor cranks the engine at normal speed for the first 2 seconds, then the cranking speed drops dramatically and the engine barely turns over. The batteries have been load tested and are within specification. What is the most likely cause?

A. The starter motor is drawing excessive current from an internal fault — a shorted armature winding, a seized bushing, or worn brushes create increasing resistance and current draw as the motor heats from the initial cranking; the batteries can supply the initial current burst but cannot sustain the elevated draw, and the voltage sags as the batteries are pulled below their capacity

B. The engine's compression release mechanism (jake brake) is inadvertently activating during cranking and adding resistance

C. The fuel injection pump is hydraulically locking one cylinder after the initial rotation due to a leaking injector

D. The battery cables have a temperature-sensitive resistance that increases after the initial current flow heats the cable connections

50. A truck equipped with LED clearance and marker lamps has a condition where one LED lamp assembly appears dimmer than the others. The electrical voltage at the lamp's connector is identical to the other lamps. What is the most likely cause?

A. The LED assembly's internal current-limiting resistor has increased in value, reducing the current through the LED elements

B. The LED assembly is from a different manufacturer with slightly different LED element specifications

C. One or more individual LED elements inside the lamp assembly have failed — LED assemblies contain multiple LED elements wired in series-parallel configurations; when individual elements fail (open), the remaining elements continue to illuminate but the total light output decreases because fewer elements are contributing; the voltage measurement appears normal because the remaining LEDs still present a load to the circuit

D. The LED assembly's lens has internal moisture condensation that is diffusing the light and reducing the apparent brightness

51. A truck's CAN bus has a condition where one specific module intermittently goes offline — it stops communicating on the CAN bus for 5-10 seconds, then comes back online. All other modules communicate continuously. What should be investigated first?

A. The CAN bus backbone for a loose connector near the affected module's CAN bus connection

B. The affected module's dedicated power supply and ground connections — if the module intermittently loses power or ground (from a loose connector, corroded terminal, or a wire break that makes and breaks contact with vibration), it goes offline until the connection is re-established; since all other modules remain online, the CAN bus backbone is functional and the fault is in the affected module's individual power or ground circuit

C. The CAN bus termination resistors for a marginal connection that affects only the bus segment where the failing module is connected

D. The affected module's firmware version, which may have a bug that causes periodic communication dropouts

52. A heavy-duty truck has two batteries connected in parallel. One battery tests at 12.6 volts (fully charged) and the other tests at 11.8 volts (partially discharged). What is the consequence of this voltage mismatch in a parallel configuration?

A. The stronger battery will supply all the vehicle's electrical loads while the weaker battery acts as a reserve

B. The parallel connection will equalize both batteries to an average voltage of 12.2 volts within minutes of connection

C. The voltage mismatch has no consequence in a parallel configuration because the batteries share the load proportionally

D. The higher-voltage battery continuously charges the lower-voltage battery through the parallel connection — this creates a constant current flow between the batteries that wastes energy as heat, accelerates the degradation of both batteries (the strong battery is constantly discharging into the weak one), and reduces the overall starting capacity of the battery bank; the weak battery must be tested and either recharged or replaced

53. A truck's exterior lighting system has a condition where the left tail light and the left front marker light are both dim, while all right-side lights are at full brightness. Both left-side lights are on different circuits from different fuses. What common element would cause both to be dim?

A. A shared ground connection — the left tail light and left front marker light, despite being on different power circuits, may share a common ground point on the left side of the vehicle; a high-resistance ground (corroded ground bolt, deteriorated ground wire) reduces the current through every lamp that depends on that ground point, dimming them all equally

B. The headlight switch has a worn contact that reduces voltage to all left-side lighting circuits simultaneously

C. The body controller module has an internal fault on its left-side output driver that limits current to all left circuits

D. The alternator has a failed diode that affects only the left-side lighting circuits due to the wiring layout

54. A truck's ABS warning lamp has illuminated and the scan tool retrieves a fault code for "Right Front Wheel Speed Sensor — Signal Erratic." The sensor was replaced 2 weeks ago. The technician measures the sensor air gap and finds it is 2.0 mm. The specification is 0.5 to 1.5 mm. What is the assessment?

A. The air gap of 2.0 mm is marginally outside the specification and the sensor will function adequately in most conditions

B. The 2.0 mm air gap is acceptable for aftermarket sensors, which have stronger magnetic fields than OEM sensors

C. The air gap is excessive — at 2.0 mm, the sensor is too far from the reluctor ring to produce a strong, consistent signal; the signal amplitude decreases with the square of the distance, so even a small increase in gap beyond the specification significantly reduces the signal strength; the weak signal is erratic at low wheel speeds and during vibration, producing the fault code

D. The air gap measurement is only critical for hall-effect sensors, not for the passive magnetic type installed on this vehicle

55. A truck equipped with a multiplexed electrical system has a condition where the right rear turn signal works correctly, but when the hazard flashers are activated, the right rear turn signal does not flash — only the left side and the front right flash during hazard operation. What is the most likely cause?

A. The hazard flasher is a separate unit from the turn signal flasher and has a faulty output for the right rear circuit

B. The right rear turn signal works on a separate wiring path when used as a turn signal versus as a hazard light

C. The BCM uses different output channels for the turn signal function and the hazard function — the right rear turn signal output works correctly, but the right rear hazard output (which may be a different channel or the same channel activated by a different command) has a fault; alternatively, the multiplexed

lighting system's configuration may route the hazard signal through a different path that has an open on the right rear circuit

D. The right rear lamp assembly has two separate filaments — one for turn signal and one for hazard — and the hazard filament has burned out

56. A truck's electronic throttle pedal has a condition where the pedal operates normally for the first 50% of travel but produces no additional engine response between 50% and 100% travel — the engine reaches approximately half its rated power and will not accelerate further regardless of pedal position. What is the most likely cause?

A. The throttle position sensor has a dead zone or an internal fault above 50% travel — the sensor produces a valid, increasing signal from 0% to 50%, but above 50% the signal either stops increasing (dead zone), drops to zero (internal wiper detachment), or produces an erratic signal that the ECM interprets as invalid; the ECM limits engine power to the last valid throttle position

B. The ECM has imposed a 50% power derate from an active fault code that limits the maximum fueling command

C. The turbocharger cannot produce adequate boost above half throttle, limiting the engine's power to whatever the naturally aspirated airflow supports

D. The fuel supply pump can only deliver enough fuel for 50% of the engine's rated output

57. A heavy-duty truck has a condition where the dome light stays on continuously even with all doors closed. The dome light switch on the dashboard is in the "door" position (automatic mode). What is the most likely cause?

A. The dome light relay has welded contacts that keep the dome light circuit energized regardless of the switch position

B. The dome light timer module has failed and is continuously powering the dome light

C. The cab wiring harness has a short to ground on the dome light control wire that mimics a door-open signal

D. A door jamb switch is stuck in the closed (door-open) position or has a wiring fault that continuously grounds the dome light circuit — the switch provides a ground signal to the dome light when the door is

opened; if the switch is stuck closed or the wire is shorted to ground, the dome light receives a permanent ground signal and stays on regardless of door position

58. A truck's fuel level gauge reads full at all times even though the fuel tank is known to be at half capacity. The gauge type is a variable-resistance sender with a float. What is the most likely cause?

A. The fuel sender float has become saturated with fuel and sunk to the bottom of the tank, producing a false full reading

B. The fuel sender's resistor card has failed at a point that corresponds to the full-tank resistance value — the sender's internal wiper is stuck or the resistor element has an open circuit at a position that the gauge interprets as full; alternatively, the signal wire between the sender and the gauge is shorted to ground, which on many systems produces a full-scale gauge reading

C. The instrument cluster has an internal calibration error that offsets all gauge readings upward

D. The fuel tank's internal baffle has shifted and is preventing the float from moving to reflect the actual fuel level

59. A heavy-duty truck's alternator produces the correct charging voltage (14.2V) at the battery terminals, but the batteries consistently test at only 75% state of charge after overnight parking. The parasitic draw is within specification. What is the most likely cause?

A. The alternator's current output is insufficient for the vehicle's total electrical load — the voltage is correct because the regulator controls voltage, not current; the alternator's maximum current output may have decreased from worn brushes, a partially shorted stator winding, or a failed diode, reducing the current available to both power the vehicle's loads and recharge the batteries simultaneously

B. The batteries have developed excessive internal self-discharge that consumes the charge faster than the alternator can restore it

C. The charging circuit has a time-delayed relay that disconnects the alternator from the batteries after a specific engine-run time

D. The battery temperature sensor is incorrectly commanding a reduced charge rate based on a false temperature reading

60. A truck equipped with a J1708/J1587 data link (older serial communication) and a J1939 CAN bus (newer protocol) has a condition where the scan tool communicates on J1939 but not on J1708. Some modules communicate only on J1708. What is the consequence of losing J1708 communication?

A. The loss of J1708 is inconsequential because all modules duplicate their data on both communication protocols

B. The truck's engine will not start because the ECM requires the J1708 link for the anti-theft immobilizer verification

C. The loss of J1708 only affects the scan tool's ability to retrieve historical fault codes that were stored using the older protocol

D. Modules that communicate exclusively on J1708 cannot be diagnosed, monitored, or have their parameters adjusted — these may include the instrument cluster, the body controller, the transmission controller, or other legacy modules; the J1708 bus fault (which is a separate physical wiring circuit from J1939) must be diagnosed and repaired to restore communication with these modules

61. A truck's electronic gauge cluster shows the engine oil pressure as "- - -" (dashes) instead of a numerical value. All other gauges display normally. What does the dashed display indicate?

A. The cluster is displaying dashes because it has received an invalid or out-of-range value from the oil pressure sender

B. The cluster has lost communication with the engine ECM that broadcasts the oil pressure data — the dashes indicate that the data is unavailable rather than zero; this is different from a zero reading, which would display "0" or position the gauge needle at zero

C. The oil pressure sender has an open circuit and the cluster displays dashes to distinguish the open-circuit condition from an actual zero-pressure reading

D. The cluster's internal oil pressure gauge driver has failed and the dashes are the default display when the driver circuit cannot process the incoming CAN data

62. A heavy-duty truck has a condition where the key-off parasitic draw is 4.2 amps. The technician pulls fuses one at a time and discovers that pulling the "Cab Power" fuse drops the draw to 65 milliamps. The cab power circuit feeds 15 different devices. How should the technician isolate which device on the circuit is causing the draw?

A. Disconnect each of the 15 devices one at a time while monitoring the ammeter — when the draw drops, the last disconnected device is the source; this is faster than reinstalling the fuse and looking for an individual device's fuse because the devices on this circuit may share the single "Cab Power" fuse

B. Measure the voltage drop across each device's connector to identify which one has the lowest resistance and is therefore drawing the most current

C. Replace all 15 devices simultaneously to ensure the draw is completely eliminated

D. Use a thermal imaging camera to identify which device on the circuit is generating heat from the continuous current draw

63. A truck's engine ECM has been replaced with a remanufactured unit. After installation, the engine starts and runs but the speedometer reads zero and the cruise control does not function, even though the vehicle is moving. All other gauges and systems work correctly. What is the most likely cause?

A. The replacement ECM has a different hardware revision that is incompatible with the vehicle's speed sensor type

B. The replacement ECM does not have the cruise control feature enabled in its software configuration

C. The new ECM's output for the vehicle speed signal has a different voltage range than the original ECM

D. The replacement ECM has not been programmed with the vehicle's specific parameters — the tire size, axle ratio, and speed sensor calibration must be entered into the replacement ECM to match the vehicle; without the correct parameters, the ECM cannot calculate an accurate vehicle speed from the raw speed sensor pulses, resulting in a zero speedometer reading and disabled cruise control

64. A truck's heated windshield has a condition where the heating grid leaves visible lines on the windshield when the heater is active. The lines correspond to the individual heating element wires. Is this condition normal?

A. The visible lines are caused by excessive voltage to the heating grid that is overheating individual wires

B. The visible lines indicate that several heating elements have failed, concentrating the current through the remaining functional elements and making them glow visibly

C. Faint grid lines visible on the windshield when the heater is active are normal — the heating elements embedded in the glass create slight temperature differences between the heated wire paths and the glass between them; these differences can create visible lines, especially when viewed at certain angles or in certain lighting conditions; the lines should disappear when the heater is turned off

D. The visible lines indicate that the windshield glass has delaminated around each heating element wire

65. A truck equipped with an electronic logging device (ELD) has a condition where the ELD shows the vehicle in "driving" status even though the truck is parked with the engine running at a job site. The vehicle speed reads zero on the dashboard. What could cause the ELD to register driving status?

A. The ELD's internal GPS detects slight positional drift from satellite signal variations and interprets the apparent movement as driving

B. The ELD uses engine RPM as one of its driving status criteria — some ELDs transition to "driving" status when the engine is running above a specific RPM threshold, regardless of vehicle speed; if the engine is running at elevated RPM for PTO operation, the ELD may interpret this as driving

C. The ELD's accelerometer detects the engine vibration and interprets the vibration as vehicle movement

D. The ELD's cellular modem is transmitting position data that includes the GPS accuracy uncertainty as apparent distance traveled

66. A heavy-duty truck has a condition where the alternator charge indicator lamp on the dashboard does not illuminate when the key is in the ON position with the engine off. The alternator charges normally when the engine is running. What is the significance of the non-illuminating indicator?

A. The indicator lamp also serves as the alternator's excitation circuit — the lamp provides the initial current to the alternator's field winding that starts the charging process; if the lamp's bulb is burned out or the circuit is open, the alternator may lose its ability to self-excite from a fully discharged state; currently the alternator charges because residual rotor magnetism provides self-excitation, but if the batteries are ever fully discharged, the alternator may not begin charging without the excitation circuit

B. The lamp has no functional significance beyond indication and a burned-out bulb has no effect on the charging system

C. The lamp circuit is controlled by the BCM and a non-illuminating lamp indicates a BCM output fault

D. The lamp is powered by the alternator's stator output and only illuminates when the alternator is producing voltage

67. A truck's scan tool retrieves a fault code from the engine ECM for "Injector Circuit 3 — Current Below Normal." The engine runs on all six cylinders but cylinder 3 is contributing less power than the others. What does "current below normal" indicate?

A. The fuel rail pressure at injector 3 is too low, causing the injector to require less current to open against the reduced pressure

B. The ECM's internal driver for injector 3 has a fault that limits the current output to that channel

C. The injector has a fuel restriction that reduces the back-pressure on the solenoid, requiring less holding current

D. The injector solenoid coil or its wiring has developed increased resistance — higher resistance reduces the current flowing through the coil (Ohm's Law: I = V/R); the reduced current produces a weaker magnetic field that cannot fully open the injector or hold it open for the commanded duration, resulting in reduced fuel delivery and lower power contribution from cylinder 3

68. A truck equipped with a telematics system has a condition where the telematics unit reports "No GPS Fix" intermittently during driving. The GPS antenna is roof-mounted and appears intact. What should the technician investigate?

A. The telematics unit's internal GPS receiver, which may be overheating and losing lock intermittently

B. The GPS antenna cable for damage, kinks, or loose connections — the antenna may be functioning correctly, but if the coaxial cable between the antenna and the telematics unit has a damaged shield, a kinked section, a loose connector, or water intrusion at a connection point, the signal reaching the unit is degraded or intermittently interrupted; the cable is the most vulnerable component in the GPS system

C. The telematics unit's firmware version, which may have a GPS processing bug that causes intermittent lock loss

D. The vehicle's route for GPS dead zones such as tunnels, dense urban canyons, or areas with heavy tree canopy

69. A heavy-duty truck equipped with a 10-speed manual transmission has a condition where the transmission is difficult to shift into any gear from neutral when the engine is running. The clutch pedal has the correct free play. When the engine is off, the transmission shifts smoothly into all gears. What is the most likely cause?

A. The clutch is not fully disengaging — either the hydraulic system has air in the line (reducing the effective slave cylinder stroke), the clutch disc is binding on the input shaft splines (preventing it from releasing completely), or the release bearing travel is insufficient to fully unload the pressure plate; the dragging clutch prevents the input shaft from stopping, and the spinning input shaft makes gear engagement difficult

B. The transmission synchronizers are worn on all gears simultaneously and cannot match the input shaft speed

C. The transmission oil viscosity is too high for the ambient temperature and is preventing the gears from meshing smoothly

D. The engine idle speed is set too high, creating excessive input shaft momentum that overwhelms the synchronizers

70. A truck equipped with an Allison automatic transmission has a condition where the "Check Trans" light illuminates and the transmission defaults to 3rd gear only. The scan tool retrieves a fault code for "Output Speed Sensor — No Signal." What is the significance of the output speed sensor to the transmission's operation?

A. The output speed sensor provides the TCM with the transmission's output shaft speed, which is proportional to vehicle speed

B. The output speed sensor is used only for the speedometer display and its loss does not affect transmission operation

C. The output speed sensor provides the TCM with data essential for calculating the gear ratio (by comparing output speed to turbine speed), determining vehicle speed for shift scheduling, and monitoring for clutch slip — without this data, the TCM cannot safely execute shifts and defaults to a single gear as a limp-home protection

D. The output speed sensor controls the torque converter lockup timing and its loss prevents lockup engagement

71. A heavy-duty truck with a manual transmission has a condition where the transmission makes a whining noise in all gears except 4th gear (direct drive). The noise changes pitch with vehicle speed. What does the absence of noise in direct drive indicate?

A. The noise is in the transmission's auxiliary section, which is bypassed during direct drive operation

B. In direct drive, the input shaft is locked directly to the output shaft through the mainshaft — the countershaft gears are not loaded because no gear reduction is occurring through the countershaft; the whining noise in all other gears is produced by the countershaft gears or bearings under load, and the silence in direct drive confirms the noise source is in the countershaft assembly

C. The mainshaft bearing is worn and produces noise in every gear except direct drive where it is unloaded

D. The direct drive gear set has been recently replaced and is quieter than the other, original gear sets

72. A truck equipped with a torque converter automatic transmission has a condition where the transmission fluid is milky pink instead of its normal red color. The fluid level appears higher than the full mark. What has contaminated the fluid?

A. Fuel dilution from a failed torque converter seal that allows fuel from the engine's fuel system to enter the converter

B. Brake fluid from a failed vacuum modulator (if equipped) that draws brake fluid into the transmission through the modulator's diaphragm

C. Power steering fluid from a cross-contaminated service where ATF and power steering fluid were accidentally mixed

D. Engine coolant — the transmission oil cooler (located inside the radiator) has developed an internal leak that allows coolant to enter the transmission fluid; the coolant is under higher pressure than the transmission fluid, so coolant pushes into the transmission circuit; the coolant and ATF mix to create the milky pink color, and the added coolant volume raises the fluid level above the full mark

73. A heavy-duty truck's driveshaft has a vibration that is present only in 5th gear at exactly 1,400 RPM. The vibration is not present at 1,400 RPM in any other gear. What does this gear-specific vibration indicate?

A. The driveshaft is operating at its critical speed (the rotational speed where its natural bending frequency matches its rotational frequency) at the specific driveshaft RPM that corresponds to 1,400 engine RPM in 5th gear — in other gears at 1,400 engine RPM, the driveshaft turns at a different RPM due to the different gear ratio and does not reach critical speed

B. The 5th gear synchronizer is worn and creates a vibration at that specific RPM from the gear mesh frequency

C. The transmission has a worn 5th gear that produces a gear-mesh vibration only at 1,400 RPM

D. The engine has a vibration at exactly 1,400 RPM that is only transmitted through the drivetrain when 5th gear is engaged

74. A heavy-duty truck equipped with a limited-slip differential has a condition where the differential allows one wheel to spin freely when the truck is stuck in mud. The limited-slip feature does not seem to be functioning. What is the most likely cause?

A. The differential's limited-slip clutch packs have worn beyond their service limit — the clutch packs no longer generate adequate friction to transfer torque from the spinning wheel to the stationary wheel; when the clutch packs cannot maintain a torque bias, the differential functions as a conventional open differential, sending power to the wheel with less traction

B. The limited-slip differential requires a minimum vehicle speed to engage and cannot function from a standing start

C. The differential lock switch must be activated manually before the limited-slip feature engages

D. The mud has entered the differential through the axle breather and contaminated the limited-slip fluid

75. A technician is replacing the pilot bearing in a heavy-duty truck's flywheel. The old bearing spins freely with no noise or roughness when rotated by hand. Should it be replaced during the clutch job?

A. The pilot bearing does not need replacement since it spins freely and shows no signs of wear or damage

B. The pilot bearing should be replaced during every clutch replacement regardless of its apparent condition — the bearing is inexpensive but extremely difficult to access without removing the

transmission; it supports the transmission input shaft's front end and its failure causes the clutch to chatter, vibrate, or not release properly; replacing it preventively avoids a repeat transmission removal

C. The pilot bearing only needs replacement if the clutch disc hub shows wear marks from the input shaft wobbling

D. The pilot bearing should be inspected further with an ultrasonic tester before making the replacement decision

76. A bus equipped with an Allison automatic transmission has a condition where the transmission shifts from 1st to 2nd and from 2nd to 3rd normally, but will not shift from 3rd to 4th. The TCM commands the 3-4 shift but the transmission remains in 3rd. What is the most likely cause?

A. The 3-4 shift solenoid is stuck in the wrong position and cannot direct fluid to the 4th gear clutch pack

B. The torque converter lockup clutch is interfering with the 3-4 shift by engaging prematurely

C. The governor pressure (on older hydraulically-controlled models) has reached its maximum at the 3rd gear operating point

D. The 4th gear clutch pack is not applying — the solenoid may be commanding the shift correctly, but the clutch pack's apply piston seal is leaking, the apply circuit has a restriction, or the clutch plates are burned and cannot develop adequate friction to hold; the transmission stays in 3rd because the 3rd gear clutch remains applied and the 4th gear clutch cannot engage

77. A heavy-duty truck has a condition where the clutch chatters during engagement — the vehicle shudders and vibrates as the clutch is released. The clutch components were replaced 20,000 km ago. What should be investigated?

A. The flywheel surface for hot spots, glazing, or warpage — even with new clutch components, a flywheel with a compromised friction surface (from heat damage, glazing, or runout) produces inconsistent friction contact during engagement, causing the disc to alternately grip and slip as it contacts the uneven surface; additionally, oil contamination on the disc from a leaking rear main seal would cause the same chatter symptom

B. The clutch disc torsional damper springs for fatigue failure that allows the hub to engage inconsistently

C. The pressure plate's diaphragm spring for uneven finger height that applies inconsistent clamping force

D. The transmission input shaft for excessive runout that causes the disc to wobble during engagement

78. A truck's transfer case has a condition where it shifts between 2WD and 4WD normally using the electronic shift motor, but the indicator lights on the dashboard do not change — they remain illuminated in the 2WD position regardless of the actual transfer case position. What is the most likely cause?

A. The transfer case position encoder or feedback switch is not communicating the actual position to the dashboard

B. The electronic shift motor has a failed position feedback sensor that reports the completed shift to the dash indicator

C. The transfer case's position feedback sensor or switch has failed or is misadjusted — the switch is mounted on the transfer case and detects which range the shift mechanism is in; if the switch is faulty, misadjusted, or has a wiring fault, it cannot report the actual position change to the dashboard indicator circuit, leaving the indicator stuck in the 2WD display regardless of the actual mechanical position

D. The dashboard indicator circuit has a short that locks the display in the 2WD position

79. A heavy-duty truck's automatic transmission produces a harsh, delayed engagement when shifted from Park or Neutral to Drive or Reverse. The transmission shifts normally between gears once in Drive. What is the most likely cause?

A. The torque converter has a failed stator one-way clutch that prevents smooth initial engagement

B. The transmission's accumulator piston is stuck and cannot cushion the initial engagement

C. The engine idle speed is too high, creating excessive torque converter turbulence during the initial engagement

D. The transmission's main line pressure is too high — the initial engagement uses the main pressure circuit to apply the forward or reverse clutch; if the pressure regulator or boost valve is producing excessive pressure, the clutch applies too aggressively, causing the harsh engagement; once in Drive, the normal shift circuits modulate the pressure for smooth gear changes

80. A heavy-duty truck equipped with a two-piece driveshaft has a vibration. The technician disconnects the rear driveshaft section at the center carrier bearing companion flange and rotates it 180 degrees (half turn) from its original position, then reconnects it. The vibration disappears. What does this confirm?

A. The driveshaft was phased incorrectly from a previous repair and the 180-degree rotation corrected the phasing error

B. The driveshaft rear section has a balance issue at the flange connection — rotating 180 degrees repositioned the heavy spot relative to the companion flange's heavy spot; the two imbalances now cancel each other instead of adding together; the permanent fix is balancing the rear section with the companion flange

C. The center carrier bearing was binding at one specific rotational position and the 180-degree rotation moved the binding point

D. The rear U-joint has a worn bearing cap at one specific position that produces vibration only when that cap is in a specific orientation relative to the flange

81. A heavy-duty truck's clutch hydraulic system has DOT 4 brake fluid. The technician accidentally adds DOT 5 (silicone-based) brake fluid to the clutch master cylinder reservoir. What is the consequence?

A. DOT 4 and DOT 5 have different boiling points but are otherwise fully compatible in clutch hydraulic systems

B. The DOT 5 fluid's purple color will mix with the DOT 4's clear color, making the fluid appear contaminated but with no functional consequence

C. DOT 5 (silicone-based) is not compatible with DOT 4 (glycol-based) — the two fluid types do not mix homogeneously, creating separation and inconsistent hydraulic properties; DOT 5 can cause DOT 4-compatible rubber seals to swell or deteriorate, and the separated fluids may trap air pockets that create a spongy pedal; the system must be drained, flushed, and refilled with the correct DOT 4 fluid

D. The DOT 5 fluid will settle to the bottom of the reservoir due to its higher specific gravity and can be drained from the system's low point

82. A truck equipped with an automated manual transmission has a condition where the transmission successfully shifts through all gears during acceleration but takes approximately 5 seconds longer than

normal to complete each shift. The engine RPM flares (rises) excessively during each shift. What is the most likely cause?

A. The AMT's clutch actuator is moving too slowly due to a weak clutch actuator motor or a restricted hydraulic supply to the actuator

B. The clutch is worn to the point where the AMT's clutch actuator must travel further to fully disengage and re-engage the clutch — the increased actuator travel adds time to each shift cycle, and the worn clutch slips during the re-engagement phase, allowing the engine RPM to flare before the clutch grabs

C. The AMT's shift actuator servo motor is operating at reduced speed from a failing motor or a restricted air supply

D. The engine brake is inadvertently activating during each shift, slowing the input shaft deceleration and extending the shift time

83. A heavy-duty truck has a rear axle that produces a humming noise that is present during acceleration and deceleration but changes pitch when transitioning between the two. The noise is constant during steady-speed cruising. What is the most likely cause?

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

B. A worn pinion bearing — the bearing produces a constant humming noise at all operating conditions because the pinion always rotates when the wheels are turning; the pitch change during acceleration-to-deceleration transition occurs because the bearing load shifts from one race to the other as the thrust direction reverses

C. The wheel bearings on the affected axle are worn and produce a speed-dependent hum that is present at all driving conditions

D. The axle shaft splines are worn and produce a humming vibration that changes frequency as the torque direction reverses

84. A truck's PTO-driven hydraulic pump has been recently replaced. After installation, the new pump produces adequate pressure and flow, but it is significantly louder than the pump it replaced. The PTO engagement is smooth and the drive gear mesh appears correct. What is the most likely cause of the noise?

A. The replacement pump has a different displacement and operates at a higher pressure to achieve the same flow rate as the original

B. The suction line or strainer may have been disturbed during the pump replacement and is now restricted — the restriction causes the pump to cavitate, producing the loud noise; the pump itself is functional, but the restricted suction prevents adequate fluid from reaching the inlet, creating vacuum conditions that generate cavitation noise

C. The replacement pump is a different brand that has naturally louder operational characteristics from its different internal design

D. The PTO is driving the replacement pump at a higher RPM than the original due to a different gear ratio in the replacement pump's drive coupling

85. A technician is performing a drive axle oil change on a heavy-duty truck and discovers metallic sludge in the drain plug magnet. The sludge contains fine metallic particles but no large chunks or fragments. The axle has 300,000 km. What is the assessment?

A. The metallic sludge indicates the ring and pinion gear set has failed and must be replaced immediately

B. The metallic sludge indicates the axle bearings are failing and the axle should be disassembled for inspection

C. A moderate accumulation of fine metallic particles on the drain plug magnet at 300,000 km is within the normal range for gear and bearing wear — the magnet's function is specifically to capture these wear particles and prevent them from circulating; the absence of large chunks or fragments confirms no catastrophic wear is occurring; the particles should be monitored at each oil change interval for changes in quantity or size

D. The metallic particles are from the drain plug magnet itself, which has corroded internally and is shedding material

86. A heavy-duty truck has a condition where the power steering makes a groaning noise during full-lock turns but operates quietly during normal steering. The fluid level is correct and the fluid is clean. What is the most likely cause?

A. The power steering pump reaches its maximum output pressure during full-lock turns — the steering gear's internal relief valve activates, and the high-pressure fluid flowing through the relief creates the groaning noise; sustained full-lock operation should be avoided because the pump operates at maximum pressure with zero flow, generating maximum heat

B. The steering gear has a worn sector shaft that contacts the housing during full-lock travel

C. The power steering lines have a loose bracket that vibrates against the frame only when the pump reaches maximum pressure during full-lock turns

D. The steering gear mounting bolts have loosened, allowing the gear to shift under the maximum hydraulic force of full-lock turns

87. A heavy-duty truck has a condition where the steer tires show a diagonal wear pattern — the wear runs diagonally across the tread face from the inner edge to the outer edge. What alignment condition typically produces this wear pattern?

A. Excessive positive camber that loads the outer tread surface more heavily than the inner

B. A combination of incorrect toe and camber that creates a compound scrubbing angle as the tire rolls

C. A worn or bent steering component that allows the toe to change during driving — the resulting dynamic toe change combines with the normal camber to create a diagonal scrubbing pattern across the tread face that neither toe nor camber alone would produce

D. Excessive positive caster that causes the tire to lean excessively during straight-line driving

88. A truck's leaf spring suspension has a condition where the rear of the truck squats excessively when the vehicle is loaded to its rated capacity. The springs are the original specification for the vehicle. What is the most likely cause?

A. The shock absorbers have failed and are not supporting the springs during loading

B. The spring shackle bushings are worn, allowing the springs to elongate and the truck to sit lower under load

C. The leaf springs have been overloaded previously and the leaves have taken a permanent set — the reduced arch means the springs have less deflection capacity remaining before they go flat; they can

support the rated load but sit lower than designed because their free arch has decreased from the permanent deformation

D. The leaf springs have lost their inter-leaf friction from worn pads, reducing the effective spring rate under load

89. A heavy-duty truck equipped with a solid front I-beam axle has a steering shimmy that occurs only at 70-80 km/h and disappears above and below this speed range. The tires are balanced and the king pins are within specification. What should be investigated?

A. The steering damper for excessive wear that allows the front axle to oscillate at the resonant frequency corresponding to 70-80 km/h

B. The steering damper (stabilizer) — a worn or failed steering damper cannot control the front axle's natural oscillation tendency; at 70-80 km/h, the road input excites the front axle's natural frequency, and without the damper's resistance, the axle oscillates (shimmies) at its resonant frequency; above and below this speed range, the excitation frequency does not match the axle's resonance and the shimmy does not occur

C. The tie rod ends for play that becomes apparent only at the specific frequency of the 70-80 km/h vibration

D. The front tire pressures for a slight underinflation that allows the sidewalls to flex at the resonant frequency

90. A heavy-duty truck has a steer axle tire that shows a cupping pattern on the inside edge only. The alignment is within specification and the tire is properly inflated. What should be inspected?

A. The shock absorber on the affected side — a worn shock absorber allows the tire to bounce, creating intermittent heavy and light contact; the inside edge cupping indicates the bouncing is combined with a slight negative camber or toe condition that loads the inside edge more heavily during the bounce, concentrating the cupping pattern on that edge

B. The king pin bushing on the affected side, which if worn could allow the wheel to tilt under braking forces

C. The brake drum on the affected side, which if out-of-round could create a once-per-revolution vibration that cups the inside edge

D. The spring's main leaf eye bushing, which if worn would allow the axle to shift and change the effective camber during suspension travel

91. A transit bus has a condition where the front suspension produces a loud metallic clunking noise when the bus drives over speed bumps at low speed. The noise comes from the right front suspension area. All visible fasteners are tight. What should be inspected?

A. The spring shackle pins and bushings, which may be worn internally despite the visible fasteners being tight

B. The stabilizer bar end links and bushings for wear or looseness

C. The upper and lower control arm bushings (on an independent front suspension bus) for wear or separation

D. The upper and lower ball joints, stabilizer bar links, control arm bushings, and shock absorber mounts — the clunking noise over speed bumps indicates a component with free play that takes up its slack under the dynamic loads of the bump; all suspension pivot points and bushings must be checked for play by loading them individually while observing for movement

92. A heavy-duty truck equipped with hub-piloted wheels has a recurring problem of wheel nut loosening on one specific wheel position. The nuts are torqued correctly with a calibrated wrench, and the re-torque procedure is performed at the specified interval. What should be investigated?

A. The wheel nut threads for damage or cross-threading from a previous over-torquing event

B. The hub pilot pads and the wheel's center bore for damage, corrosion, or debris that prevents the wheel from centering properly on the hub — if the wheel is not concentric with the hub, it oscillates during rotation, cyclically loading the nuts and gradually loosening them; the correct torque cannot compensate for a wheel that is not properly centered on its pilot

C. The wheel stud material, which may have been weakened from the repeated loosening and re-torquing cycles

D. The brake drum for an out-of-balance condition that creates a cyclical force on the wheel nuts during rotation

93. A heavy-duty truck's frame has been inspected and a vertical crack has been found in the frame rail's web, directly below a crossmember attachment point. The crack extends from the bottom flange upward approximately 40 mm into the web. What is the structural significance of this crack?

A. The web carries the frame's shear load — a vertical crack in the web directly reduces the frame's ability to resist the vertical loads (from the vehicle's weight, cargo, and dynamic forces) at that cross-section; the crack must be stop-drilled immediately to arrest propagation, and the frame must be repaired according to the manufacturer's approved procedure before the vehicle carries any load

B. The web crack is less critical than a flange crack because the web carries only torsional loads, not bending loads

C. The crack is cosmetic if the flanges are intact because the flanges carry all structural loads in an I-beam frame

D. The crack at 40 mm is too short to affect the frame's structural capacity and should be monitored at the next inspection

94. A trailer with leaf spring suspension has been converted from a single axle to a tandem axle by adding a second axle and equalizer beams. After the conversion, the trailer tires on both axles wear significantly faster than before the conversion. What is the most likely cause?

A. The added weight of the second axle increases the load on each tire beyond its rated capacity

B. The equalizer beams are too long for the spring spacing, creating excessive inter-axle distance

C. The tandem axle alignment has not been set correctly after the conversion — both axles must be square to the trailer frame and parallel to each other; if either axle is angled, the tires on that axle scrub during driving; the conversion shop must verify the alignment of both axles using the trailer's centerline as the reference

D. The leaf springs on the original axle have weakened from the additional load of the second axle

95. A heavy-duty truck equipped with air ride suspension has a condition where the vehicle bounces excessively after hitting a bump. The bounce dampens within 2 cycles, which is within specification. However, the driver finds the bounce uncomfortable compared to similar trucks. What component adjustment might improve the ride without modifying the suspension system?

A. Adjusting the ride height downward to lower the vehicle's center of gravity and reduce the bounce amplitude

B. Adjusting the height control valve response delay — if the valve responds too quickly to suspension inputs, it adds and vents air in response to each bump, actually amplifying the bounce; increasing the delay time prevents the valve from chasing each bump and allows the shock absorbers to control the oscillation without the valve interfering

C. Increasing the air spring pressure to reduce the suspension's travel and limit the bounce amplitude

D. Adjusting the shock absorbers' internal valving to increase the damping rate

96. A truck's steer axle has a condition where the steering wheel is off-center (rotated to the right) during straight-line driving. The vehicle tracks straight and does not pull to either side. The alignment has been measured and is within specification. What is the correct adjustment to center the steering wheel?

A. Adjust the steering gear's sector shaft to recenter the gear's internal mechanism

B. Adjust the drag link length — the drag link connects the steering gear's output (pitman arm) to the steering linkage; lengthening or shortening the drag link changes the angular position of the steering wheel relative to the road wheels; adjusting the drag link to center the steering wheel does not affect the toe setting or the wheel alignment

C. Loosen the steering wheel and reposition it on the steering shaft splines to the center position

D. Adjust the tie rod length to change the total toe setting until the steering wheel centers

97. A truck equipped with disc brakes on all axle positions has a condition where the brake rotors on the drive axle develop a blue-colored ring on the friction surface after highway driving. The rotors on the steer axle show no discoloration. What does the blue ring indicate?

A. The drive axle rotors have been heated to a temperature that changes the metallurgy of the cast iron at the friction surface — the blue color indicates temperatures exceeding 300°C that alter the rotor's hardness and stress properties; the cause could be brake drag, excessive brake use, or improperly bedded pads; the rotors should be checked for hardness and thickness variation

B. The blue ring is a normal heat tint on cast iron rotors and does not indicate any operational problem

C. The blue color is from the brake pad material transferring to the rotor surface during normal operation

D. The drive axle rotors are a different metallurgical specification than the steer axle rotors and the blue tint is a normal characteristic

98. A trailer equipped with self-steering (caster steer) tag axle tires shows rapid, even tread wear across the entire tread face. The tire pressure is correct and the tag axle alignment has been verified. What is the most likely cause of the accelerated wear?

A. The tag axle's caster angle is set too aggressively, causing the tires to scrub excessively during cornering and straight-line driving

B. The tag axle load share is too high — the axle is carrying more weight than its designed proportion of the trailer's total weight, overloading the tires and causing accelerated wear from the excessive contact pressure

C. The self-steering mechanism's centering device is worn and the axle is oscillating during straight-line driving

D. The tag axle tires are a lower load rating than required for the axle's weight share

99. A heavy-duty truck has a condition where the left rear inside dual tire shows abnormal wear on its inner sidewall — the rubber is worn away in a circumferential strip approximately 25 mm from the bead. The right side shows no such wear. What is the most likely cause?

A. The left inside dual is rubbing against a vehicle component — a brake chamber, an air line, a mud flap bracket, or a shifted axle position is placing the tire in contact with a fixed component that wears the inner sidewall during rotation

B. The left inside dual was manufactured with a thinner sidewall than specification

C. The left rear axle has excessive negative camber that tilts the inside dual inward, causing the inner sidewall to contact the road

D. The left inside dual has been running at significantly lower inflation pressure than the outer dual, causing the underinflated sidewall to bulge and contact an adjacent component

100. A truck's front suspension has leaf springs with rubber bushings at the spring eyes. The technician notices that the rubber bushings on one side are cracked and deteriorated while the other side's bushings are in good condition. Both sides are the same age. What could cause the one-sided deterioration?

A. The deteriorated side's bushings are exposed to a heat source (such as the exhaust pipe routing or a catalytic converter mounted on that side) that accelerates the rubber's thermal and chemical degradation — rubber deteriorates rapidly when exposed to sustained heat above its rated temperature

B. The deteriorated bushings were installed with a petroleum-based lubricant during assembly that chemically attacked the rubber

C. The deteriorated side is exposed to more road salt spray than the other side due to the vehicle's driving patterns

D. The deteriorated bushings are a different rubber compound than the good side from a manufacturing batch variation

101. A trailer equipped with air ride suspension has a condition where the ride height is correct but the trailer produces a harsh, jarring ride over every bump. The air springs appear inflated. What is the most likely cause?

A. The air springs are overinflated beyond the specification for the current load, reducing the suspension's ability to absorb impacts

B. The air spring bellows have aged and lost their flexibility, preventing them from extending and compressing smoothly

C. The height control valve is overreacting to road inputs and rapidly adjusting the air spring pressure during each bump event

D. The shock absorbers have failed — the air springs are at the correct pressure and height, but the shock absorbers cannot control the rate of compression and rebound; without adequate damping, the springs transmit every road input directly to the trailer frame as a harsh, uncontrolled jolt

102. A heavy-duty truck has a condition where the steering feels progressively heavier as the truck is driven throughout the day. When the truck is first started in the morning, the steering effort is normal. By the end of the day, the steering is noticeably harder. What should be investigated?

A. The power steering pump belt tension, which may decrease as the belt heats and stretches during the day

B. The power steering fluid, which may be breaking down from the heat of continuous operation — degraded fluid has reduced viscosity and lubrication properties that increase the steering gear's internal friction; additionally, a partially restricted power steering filter or cooler that becomes more restrictive as debris accumulates during the day's operation could progressively reduce pump efficiency

C. The steer axle king pin bushings, which expand from heat during the day and create increasing friction

D. The tire pressures, which increase throughout the day from heat and paradoxically should make the steering lighter, not heavier

103. A truck has a condition where one drive axle dual tire pair runs significantly cooler than the other pairs on the same axle. All tires are the same specification and inflation pressure. What could cause one pair to run cooler?

A. The cool-running pair has a brake that is not applying — while the other wheels are doing their proportional share of braking (and generating heat from friction), the cool pair's brake is not contributing, so those tires do not receive heat from the braking process; the brake on the cool side must be inspected for a disconnected air line, a failed chamber, or a non-functioning slack adjuster

B. The cool-running pair is on the side of the vehicle that receives more wind cooling from the vehicle's aerodynamic profile

C. The cool-running pair has a slightly higher inflation pressure that reduces the tire's flexing and heat generation

D. The cool-running pair's brake drum is a thicker casting that absorbs more heat and transfers less to the tire

104. A heavy-duty truck's cab produces a rhythmic creaking noise from the cab mounting area when the vehicle drives over uneven pavement. The noise is most noticeable at low speed. What is the most likely cause?

A. The cab air suspension system has a leak that causes the cab to rock on its springs during pavement transitions

B. The cab mounting bushings have dried out, worn, or deteriorated — the rubber or polyurethane bushings that isolate the cab from the frame have lost their lubrication or flexibility, and the metal-to-rubber contact surfaces produce a creaking noise as the cab pivots on the bushings during the frame's torsional movement over uneven pavement

C. The cab tilt latch mechanism has loosened and allows the cab to shift microscopically during frame twist

D. The windshield adhesive has dried out and the glass creaks against the cab's A-pillar during body flex

105. A transit bus has a condition where the passenger compartment emergency exit windows cannot be opened. The latches are functional and unlock, but the windows do not push out. What is the most likely cause?

A. The window frames have corroded and are seized to the bus body from years of moisture exposure

B. The emergency exit windows have been painted over during a bus refurbishment and the paint has sealed the window frame to the body

C. The window hinges or pivot points have seized from corrosion — the hinge mechanisms that allow the windows to swing open are exposed to weather and road conditions and can corrode to the point where they are immovable; the latches release but the seized hinges prevent the window from opening

D. The window rubber seals have swollen from age and chemical exposure, creating a suction that prevents the windows from opening even when unlatched

106. A heavy-duty truck's sleeper berth has a condition where the bunk heater (fuel-fired type) operates normally for heating but produces a strong exhaust odor inside the sleeper when the heater is running. The combustion chamber and exhaust pipe have been inspected and show no leaks. What is the most likely cause?

A. The heater's combustion air intake is drawing air from inside the cab rather than from outside — the combustion chamber is sealed, but if the intake draws cab air, the exhaust gases discharged outside the vehicle re-enter the cab through the ventilation system or window seals, creating the odor; alternatively, the exhaust outlet is positioned where wind currents carry the exhaust back into the cab's fresh air intake

B. The heater's fuel nozzle is dripping fuel onto the exterior of the combustion chamber, and the raw fuel odor is entering the cab through the floor grommets

C. The heater's combustion chamber gasket has a micro-leak that is too small to detect visually but allows combustion gases to seep into the cab structure

D. The DEF tank vent is located near the bunk heater intake and the urea odor is being confused with exhaust odor

107. A truck's cab door has developed a wind noise at highway speed that is localized to the upper rear corner of the driver's door. The door seal is intact and the door closes firmly. What should be inspected?

A. The door's internal vapor barrier, which if torn would allow air to flow through the door panel and exit at the upper corner

B. The exterior mirror mounting, which may be creating turbulence that directs airflow into the upper corner seal area

C. The door seal's compression at the upper rear corner — even though the seal appears intact, it may not be compressed adequately at that specific point due to body panel misalignment, a shifted hinge position, or a dented door frame that prevents the seal from making full contact; the gap allows high-speed air to penetrate and create the wind noise

D. The window glass run channel at the upper rear corner, which may have separated from the door frame

108. A heavy-duty truck has a condition where the cab interior lights (dome, map, and reading lights) all flicker at a frequency of approximately 2 Hz. The flickering is constant regardless of engine RPM or vehicle speed. What is the most likely cause?

A. The body controller module has a software fault that is cycling the interior light output at 2 Hz

B. The interior light circuit has a loose connection or a failing switch that intermittently opens and closes the circuit at the flickering frequency — a connection that is on the verge of failure (a corroded pin, a loose splice, or a failing relay contact) can oscillate between open and closed states, creating a flicker; the 2 Hz frequency corresponds to the rate at which the thermal or mechanical dynamics of the failing connection cycle

C. The alternator's AC ripple is coupling into the interior lighting circuit through a shared ground connection

D. The dimmer control for the interior lights is malfunctioning and cycling the brightness at its minimum adjustment rate

109. A technician inspecting a grain hopper trailer discovers that one of the hopper doors does not close fully — a gap of approximately 10 mm remains between the door and the hopper body when the door handle is in the closed and locked position. What is the concern?

A. The gap will allow insects and rodents to enter the hopper and contaminate the grain during storage

B. The gap will allow grain to leak from the hopper during transport — even a 10 mm gap can allow significant grain loss at highway speed when vibration and airflow work the grain through the opening; the door mechanism, hinges, latch, and sealing surfaces must be inspected and repaired to achieve a full closure

C. The gap is within the acceptable tolerance for hopper door closure and does not require corrective action

D. The gap will only cause a problem during loading when the grain level rises above the door's sealing surface

110. A trailer's ABS system has been functioning normally, but after a brake reline, the ABS warning lamp illuminates and stays on. No ABS fault codes were present before the brake work. What could the brake work have affected?

A. The brake technician may have inadvertently damaged an ABS wheel speed sensor wire, connector, or the sensor itself during the brake shoe removal and installation process

B. The new brake shoes are a different material that affects the ABS modulator's pressure sensitivity

C. The ABS system requires a reset procedure after any brake maintenance to recalibrate the wheel speed sensor thresholds — the technician may have disconnected the ABS ECU power during the brake work, or the sensor wiring, mounting bracket, or air gap may have been disturbed during the shoe replacement; any of these would cause the ABS to detect a fault on the first power-up after the service

D. The brake drum's new contact surface has a different friction profile that confuses the ABS wheel speed sensor

111. A flatbed trailer has a condition where the deck boards have warped upward at the ends, creating a raised lip at each board joint. What is the consequence of this warping?

A. The warped board ends create trip hazards for personnel walking on the deck, damage cargo packaging, and can interfere with forklift operations — the raised lips catch forklift wheels and cargo edges during loading and unloading, potentially damaging both the cargo and the forklift; the warped boards must be replaced or planed flat

B. The warped boards are a cosmetic issue that does not affect the trailer's cargo-carrying function

C. The warped boards will flatten under the weight of the first load and do not require replacement

D. The warping indicates the boards were not properly seasoned before installation and will stabilize after one season of use

112. A trailer equipped with electric-over-hydraulic brakes (used on some smaller trailers) has a condition where the brakes on the left side are significantly weaker than the right side. The hydraulic fluid level is correct. What should be investigated?

A. The left side brake calipers for seized slide pins that prevent even pad application

B. The left side hydraulic lines for restrictions, kinks, or air bubbles that limit the fluid pressure reaching the left brake assemblies

C. The trailer's breakaway switch, which may have a partial contact that reduces current to the left side actuator

D. The electric-over-hydraulic actuator's hydraulic circuit for a restriction or leak on the left-side output — the actuator produces hydraulic pressure from an electric motor/pump combination, and the pressure is distributed to both sides; a restriction, kinked line, or leaking fitting on the left side reduces the pressure reaching the left brake assemblies while the right side receives full pressure

113. A reefer trailer's cargo has arrived at the destination with temperature damage — the cargo temperature has risen 5°C above the setpoint during the trip. The TRU operated continuously and the return air temperature sensor reads correctly. What should be investigated?

A. The trailer's insulation integrity — check for damaged wall panels, deteriorated door seals, and floor or roof insulation failures that allow ambient heat to infiltrate the trailer faster than the TRU can remove it

B. The TRU's evaporator fan motors, which may be running at reduced speed and not circulating air adequately through the cargo

C. The cargo loading pattern — improper stacking may have blocked the airflow channels between the cargo and the evaporator, creating warm spots where the refrigerated air cannot reach; even with the TRU operating at full capacity, blocked airflow prevents the cold air from reaching all cargo surfaces

D. The TRU's condenser for debris accumulation that would reduce its heat rejection capacity

114. A trailer's upper coupler plate (the plate that sits on the fifth wheel) shows deep scoring marks across its surface. What caused these marks and what is the consequence?

A. The scoring was caused by repeated coupling and uncoupling without adequate lubrication between the upper coupler plate and the fifth wheel top plate

B. The scoring is normal wear from the trailer's normal articulation during turning and maneuvering

C. The deep scoring indicates that the upper coupler plate and/or the fifth wheel top plate were operated without adequate grease — the metal-to-metal contact during trailer articulation (turning, backing, grade changes) gouged the surfaces; the scoring increases friction, generates heat, accelerates further wear, and in severe cases can cause the fifth wheel to bind during articulation

D. The scoring was caused by a foreign object trapped between the upper coupler plate and the fifth wheel during a coupling event

115. A tandem-axle trailer has a condition where the right-side tires on both axles show identical wear patterns — feathered wear on the inner ribs. The left-side tires on both axles show no feathering. What alignment condition would produce this asymmetric wear?

A. The tandem axle group is shifted laterally to the right, causing all right-side tires to toe-out and feather on the inner ribs while the left-side tires track true

B. Both right-side tires have a manufacturing defect in the tread pattern that creates feathering under normal driving conditions

C. The right-side brakes on both axles are dragging slightly, generating heat that causes the inside rib rubber to feather from thermal degradation

D. The trailer frame has a slight twist that loads the right-side tires differently from the left, causing the feathered wear pattern on the right only

116. A trailer's air system has a condition where the spring brakes do not apply when the emergency (supply) glad hand is disconnected from the tractor. Air is heard exhausting from the glad hand area when disconnected. The spring brakes should apply within seconds of disconnection. What is the most likely cause?

A. The trailer's spring brake relay valve has a stuck inlet valve that does not close when the supply line pressure is lost

B. The spring brake chambers' power springs have weakened and cannot overcome the residual hold-off air pressure

C. The trailer's check valve between the supply line and the spring brake circuit is stuck open, continuously feeding air from an alternative source

D. The trailer's spring brake relay valve is not exhausting the hold-off air from the spring brake chambers — when the supply line is disconnected, the relay valve should close its inlet and open its exhaust to vent the hold-off air; if the relay valve's exhaust function has failed (stuck closed or blocked), the hold-off air remains trapped in the spring brake chambers and the springs cannot extend to apply the brakes

117. A truck's A/C system has been recharged with the correct weight of refrigerant after a leak repair. The system pressures are normal on the manifold gauges. However, the vent temperature is 15°C instead of the expected 5-8°C. What should the technician check?

A. The compressor oil charge, which if low would reduce the compressor's ability to compress the refrigerant fully

B. The evaporator airflow — a clogged cabin air filter, a blower motor running at reduced speed, or a blocked evaporator drain (causing water to pool and ice to form on the evaporator) can all reduce the volume of air passing over the evaporator; reduced airflow means less air is cooled per unit time, and the vent temperature rises because the air spends less time in contact with the cold evaporator surface

C. The condenser fan speed, which if too high would overcool the high side and reduce the evaporator's cooling capacity

D. The refrigerant type, which may have been mixed with a non-compatible refrigerant during the charge despite the correct weight being achieved

118. A truck's heating system produces heat from the floor vents only — no air comes from the defrost or dashboard vents regardless of the mode setting. The blower motor operates at full speed. What is the most likely cause?

A. The blower motor is running in reverse, pushing air through the duct system in the wrong direction

B. The defrost and dashboard duct openings are blocked by debris that has accumulated in the HVAC housing

C. The HVAC mode door is stuck in the floor position — the actuator motor, the control signal, or the door's mechanical linkage has failed, preventing the door from redirecting airflow to the defrost or dashboard duct openings; the blower pushes air through the only open path (the floor duct) regardless of the mode selection

D. The dashboard and defrost ducts have collapsed from heat degradation, blocking the airflow path

119. A truck's A/C system has a condition where the compressor clutch cycles rapidly — engaging for 2 seconds, disengaging for 1 second, continuously. The manifold gauges show the low-side pressure dropping to 15 psi during the on cycle and rising to 40 psi during the off cycle. What is the most likely diagnosis?

A. The system has a low refrigerant charge — the reduced volume of refrigerant causes the suction pressure to drop rapidly to the low-pressure switch's cut-out threshold during each compressor cycle; the switch opens, the compressor stops, pressure equalizes above the cut-in point, and the cycle repeats; the rapid cycling and the low suction pressure confirm insufficient refrigerant

B. The compressor clutch coil has a thermal intermittent fault that causes it to lose magnetic force after 2 seconds of engagement

C. The expansion valve is stuck partially closed, restricting refrigerant flow and causing the low-side pressure to drop rapidly

D. The low-pressure cycling switch has a calibration error with the cut-in and cut-out points set too close together

120. A truck's HVAC system has a musty, sour odor that is strongest when the A/C system is first turned on and diminishes after a few minutes of operation. The cabin air filter has been recently replaced. What is the most likely source of the odor?

A. The HVAC drain tube is clogged, allowing stagnant water to accumulate in the evaporator housing

B. The heater core has a micro-leak that releases coolant vapor into the airstream when the system activates

C. The new cabin air filter has an antimicrobial coating that produces a temporary odor during the first week of use

D. Microbial growth (mold and mildew) on the evaporator core surface — the evaporator operates at near-dew-point temperatures and the condensation creates a consistently moist environment ideal for microbial colonization; the growth produces the musty odor that is strongest during initial blower activation because the first blast of air carries the highest concentration of microbial byproducts from the undisturbed colony

121. A truck's heated windshield washer system works correctly, but the driver reports that the heated washer fluid creates a temporary fog on the windshield when sprayed in cold weather. What causes this fogging?

A. The windshield glass is cold from the ambient temperature, and the warm washer fluid raises the temperature of the outer glass surface above the dew point of the surrounding air momentarily

B. The heated washer fluid is evaporating on contact with the cold windshield, creating a vapor layer that appears as fog on the exterior surface — this is a normal, temporary phenomenon; the wiper blade disperses the vapor within one or two swipes, and the effect diminishes as the windshield warms from the defrost system

C. The washer fluid concentration is incorrect and the alcohol in the fluid is evaporating as vapor on the cold glass

D. The windshield has microscopic surface defects that trap the heated fluid and release it as fog during evaporation

122. A bus's rear passenger A/C unit has been serviced and recharged. The system cools adequately, but the evaporator produces a visible mist from the outlet vents during high-humidity conditions. Is this a concern?

A. The mist indicates the system is overcharged and liquid refrigerant is escaping through the evaporator outlet

B. The mist is caused by an internal refrigerant leak at the evaporator that is spraying refrigerant into the airstream

C. Visible mist from the evaporator during high-humidity conditions is normal — the evaporator cools the air below its dew point, and the water vapor in the humid air condenses into fine droplets that are carried out of the vent as a visible mist; this is the same principle as seeing your breath on a cold day; the mist is water vapor, not refrigerant

D. The mist indicates the evaporator drain is clogged and condensate is being blown out through the vents

123. A truck's A/C system has been diagnosed with a failed expansion valve. The technician replaces the valve and evacuates and recharges the system. After the repair, the A/C works correctly for 2 days, then the new expansion valve fails in the same manner as the original (stuck closed). What should the technician investigate?

A. The system for contamination — moisture, debris, or sealant residue in the liquid line upstream of the expansion valve can migrate to the new valve and cause the same failure; a failed compressor that is shedding metallic debris, a decomposing desiccant from an old receiver-drier, or residual contamination from a previous repair can all reach the expansion valve and block it; the system must be flushed, the receiver-drier replaced, and the contamination source identified before installing another expansion valve

B. The refrigerant type, which may be incorrect for the expansion valve's operating range

C. The system charge weight, which if slightly overfilled could create excessive liquid pressure that forces the expansion valve closed

D. The expansion valve manufacturer, which may have produced a defective batch of valves

124. A hydraulic system on a truck-mounted crane has a condition where all functions operate normally except the boom telescope function, which moves at approximately half its normal speed. All other functions (boom lift, boom swing, outrigger extend) operate at full speed from the same pump. What is the most likely cause?

A. The hydraulic pump is worn and cannot maintain adequate flow when the telescope function demands a higher flow rate

B. The main relief valve is set too low for the telescope function's pressure requirement

C. The boom telescope cylinder's piston seal has a partial bypass that allows fluid to leak past the piston internally

D. The telescope circuit's dedicated flow control valve or proportional valve is partially restricted or not opening fully — since all other functions operate at full speed from the same pump, the pump output is adequate; the restriction is in the telescope circuit specifically, limiting the flow reaching the telescope cylinder while other circuits receive their normal flow

125. A hydraulic system uses a return line filter. The filter's bypass indicator has never activated in 3 years of operation. The technician pulls the filter element and finds it is completely clean — virtually no contamination captured. What does a perpetually clean return filter indicate?

A. The hydraulic system has been meticulously maintained and the clean filter confirms excellent contamination control practices

B. The return filter's bypass valve is stuck open, and all return flow has been bypassing the filter element since installation — the element is clean because no fluid has passed through it; all return oil has flowed through the bypass valve directly to the reservoir without filtration, and the system has been operating unfiltered for 3 years

C. The hydraulic system uses such high-quality fluid that the filter has had nothing to capture over 3 years

D. The return filter is the incorrect micron rating (too coarse) for the system and is allowing all contamination to pass through the element without being captured

126. A hydraulic crane's boom lift cylinder has a condition where the boom drifts downward approximately 5 mm per minute when holding a 10,000-pound load. The directional valve is in the

neutral (hold) position. The technician disconnects the cylinder's cap-end line at the directional valve and plugs the cylinder port. The drift stops completely. What has this test determined?

A. The directional control valve has internal leakage across its spool that is allowing fluid to bypass from the cylinder's work port to the tank port — plugging the cylinder port eliminated the leak path through the valve, confirming the valve as the leak source; the cylinder's internal piston seal is intact because the drift stopped when the valve was isolated

B. The cylinder's piston seal is the leak source because the drift only occurs when the line is connected to the valve

C. The pump's check valve is leaking and allowing pressure to bleed back through the pump when the valve is in neutral

D. The counterbalance valve in the cylinder circuit is the leak source

127. A hydraulic system has a condition where the operator hears a loud "bang" from the hydraulic system when a control lever is moved rapidly from full flow to neutral. What causes this bang?

A. The relief valve is opening and closing rapidly from the sudden pressure change when the lever is moved

B. The hydraulic pump is cavitating momentarily from the sudden change in system demand

C. The bang is hydraulic shock (water hammer) — the sudden change of flow velocity creates a pressure spike that reverberates through the hydraulic lines and components

D. The sudden closure of the directional valve spool traps a column of moving fluid and creates hydraulic shock (water hammer) — the moving fluid's momentum carries it forward against the suddenly closed valve, creating a pressure spike that can reach several times the system's normal operating pressure; the spike stresses hoses, fittings, and components and produces the audible bang

128. A technician is troubleshooting a hydraulic system where the pump produces adequate pressure but the cylinder extends very slowly. The technician connects a flow meter in the circuit and measures the pump's output. The flow meter reads 8 GPM. The pump is rated at 15 GPM. The engine RPM is correct. What does the reduced flow confirm?

A. The pump has significant internal wear that reduces its volumetric efficiency — the pump can still build pressure (by running against the relief valve), but it cannot deliver the volume of fluid needed to extend the cylinder at normal speed; the worn internal clearances allow 7 GPM of fluid to bypass instead of being pumped

B. The flow meter is inaccurate and must be recalibrated before the test results can be trusted

C. The directional valve is restricting the flow between the pump and the cylinder, causing the reduced meter reading

D. The relief valve is set too low, diverting flow away from the cylinder and reducing the meter reading

129. A hydraulic system on a refuse truck has a condition where the packer blade cylinder extends and retracts normally, but the packer blade bounces back slightly at the end of each retraction stroke before settling. What is the most likely cause?

A. Air trapped in the rod end of the cylinder — the trapped air compresses during retraction and then expands when the piston reaches the end of stroke, pushing the piston back slightly before the air stabilizes; the bounce will continue until the air is purged from the rod-end port and replaced with incompressible hydraulic fluid

B. The cylinder's internal cushion has failed and the piston is impacting the rod-end cap and bouncing back

C. The directional valve's spool is not centering properly and briefly redirects flow after the retraction stroke

D. The packer blade's return spring is too strong and pushes the blade back against the cylinder's retraction force

130. A hydraulic system's reservoir has a sight glass that shows the oil level is correct when the system is at rest, but the level drops below the minimum mark during operation. What is the most likely explanation?

A. An external leak that only occurs under operating pressure is draining fluid from the reservoir during operation

B. The system's cylinders are extending during operation, drawing fluid from the reservoir — a properly designed reservoir accounts for the volume of fluid displaced into the cylinders during maximum extension; if the reservoir is undersized for the system, or if additional cylinders were added without increasing reservoir capacity, the reservoir level drops below minimum when the cylinders draw fluid from it

C. The hydraulic pump is aerating the fluid during operation, creating foam that drops the visible oil level in the sight glass

D. The system's heat exchanger is absorbing fluid volume during operation through thermal expansion of its internal components

131. A hydraulic hose assembly has been custom-built in the shop. The technician cut the hose to length, installed the fittings using a crimping machine, and pressure-tested the assembly. The assembly passed the pressure test at 1.5 times the working pressure. After installation in the system, the hose develops a leak at one fitting after 2 weeks of service. What is the most likely cause?

A. The fitting was not crimped completely — it passed the static pressure test but the dynamic operating conditions (pressure pulsation, vibration, thermal cycling, and flexing during machine operation) gradually work the hose out of the under-crimped fitting over the 2-week period; the crimp dimensions should have been verified with calipers against the fitting manufacturer's specification

B. The pressure test damaged the hose's internal liner at the fitting and the damage progressed to a leak over 2 weeks

C. The hose material is incompatible with the hydraulic fluid and has deteriorated at the fitting's contact area

D. The hose assembly was installed with an excessive bend radius that concentrates stress at the fitting connection

132. A battery electric transit bus has a condition where the available driving range displayed on the dashboard varies significantly depending on the route — the bus achieves 200 km on suburban routes but only 130 km on the same charge level on urban stop-and-go routes with heavy passenger loads. What explains the range difference?

A. The battery cells degrade faster on urban routes due to the higher ambient temperature in urban areas

B. The regenerative braking system recovers more energy on suburban routes where the braking events are less frequent but more gradual

C. Urban stop-and-go driving with heavy passenger loads consumes more energy per kilometer than suburban driving — frequent acceleration from stops requires high traction motor current that drains the battery faster, the heavy passenger load increases the energy needed for each acceleration, and the frequent stops reduce the effectiveness of regenerative braking because the short distances between stops limit the energy recovered during each braking event

D. The bus's auxiliary systems (HVAC, door mechanisms, wheelchair ramps) consume more battery energy on urban routes from the frequent passenger boarding events

133. A hybrid electric truck has a condition where the engine starts unexpectedly during highway cruising even though the battery SOC is above the normal engine-start threshold and the power demand does not exceed the electric motor's capacity. What could cause the unexpected engine start?

A. The battery management system has detected a cell temperature above the maximum threshold and is starting the engine to power the A/C compressor that cools the battery thermal management system — even with adequate SOC and low power demand, elevated cell temperature triggers the engine start to protect the battery from thermal damage

B. The engine ECM has a scheduled idle event programmed to maintain the engine's lubrication at regular intervals

C. The transmission TCM is requesting engine assist for a specific gear ratio that requires more torque than the electric motor can provide

D. The VCU is starting the engine to maintain the exhaust aftertreatment system's operating temperature and prevent DPF clogging

134. A technician is measuring the high-voltage battery pack's total voltage on a battery electric truck. The pack contains 96 cells in series, each with a nominal voltage of 3.7V. The expected pack voltage is approximately 355V. The measured voltage is 348V. What is the most likely explanation?

A. The voltage measurement is within the normal variation for a pack at its current state of charge

B. The measurement error is caused by the technician's meter leads having excessive resistance

C. The 348V reading is within the expected range for a 96-cell pack at moderate SOC — at 100% SOC, each cell reads approximately 4.2V (pack total ~403V), and at 0% SOC, each cell reads approximately 2.5V (pack total ~240V); the nominal 3.7V is the mid-point value, but the actual voltage varies with SOC; a reading of 348V corresponds to approximately 3.63V per cell, indicating a moderate SOC rather than a fault

D. One or more cells have failed and the reduced voltage indicates a pack with fewer functional cells than the designed 96

135. A battery electric delivery truck equipped with a DC fast-charging system has a condition where the truck will not accept a charge from any DC fast-charging station but charges normally using the onboard AC charger (Level 2). What is the most likely cause?

A. The DC fast-charging stations are incompatible with the truck's charging standard (CCS vs CHAdeMO)

B. The truck's DC fast-charging circuit has a fault — the DC charging inlet, the DC contactors, the communication circuit between the truck and the DC charger, or the BMS's DC fast-charge enable logic has a fault that prevents the truck from completing the DC charging handshake protocol; the AC charging circuit is a separate system that functions independently and is unaffected by the DC circuit's fault

C. The high-voltage battery has reached its maximum charge cycle count for DC fast charging and the BMS has disabled DC charging to protect the cells

D. The battery temperature is outside the acceptable range for DC fast charging but within the range for AC charging

Practice Exam 10: Answer Key and Explanations

1. B — Spring-loaded belt tensioners store significant mechanical energy in their internal spring. If the wrench or tool slips off the tensioner bolt during rotation against the spring, the tensioner arm snaps back to its resting position with enough force to fracture fingers or hands. The technician must use a properly fitting tool designed for the tensioner bolt head and keep all body parts clear of the snap-back path throughout the procedure.

2. D — Although DEF is a non-toxic urea-water solution, large volumes should be collected in a dedicated waste container rather than poured down drains without verifying local wastewater

regulations. The container may also contain residual contaminants from the truck's DEF system. Proper disposal ensures regulatory compliance and prevents potential contamination of local water treatment systems that may not be designed to process large volumes of urea solution.

3. A — Grinding produces high-velocity metal particles capable of penetrating eyes from any angle (including from the sides and below), hot sparks that burn exposed skin, and noise levels that exceed safe exposure limits within seconds. The minimum PPE requirement includes safety glasses with side shields plus a face shield for full-face protection, hearing protection, leather gloves to protect hands from heat and particles, and long sleeves or a leather jacket to protect exposed skin from sparks and hot metal.

4. C — A spread or worn open-end jaw cannot grip the fastener's flats securely. Under the force of a pull, the worn jaw rounds the fastener head (damaging it for future removal) and can slip off suddenly, sending the technician's hand into adjacent sharp edges, hot surfaces, or rotating components. A wrench with a worn jaw is unsafe regardless of its other physical condition and must be removed from service.

5. D — Diesel fuel has a higher flash point than gasoline (approximately 52°C versus −43°C), but it is still a combustible liquid. Atomized diesel spray during draining, spills on hot exhaust surfaces, and accumulated vapors in poorly ventilated enclosed spaces all present fire hazards. Additionally, prolonged inhalation of diesel fuel vapors causes respiratory irritation and potential long-term health effects. Ventilation, ignition source elimination, and fire extinguisher availability are essential precautions.

6. B — An uncovered container of volatile solvent evaporates continuously, releasing flammable and potentially toxic vapors into the shop air. Over 12 hours, the vapor concentration near the container can approach the lower explosive limit, creating an explosion hazard from any ignition source. The chronic inhalation exposure to solvent vapors is a health hazard for all shop personnel. The container must be covered immediately, the area ventilated, and the incident documented to prevent recurrence.

7. A — Hardened steel components such as bearings, bushings, and press-fit parts can shatter explosively under the extreme forces of a hydraulic press. The fragments project at high velocity in unpredictable directions. A press safety shield or containment cage surrounds the pressing area and absorbs the energy of the fragments, preventing them from striking personnel or equipment. The shield must be in place before every pressing operation regardless of the component being pressed.

8. D — Only distilled water may be added to replenish battery electrolyte that has been lost through evaporation during charging. Tap water contains dissolved minerals (calcium, magnesium, iron,

chlorine) that contaminate the electrolyte, coat the battery plates, and accelerate sulfation and plate deterioration. Sulfuric acid should never be added because the electrolyte's acid concentration increases naturally as water evaporates — adding acid would make the electrolyte too concentrated, damaging the plates.

9. C — Turbocharger lag is the inherent delay between the ECM commanding full fuel delivery and the turbocharger spooling up to deliver the corresponding air volume. During rapid throttle application, the fuel arrives at the cylinders immediately but the turbocharger requires 1-2 seconds to accelerate its rotating assembly to the speed needed for full boost. This brief period of excess fuel relative to available air creates a rich condition that produces black smoke until the air supply catches up.

10. B — A cracked cylinder head at a location where a coolant passage runs adjacent to the exhaust ports creates a path for pressurized coolant to migrate from the internal passage to the exhaust manifold gasket surface. The coolant seeps through the crack under system pressure and exits externally between the manifold and the head. This type of crack may not be visible without removing the exhaust manifold and cleaning the head surface.

11. A — Oil consumption of 2.0 litres per 1,000 km with no external leaks, no visible blue smoke, and normal crankcase pressure indicates oil is being consumed through a path that does not affect blow-by. The turbocharger's compressor-side seal leaks oil into the intake tract, where it mixes with the intake air and burns in the cylinders. The quantity per combustion event is small enough that the exhaust does not show visible blue smoke, but the cumulative consumption over 1,000 km is measurable.

12. D — Carbon and soot from diesel exhaust deposit on the VGT vane surfaces and the vane ring mechanism inside the turbine housing. The buildup physically resists the vanes' movement, creating friction that the actuator must overcome. The actuator commands the correct position, but the contaminated mechanism responds slowly as the vanes work through the carbon deposits. The vanes eventually reach the commanded position (producing adequate boost) but the 3-second delay reduces the engine's transient response performance.

13. C — Mixing OAT (orange, organic acid technology) coolant with IAT (green, inorganic acid technology) coolant causes the two different inhibitor packages to react chemically. The organic acids and inorganic silicates precipitate out of solution, forming the murky brown discoloration and creating a sludge that can restrict coolant passages and reduce heat transfer. The mixed coolant's corrosion protection is also compromised because neither inhibitor package functions correctly when contaminated with the other.

14. A — A cylinder contribution test measures each cylinder's individual power output at idle. Cylinder 2 contributing 40% less than the average confirms it is the weak cylinder. The reduced contribution creates an imbalance in the engine's firing impulses that produces the idle vibration. Above 1,000 RPM, the flywheel's increased rotational inertia smooths the imbalance. The cause of the weak contribution — faulty injector, low compression, or incorrect valve lash — must be diagnosed.

15. D — Active DPF regeneration relies on the DOC to generate the heat needed to raise the exhaust temperature from the engine-out level (typically 250-350°C) to the 550-600°C threshold required for soot oxidation. The DOC produces this heat through an exothermic catalytic reaction — it oxidizes the late-injected (post-injection) fuel and converts the chemical energy to heat. A degraded or contaminated DOC cannot catalyze this reaction efficiently, limiting the achievable temperature below the soot oxidation threshold.

16. B — An oil level that rises without oil being added, combined with a fuel odor and reduced viscosity, confirms fuel dilution. On modern engines with DPF, the most common source is post-injection fuel events during active regeneration — the late-injected fuel intended for the DOC can wash past the piston rings into the crankcase. Without DPF regeneration as a cause, a leaking injector o-ring, cracked injector body, or failed fuel pump seal can introduce raw fuel into the oil through other internal paths.

17. C — Wet cylinder liners are directly exposed to the engine's coolant on their exterior surfaces. During each combustion event, the liner wall vibrates at high frequency from the combustion impulse. This vibration creates and collapses microscopic vapor bubbles in the coolant adjacent to the liner surface (cavitation). The collapsing bubbles produce localized impact forces that progressively erode the liner's outer wall. SCA chemicals form a protective barrier on the liner surface that resists this erosive action.

18. A — A boost leak test pressurizes the intake system from the turbocharger outlet to the intake valves. A hissing sound at the turbocharger compressor housing indicates pressurized air is escaping at the compressor — through a cracked housing, a failed gasket at the compressor outlet connection, or a leaking seal between the compressor housing and the backplate. This leak allows boost pressure to escape before reaching the intake manifold, reducing the effective boost and causing power loss.

19. D — Consistent water accumulation every 2-3 days indicates a chronic, external water source rather than normal condensation. The most common sources are a contaminated fuel supply (the fueling station's underground tank has water intrusion from ground water, a faulty fill cap seal, or a damaged tank vent), or the truck's own fuel tank has a compromised cap seal, vent check valve, or fill neck seal

that allows rainwater to enter. The fuel supply source must be investigated and the truck's tank integrity verified.

20. B — The charge air cooler (intercooler) performs two functions: it cools the compressed intake air (lowering the manifold temperature) and it provides the passage for the compressed air to flow from the turbocharger to the intake manifold. A partial internal restriction reduces the cooler's airflow capacity — less air passes through (reducing effective boost) and the air that does pass through has less contact time with the cooling surface (raising the temperature). Both symptoms arise from the single restriction.

21. C — The ECM's idle speed control algorithm continuously adjusts fuel delivery to maintain a stable idle speed based on multiple sensor inputs. If any input signal oscillates — a coolant temperature sensor with an unstable output, a fuel pressure signal that fluctuates from a marginal fuel supply, or a throttle position sensor with a noisy signal — the ECM chases the varying input, adjusting fuel delivery up and down in response. The rhythmic 3-4 second cycle corresponds to the control loop's response time.

22. A — A stuck-open EGR valve continuously introduces exhaust gas into the intake manifold at all operating conditions, including idle and low load where no EGR is commanded. The exhaust gas displaces fresh intake air, reducing the oxygen available for combustion. At idle, where the intake air volume is already at its minimum, the additional exhaust gas can reduce oxygen concentration enough to cause rough running, misfiring, black or white smoke, and potential stalling.

23. D — Sodium's steadily increasing trend across three consecutive samples — 8 to 15 to 25 ppm — indicates a progressive contamination source that is worsening over time. Sodium is a component of coolant additive packages, particularly SCA and OAT formulations. A slow, worsening internal coolant leak (from a progressively failing oil cooler seal, an expanding head gasket breach, or a growing EGR cooler crack) introduces increasing amounts of coolant into the oil with each successive sample.

24. B — The mechanical test gauge reads normal oil pressure at the engine's oil gallery (55 psi at operating RPM, 18 psi at idle), confirming the engine's oil system is functioning correctly. The dashboard gauge reads zero despite adequate actual pressure, isolating the fault to the electronic reporting circuit — the oil pressure sender, its wiring, or the instrument cluster's gauge driver. The sender may have an open or short circuit, or the wire between the sender and gauge may be damaged.

25. C — The engine runs normally at idle and light load because the fuel demand is low and the restricted supply can keep up. At moderate to heavy load, the fuel demand exceeds what the restricted supply can deliver. A collapsed pickup tube, kinked supply line, restricted check valve, or cracked

suction line that ingests air all limit the fuel volume reaching the high-pressure pump. The pump starves intermittently under the higher demand, causing the surge and hesitation.

26. D — Without DPF post-injection as a fuel source, the most common cause of fuel-in-oil on a diesel engine is leaking fuel injectors. A leaking injector o-ring or a cracked injector body allows fuel to drip into the cylinder when the engine is off — the fuel accumulates on the piston top and washes past the rings into the crankcase during the next start. During operation, an injector with a severely degraded spray pattern can inject fuel directly onto the cylinder wall, where it washes past the rings continuously.

27. A — Running the fuel tank empty introduced air into the entire fuel circuit — the supply line, transfer pump, fuel filter, high-pressure pump, fuel rail, and injectors are all filled with air instead of fuel. Diesel fuel systems cannot compress air into a combustible charge. The air must be purged using the manufacturer's specified bleed procedure, which typically involves operating the electric priming pump (if equipped), cranking with bleed screws open to displace air with fuel, or cycling the ignition to activate the transfer pump repeatedly.

28. A — Exhaust gas temperature directly reflects combustion activity. A cylinder reading 80°C lower than the average is producing significantly less combustion heat. The most common causes are a failed injector (no fuel delivery), a compression loss (the charge does not reach autoignition temperature), or an intake valve that is not closing (the charge escapes before compression). Each of these conditions reduces or eliminates combustion in the affected cylinder, producing the measurably lower EGT.

29. C — New engine components produce fine wear particles during their initial break-in period as microscopic surface irregularities on the bearing overlays, ring faces, liner walls, and gear teeth wear smooth and the mating surfaces establish their final contact pattern. The 500 km oil change is specifically scheduled to remove this break-in debris before the particles can circulate and cause abrasive damage. The absence of large fragments or unusual debris confirms the break-in is progressing normally.

30. D — System pressure is normal (compressor and governor functional), brake adjustment is correct (mechanical components are set properly), and linings have adequate thickness (friction material is present). The remaining variable that could require progressively more pedal effort is the friction material's effectiveness. Glazed linings lose friction coefficient from sustained heat exposure, and oil-contaminated linings lose friction from compressor oil pass-by. Both conditions worsen gradually over time.

31. A — With brakes released: primary drops 1 psi/min (within the 2 psi/min single-vehicle maximum), secondary holds at zero (ideal). With brakes applied on a combination: primary drops 4 psi/min (at the 4 psi/min combination maximum — technically passes but at the boundary), secondary drops 3 psi/min (within the 4 psi/min maximum). The vehicle passes both tests, but the primary circuit's boundary-level loss with brakes applied warrants investigation to identify the leak source before it worsens.

32. C — A single clunk during the initial brake application that does not repeat indicates free play being taken up. When the brake is applied, the application force must first take up all the slack in the mechanical chain — the S-cam bushing clearance, the slack adjuster clevis pin clearance, and the anchor pin clearance — before the shoes contact the drum. The cumulative free play in these worn components produces the clunk as the slack is consumed. Once loaded, the components stay in contact and no further noise occurs.

33. A — The vehicle passes. The specification for a tractor-trailer combination with brakes released is a maximum of 2 psi per minute. The observed loss is 2 psi over 5 minutes, which calculates to 0.4 psi per minute — well within the specification. A loss rate of 0.4 psi/min indicates a tight air system with only minimal, normal air consumption from valve tolerances and component seating.

34. D — After a brake pad replacement on air disc brakes, the caliper pistons are at the retracted position to accommodate the thicker new pads. The increased clearance between the pads and the rotor means the pistons must travel further before the pads contact the rotor. The first several brake applications feel spongy as the pistons advance to take up this extra clearance. The self-adjusting mechanism ratchets the pistons outward with each application until the normal running clearance is established.

35. B — A governor that does not unload the compressor until 145 psi subjects every air system component to pressures 20 psi above the standard 120-125 psi design range. Hoses, fittings, valves, reservoirs, and brake chamber diaphragms are all rated for the standard operating range. The safety valve (set at approximately 150 psi) should have opened before reaching 145 psi — its failure to activate indicates the safety valve is also malfunctioning, creating a dual-failure condition.

36. C — Compressed air contains atmospheric moisture that condenses when the air is compressed and cooled. When the trailer is connected to the tractor, the tractor's air dryer removes moisture before it enters the system. When disconnected, the residual moisture in the trailer's air system condenses as the system depressurizes and cools during storage. Draining the trailer reservoirs during the pre-trip inspection is a mandatory step to remove accumulated water before it can freeze in cold weather and block valves or corrode components.

37. A — Moisture in the spring brake hold-off air lines or chambers freezes in sub-zero temperatures. The ice physically blocks the air path, preventing the hold-off air from fully compressing the power springs when the parking brake is released. The partially compressed springs hold the brakes partially applied, creating drag. As the vehicle drives, friction heat and engine heat thaw the ice, allowing the hold-off air to fully compress the springs, and the drag disappears.

38. D — An automatic slack adjuster is designed to automatically compensate for lining and drum wear. If the ASA cannot maintain the correct stroke, the underlying cause must be identified — worn shoes beyond the ASA's compensation range, an oversized drum, worn anchor pins, worn S-cam bushings, or a defective ASA mechanism. Manually backing off the adjuster temporarily masks the symptom but does not fix the root cause. The brake will return to an over-stroke condition within a short operating period.

39. A — A temperature-sensitive fault develops as a component heats during operation. Wheel speed sensor coils have resistance that increases with temperature. A coil with marginal resistance passes the cold self-test at startup but drifts above the ABS module's maximum resistance specification as the brake drum's heat radiates to the adjacent sensor over 30 minutes of driving. The module detects the out-of-specification resistance and illuminates the warning lamp.

40. A — When the spring brakes are released rapidly, the hold-off air rushes into the spring brake chamber. On some chamber designs, the rapid air pressure increase can momentarily push through the internal passage between the spring side and the service side diaphragm, briefly pressurizing the service side and applying the foundation brake. The pressure equalizes within seconds as the air redistributes, and the brief brake application releases. This can be mitigated by a controlled spring brake release rate.

41. B — The safety valve's rated opening pressure is 150 psi, but the weakened spring can no longer hold the valve closed at that pressure. The valve opens at a lower pressure — possibly near the governor's 125 psi cut-out — venting air that the system should retain. The governor functions correctly (cutting out at 125 psi), but the safety valve's premature opening wastes the stored air. The safety valve must be replaced with a new unit calibrated to 150 psi.

42. C — The foot valve's secondary circuit (which supplies the trailer service brake signal through the tractor protection valve) has internal wear that reduces its output pressure below the normal level. The trailer's relay valve receives a weaker signal than designed, but the trailer relay valve's low crack pressure compensates by delivering a disproportionately high percentage of its capacity to the trailer chambers. The net effect is an imbalanced brake response where the trailer brakes harder than the tractor.

43. B — Air pressure, pushrod stroke, and brake chambers are all correct — the pneumatic and mechanical systems are delivering the designed force to the shoes. The inadequate stopping force must come from reduced friction at the shoe-to-drum interface. Non-OEM linings with a lower friction coefficient, or linings contaminated with oil, grease, or brake fluid, generate less friction force for the same application pressure. The rear brakes produce normal force because their linings are unaffected.

44. C — The system pressure reads 110 psi, well above the low-pressure warning threshold. The warning is activating during each brake application, suggesting the pressure fluctuation from the application is triggering a marginal switch. The switch may be installed where it is sensitive to application-induced pressure drops, or its calibration has drifted to a threshold close to the application-induced low point. The switch should be tested and replaced if its activation pressure has shifted.

45. A — A new air compressor should pass minimal oil during normal operation. Excessive oil in the discharge (visible as oil dripping from the air dryer purge valve) indicates the compressor's piston rings are not sealing properly, the compressor may be defective, the oil fill level is too high, or the compressor's air intake is drawing oil-laden air from the crankcase ventilation system instead of the clean air intake. The oil source must be identified and corrected to prevent contaminating the entire air system.

46. B — The vehicle pulls to the right during braking with equal strokes and equal air pressure on all positions. The imbalance must come from different friction characteristics between the left and right sides. Mixed brake lining brands or formulations — even if they appear identical — can have different friction coefficients that produce different braking forces at the same application pressure. All positions on an axle must use the same lining brand, part number, and formulation.

47. B — Pulling the inverter circuit fuse dropped the parasitic draw from 3.5A to 60mA, identifying the inverter circuit as the source of the excessive draw. The draw could be the inverter itself (stuck in active mode or drawing standby current), a device plugged into the inverter, or a wiring fault in the circuit between the fuse and the inverter. The technician must investigate the specific source within the identified circuit.

48. D — The ECM broadcasts the correct temperature (92°C) on the CAN bus, but the cluster displays 120°C. If the cluster receives its data from the ECM via CAN, the cluster has an internal interpretation or display fault. However, many vehicles use a separate, dedicated coolant temperature sensor for the gauge that is independent of the ECM's sensor. If the cluster has its own sensor, that sensor's calibration drift or fault would explain the discrepancy while the ECM reads correctly from its own sensor.

49. A — The starter cranks normally for 2 seconds (batteries deliver adequate initial current), then slows dramatically. The batteries are within specification, ruling out weak batteries. The starter motor is the likely cause — a shorted armature winding, seized bushing, or worn brushes create increasing current draw as the motor heats from the initial cranking. The batteries can supply the initial burst but cannot sustain the abnormally high current draw, and the voltage sags as the batteries are overtaxed.

50. C — LED lamp assemblies contain multiple individual LED elements wired in series-parallel configurations. When individual elements fail (typically open circuit), the remaining elements continue to illuminate at reduced total light output. The voltage at the connector appears normal because the remaining LEDs still present an electrical load. The dimmer appearance results from fewer active LED elements contributing to the total light output.

51. B — One module intermittently going offline while all others communicate continuously points to a fault specific to that module — not the CAN bus backbone. The most common cause is an intermittent power supply or ground connection. A loose connector pin, corroded terminal, or vibration-sensitive wire break causes the module to lose power momentarily, go offline, then resume when the connection re-establishes. The CAN bus backbone is ruled out because all other modules remain online.

52. D — In a parallel battery configuration, the higher-voltage battery continuously discharges into the lower-voltage battery through the parallel connection. This creates a constant parasitic current flow between the batteries that wastes energy as heat, works both batteries harder than necessary, and accelerates degradation. The strong battery is constantly being pulled down while trying to charge the weak battery. The weak battery must be identified, tested, and either recharged or replaced.

53. A — The left tail light and left front marker light are on different power circuits (different fuses), yet both are dim while the right side is bright. The common element is a shared ground connection on the left side of the vehicle. A high-resistance ground — corroded bolt, deteriorated wire, or poor chassis contact — restricts the current return path for every lamp connected to that ground point. The reduced current dims all left-side lamps equally while the right side's clean ground provides full current.

54. C — The sensor air gap specification is 0.5 to 1.5 mm. The measured gap of 2.0 mm exceeds the maximum by 0.5 mm. Signal amplitude from a passive magnetic sensor decreases with the square of the distance — even a small increase beyond the specification significantly reduces the signal strength. The weak signal becomes erratic at low wheel speeds and during vibration, producing the fault code. Correcting the gap to within specification restores a strong, consistent signal.

55. C — The right rear turn signal functions correctly as a turn signal but fails as a hazard. On multiplexed systems, the BCM may use different output channels or different activation commands for the turn signal function versus the hazard function. The right rear turn signal output channel works, but the hazard activation for the right rear may route through a different channel or path that has a fault. This system-level routing difference produces the paradoxical one-function-works, other-doesn't condition.

56. A — The throttle position sensor produces a valid signal from 0% to 50% travel, but above 50% the signal either stops increasing (dead zone from a worn resistor card), drops to zero (internal wiper detachment from the card), or produces erratic output (damaged card section). The ECM limits fueling to the last valid position because it cannot determine the driver's intent beyond the sensor's functional range. The pedal assembly must be replaced.

57. D — The door jamb switch provides a ground path to the dome light circuit when the door opens. If the switch is stuck closed or its wire is shorted to ground, the dome light receives a permanent ground signal regardless of door position. The dashboard switch in "door" mode tells the circuit to respond to the door switches — and the stuck switch continuously reports "door open." The switch mechanism, its wiring, and ground path must be inspected.

58. B — A variable-resistance fuel sender uses a float-operated wiper that moves across a resistor card. The resistance value changes with float position, and the gauge displays the corresponding level. If the resistor card has failed at a point corresponding to the full-tank value, or the signal wire is shorted to ground (which many gauge circuits read as full), the gauge displays full regardless of actual level. The sender's resistance must be measured at the connector and compared to specification.

59. A — The alternator produces the correct voltage (14.2V) because the voltage regulator controls output voltage, not current. However, the alternator's maximum current capacity may have decreased from worn brushes, a partially shorted stator winding, or a failed rectifier diode. The reduced current output is split between powering the vehicle's electrical loads and charging the batteries — with less current available, the batteries receive less charge than they need, arriving at only 75% SOC after overnight rest.

60. D — J1708/J1587 and J1939 are physically separate communication buses with different wiring circuits. Some older modules (instrument clusters, body controllers, and legacy transmission controllers) may communicate exclusively on J1708. Loss of J1708 communication means these modules cannot be diagnosed, have their parameters read or adjusted, or have their fault codes retrieved. The J1708 bus wiring must be diagnosed and repaired independently of the functional J1939 bus.

61. B — Dashes (- - -) on a digital gauge display indicate the cluster has not received valid data for that parameter. This is distinct from a zero reading, which would display "0." The cluster is communicating with other modules successfully (other gauges work), but the specific CAN message carrying the oil pressure data is not being received. The ECM may not be broadcasting the oil pressure message, the sender may have an open circuit, or the specific CAN message may be blocked.

62. A — The "Cab Power" fuse feeds 15 devices. The technician must systematically disconnect each device one at a time while monitoring the ammeter. When the draw drops to normal after disconnecting a specific device, that device (or its wiring) is the source. This is the most efficient method because it isolates the individual device from the known problem circuit without requiring physical access to sub-fuses or individual circuit branches.

63. D — A remanufactured ECM does not contain the original vehicle's specific programming parameters. The tire size, axle ratio, speed sensor pulse count, and speed calibration factors must be programmed into the replacement ECM to match the specific vehicle. Without these parameters, the ECM cannot calculate accurate vehicle speed from the raw speed sensor pulses. The resulting zero speed disables the speedometer and the cruise control system, which requires valid speed data.

64. C — Heated windshield grid lines visible when the heater is active are a normal characteristic of the embedded heating element design. The thin resistance wires create slight temperature differences between the heated wire paths and the glass between them. These temperature differences can create visible lines, especially when viewed at certain angles or in specific lighting conditions. The lines should disappear completely when the heater is deactivated.

65. B — Some ELDs use engine RPM as one of their driving-status criteria. If the engine is running at elevated RPM for PTO operation at a job site, the ELD may interpret the sustained above-idle RPM as driving activity, even though the vehicle speed reads zero. The ELD's driving-status logic, RPM threshold settings, and configuration for PTO-equipped vehicles must be reviewed and adjusted to account for stationary elevated-RPM operation.

66. A — On many charging systems, the dashboard charge indicator lamp serves a dual purpose: it warns the driver of a charging fault AND it provides the initial excitation current to the alternator's field winding through the lamp circuit. If the bulb burns out or the circuit opens, the initial excitation current path is broken. The alternator currently charges through residual rotor magnetism (self-excitation), but if the batteries are ever fully discharged, the residual magnetism may be insufficient to start the charging process without the lamp circuit's excitation.

67. D — The injector solenoid coil or its wiring has developed increased resistance. By Ohm's Law (I = V/R), increased resistance reduces the current flow through the coil at the same applied voltage. The reduced current produces a weaker electromagnetic field that cannot fully open the injector or maintain it open for the full commanded duration. The result is reduced fuel delivery from cylinder 3, producing the lower-than-normal power contribution detected by the ECM.

68. B — The GPS antenna cable is the most vulnerable component in the GPS signal chain. The coaxial cable runs from the roof-mounted antenna through the vehicle's body structure to the telematics unit. Damage to the cable shield, kinks that change the cable's impedance, loose connectors that allow signal reflections, or water intrusion at a connection point all degrade the GPS signal reaching the unit. These conditions can cause intermittent signal loss depending on satellite geometry and signal strength.

69. A — The transmission shifts smoothly into all gears with the engine off (input shaft stationary) but is difficult with the engine running (input shaft spinning). The clutch is not fully stopping the input shaft when the pedal is pressed. Air in the hydraulic line reduces the slave cylinder's effective stroke, a binding clutch disc on the input shaft splines prevents full release, or insufficient release bearing travel leaves the pressure plate partially engaged. The spinning input shaft makes synchronizer engagement difficult.

70. C — The output speed sensor provides the TCM with data critical for three essential functions: calculating the actual gear ratio (comparing turbine speed to output speed), determining vehicle speed for shift scheduling, and monitoring for clutch slip. Without output speed data, the TCM cannot verify which gear is engaged, cannot determine when to shift, and cannot detect dangerous clutch slippage. Defaulting to a single gear is the TCM's protective response.

71. B — In direct drive (4th gear on a 4-speed, typically), the input shaft is locked directly to the mainshaft through the engaged gear, and the countershaft is unloaded — it rotates but carries no torque because no gear reduction is occurring through it. The whining noise in all other gears is produced by the countershaft gears and bearings operating under torque load. The silence in direct drive confirms the noise source is specifically in the countershaft assembly.

72. D — The transmission oil cooler is housed inside the radiator. An internal cooler leak allows engine coolant (at higher pressure than the transmission fluid) to push through the leak into the transmission fluid circuit. The glycol-based coolant mixes with the red ATF to create a milky pink color, and the added coolant volume raises the fluid level above the full mark. The coolant also attacks the transmission's clutch friction material and rubber seals.

73. A — The vibration occurs at 1,400 engine RPM only in 5th gear. In 5th gear at 1,400 RPM, the driveshaft turns at a specific RPM determined by the 5th gear ratio. This specific driveshaft RPM happens to match the driveshaft's critical speed (the rotational speed where its natural bending frequency equals its rotational frequency). In other gears at 1,400 engine RPM, the driveshaft turns at different RPM values that do not match the critical speed.

74. C — The limited-slip differential's clutch packs provide the torque biasing function. When one wheel spins, the clutch packs should transfer torque from the spinning wheel to the stationary wheel through friction. If the clutch packs have worn beyond their service limit, they cannot generate adequate friction to transfer torque. The differential reverts to open-differential behavior, sending all power to the path of least resistance — the spinning wheel.

75. B — The pilot bearing supports the front end of the transmission input shaft inside the flywheel bore. Even a bearing that appears functional when spun by hand may have worn races, degraded grease, or microspalling that becomes significant under the dynamic loads of engine operation. Replacing the pilot bearing during every clutch replacement is standard practice because the bearing is inexpensive but requires full transmission removal to access — a premature failure means a repeat removal.

76. D — The TCM commands the 3-4 shift (the solenoid receives the command), but the transmission remains in 3rd. The solenoid may be functioning, but the 4th gear clutch pack is not applying — a leaking apply piston seal reduces the clamping force, a restricted apply circuit limits the fluid pressure reaching the clutch, or burned clutch plates cannot develop adequate friction. The 3rd gear clutch remains applied and the transmission stays in 3rd because 4th cannot engage.

77. A — Clutch chatter 20,000 km after a clutch replacement indicates either the flywheel surface was not properly prepared during the installation (hot spots, glazing, or warpage) or a new condition has developed (rear main seal leak contaminating the disc with oil). The flywheel's compromised friction surface causes inconsistent contact between the disc and the flywheel during engagement — the disc alternately grips and slips across the uneven surface, producing the shudder.

78. C — The transfer case physically shifts between 2WD and 4WD (confirmed by the correct driving behavior in each mode), but the dashboard indicator does not update. The position feedback sensor or switch on the transfer case detects the shift mechanism's position and reports it to the dashboard. If this sensor is faulty, misadjusted, or has a wiring fault, it cannot report the actual position change, leaving the indicator stuck in the last position it successfully reported.

79. D — The initial engagement from Park/Neutral to Drive or Reverse uses the main pressure circuit to apply the forward or reverse clutch. If the pressure regulator or boost valve produces excessive pressure, the clutch applies too aggressively — the full clamping force hits the clutch pack instantaneously rather than building progressively. Once in Drive, the normal shift circuits use modulated pressure with accumulator cushioning for smooth gear-to-gear transitions.

80. B — Rotating the rear section 180 degrees on the companion flange changed the vibration from noticeable to gone. This means the rear section has an imbalance at the flange connection point. In its original position, the section's heavy spot aligned with the companion flange's heavy spot, adding the imbalances together. After the 180-degree rotation, the two heavy spots oppose each other, cancelling the combined imbalance. The permanent solution is balancing the rear section as an assembly with the flange.

81. C — DOT 5 is silicone-based and DOT 4 is glycol-based — they are chemically incompatible. The two fluids do not mix homogeneously, creating separation and inconsistent hydraulic properties (variable compressibility throughout the circuit). DOT 5 can cause DOT 4-compatible rubber seals to swell or deteriorate, leading to hydraulic leaks and clutch failure. The system must be completely drained, flushed with the correct fluid, and all rubber components inspected.

82. B — The 5-second shift delay with engine RPM flare indicates the clutch is not engaging quickly enough. A worn clutch disc requires the AMT's clutch actuator to travel further to reach the engagement point (because the disc is thinner). The increased travel adds time to each shift cycle. During re-engagement, the worn disc slips before gripping, allowing the engine RPM to flare upward before the clutch finally holds. The extended shift time and RPM flare are proportional to the clutch disc wear.

83. A — A humming noise present during both acceleration and deceleration that changes pitch during the transition indicates a component that is always loaded but whose load direction changes. The ring and pinion gear set contacts the drive side of the teeth during acceleration and the coast side during deceleration. Worn gears produce noise on both sides, and the pitch change during the transition reflects the momentary unloading as the contact shifts from one tooth face to the other.

84. B — The PTO drives the replacement pump, and the drive gear mesh is correct. The pump produces adequate pressure and flow, confirming it is mechanically functional. The excessive noise points to the pump's suction supply. If the suction line, strainer, or reservoir connections were disturbed during the pump replacement, a restriction or air leak may have been introduced. The pump cavitates as it struggles to draw fluid through the restricted or air-contaminated suction path.

85. C — Fine metallic particles on the drain plug magnet at 300,000 km represent normal accumulated wear from the ring and pinion gear teeth and the carrier bearings over the axle's service life. The magnet's function is specifically to capture these wear particles and prevent them from recirculating. The absence of large chunks or fragments confirms no catastrophic gear tooth breakage or bearing failure has occurred. The particles should be monitored at each oil change for changes in quantity.

86. A — During full-lock turns, the steering gear reaches its mechanical stop and the power steering pump operates against maximum system pressure with zero flow (dead-head condition). The relief valve inside the steering gear opens to prevent overpressure, and the high-velocity fluid flowing through the relief creates the groaning noise. This condition generates maximum heat in the power steering fluid and should be limited to brief periods to avoid pump damage and fluid degradation.

87. C — A diagonal wear pattern running across the tread face from the inner to outer edge indicates a compound scrubbing angle that neither toe nor camber alone would produce. A worn or bent steering component (tie rod end, drag link, or steering arm) that allows the toe setting to change dynamically during driving creates a varying scrub angle. When combined with the existing static camber, the result is a diagonal wear path across the tread.

88. D — The shock absorbers do not carry the vehicle's weight — the springs do. Shock absorbers control the rate of spring deflection. The springs have taken a permanent set from previous overloading — the leaves have permanently deformed, reducing their free arch and available deflection capacity. At rated capacity, the reduced arch means the springs sit lower than designed because they start from a lower unloaded position and compress further under load.

89. B — A steering shimmy that occurs only within a specific speed range (70-80 km/h) and disappears above and below is a resonance-driven oscillation. The front I-beam axle has a natural oscillation frequency, and at 70-80 km/h, the road input excites this frequency. A functional steering damper controls the oscillation by resisting the axle's tendency to shimmy at its resonant frequency. A worn or failed damper cannot provide this resistance, allowing the resonance to develop.

90. A — Inside-edge cupping with correct alignment and inflation points to a damping-related wear pattern. A worn shock absorber on the affected side allows the tire to bounce, creating intermittent heavy and light ground contact. The cupping concentrates on the inside edge because the bouncing combines with the wheel's slight inward lean (from the alignment geometry and suspension compliance) to load the inside edge more heavily during each bounce cycle.

91. D — A metallic clunking from the suspension over speed bumps with all visible fasteners tight indicates internal wear at a suspension pivot point. Upper and lower ball joints, stabilizer bar end links, control arm bushings, and shock absorber mounts all contain pivoting or rotating elements that can develop internal play while their external fasteners remain tight. Each pivot point must be loaded individually while observing for movement to identify the worn component.

92. B — Hub-piloted wheels center on the hub's pilot pads. If the pilot pads or the wheel's center bore are damaged, corroded, or have debris preventing proper seating, the wheel cannot center precisely on the hub. The off-center wheel oscillates during rotation, applying a cyclic side load to the wheel nuts that gradually loosens them despite correct torque. Cleaning the hub pilot surfaces and the wheel bore, and verifying the wheel seats flat, prevents the recurrence.

93. A — The web of an I-beam frame rail carries the shear loads — the vertical forces from the vehicle's weight, cargo, and dynamic driving loads. A vertical crack in the web directly reduces the cross-section's ability to resist these shear forces. The crack at a crossmember attachment point is initiated by the stress concentration at the bolt hole and propagated by the cyclic loading. Immediate stop-drilling and a manufacturer-approved repair are required.

94. C — Adding a second axle and equalizer beams to a single-axle trailer requires precise alignment of both axles relative to the trailer's frame centerline and to each other. If either axle is angled (not square to the frame) or the two axles are not parallel to each other, the tires on the misaligned axle scrub during driving. The accelerated wear across all tire positions on both axles confirms a systemic alignment issue rather than a single-axle problem.

95. D — The suspension dampens within specification (2 cycles), confirming the shock absorbers are functional. The driver's comfort complaint is subjective but may be addressed by adjusting the height control valve's response delay. If the valve responds too quickly to suspension inputs, it adds and vents air in response to each bump, actively interfering with the shock absorbers' damping. Increasing the valve's time delay prevents it from chasing individual bumps while still maintaining correct ride height over time.

96. B — The drag link connects the steering gear's output (pitman arm) to the steering linkage at the steer axle. The drag link's length determines the angular relationship between the steering wheel position and the road wheel position. Adjusting the drag link length rotates the steering wheel on its splines without changing the toe setting or wheel alignment. This is the correct method to center a steering wheel that is off-center during straight-line driving.

97. A — A blue ring on the brake rotor friction surface indicates the rotor has been heated to temperatures that alter the cast iron's metallurgy at the surface layer. Temperatures above 300°C cause phase changes in the iron that permanently change the rotor's hardness and stress properties. The blue color is a heat tint that specifically corresponds to temperatures in the 300-400°C range. The cause must be identified (brake drag, excessive use, improper pad bedding) and the rotors checked for hardness variations and DTV.

98. D — The tag axle's load share determines the weight its tires must support. If the load share is set too high (the axle carries more than its designed proportion of the trailer's weight), the tires are overloaded beyond their rated capacity. The excessive contact pressure from the overload causes the tread rubber to wear faster across the entire tread face, even though the alignment, inflation, and steering geometry are correct.

99. A — Circumferential sidewall wear in a strip near the bead on the inner sidewall of one inside dual tire indicates the tire is rubbing against an adjacent component during rotation. The component could be a brake chamber, an air line bracket, a mud flap support, or a shifted axle position that has moved the tire into contact with a fixed part of the vehicle structure. The contact must be identified and corrected to prevent the wear from progressing to a sidewall failure.

100. A — One-sided rubber bushing deterioration while the other side remains intact at the same age points to an environmental factor affecting only one side. The most common cause is heat exposure — an exhaust pipe routed near the deteriorated bushings, a catalytic converter positioned close to the spring, or a turbocharger heat shield that has shifted can all expose the rubber to sustained temperatures above its rated service limit. Rubber degrades rapidly under sustained heat exposure.

101. D — The ride height is correct and the air springs are at the proper pressure for the load, confirming the air suspension system is functioning. The harsh ride indicates inadequate damping — the shock absorbers cannot control the rate of spring compression and rebound. Without effective damping, every road input is transmitted directly through the air springs to the trailer frame as an uncontrolled jolt. Replacing the shock absorbers restores the controlled compression and rebound rates.

102. B — A progressive increase in steering effort throughout the day suggests a component that degrades with continuous operation. The power steering fluid may be thermally degrading — breaking down from the heat of continuous operation, reducing its viscosity and lubrication properties, which increases internal friction in the steering gear. Additionally, a partially restricted filter or cooler that becomes more restrictive as debris accumulates throughout the day progressively reduces pump efficiency.

103. A — One dual pair running significantly cooler than the others with equal tires and inflation indicates that pair is not receiving the same heat input as the others. The most likely heat source difference is the brake — if the cool pair's brake is not applying during stops, those tires do not receive braking friction heat. The brake on the cool side must be inspected for a disconnected air line, a failed chamber, or a non-functioning slack adjuster that prevents brake application.

104. B — Cab mounting bushings isolate the cab from the frame and allow controlled relative movement during frame twist over uneven pavement. Deteriorated bushings lose their lubrication and flexibility — the dried or worn rubber-to-metal interface produces a creaking noise as the cab pivots on the bushings during the frame's torsional movement. The noise is most noticeable at low speed because road noise at higher speeds masks the creaking.

105. D — Emergency exit windows have pivot hinges or snap-out mechanisms that are exposed to weather, road spray, salt, and temperature extremes. The hinge mechanisms corrode over time and can seize to the point where they are immovable even when the latch is released. The latches release because they are typically protected inside the window frame, but the exposed hinge mechanisms are seized. Regular inspection and lubrication of emergency exit hinges is essential for passenger safety.

106. A — The combustion chamber and exhaust pipe have no leaks (inspected and verified), so the exhaust gases are exiting at the designed outlet point. The odor must be re-entering the cab through a pathway that does not involve a leak. The most common cause is the exhaust outlet's position relative to the cab's fresh air intake — wind currents during driving carry the exhaust gases from the outlet to the intake, where the HVAC system draws them into the cab.

107. C — The wind noise is localized to a specific point (upper rear corner of the driver's door), and the seal appears intact. Even a visually intact seal may not compress adequately at a specific point if the door-to-body gap varies from designed dimensions — from a slightly shifted hinge position, a minor dent in the door frame, or body panel misalignment. The insufficient compression at that point allows high-speed air to penetrate the gap between the seal and the body.

108. B — All cab interior lights flickering at a constant 2 Hz regardless of engine RPM or vehicle speed indicates an electrical connection that is cycling between open and closed states at that frequency. A failing relay contact, a corroded connector pin, or a loose splice on the shared power circuit for the interior lights oscillates at the rate determined by the thermal or mechanical dynamics of the failing connection. The source must be isolated by inspecting all connections in the interior light circuit.

109. B — A 10 mm gap between the hopper door and the body allows grain to leak during transport. Highway speed vibration works the grain through the gap continuously, and the airflow around the trailer creates a suction effect that pulls grain through any opening. Over a long trip, the grain loss can be significant. The door mechanism, hinges, latch, and sealing surfaces must be inspected and corrected to achieve a complete closure.

110. C — The ABS system was functioning normally before the brake work, and a fault appeared immediately after. The brake technician may have damaged an ABS wheel speed sensor wire (by cutting, pinching, or pulling during shoe removal), dislodged a sensor from its mounting (changing the air gap), or disconnected the ABS ECU power during the work. The sensor wiring, mounting, and air gap at each wheel position that was serviced must be inspected.

111. A — Warped deck boards with raised lips at the joints create multiple operational and safety hazards. Personnel walking on the deck can trip on the raised edges. Forklift wheels catch on the lips during loading and unloading operations. Cargo packaging is damaged by the uneven surface during transport. The warped boards must be replaced with properly seasoned material or planed flat to restore a safe, functional deck surface.

112. D — The electric-over-hydraulic actuator produces hydraulic pressure from an electric motor/pump assembly and distributes it to both left and right brake circuits. If the left-side output circuit has a restriction (kinked line, contaminated fitting), a leak (loose connection, damaged hose), or trapped air that compresses under pressure, the left brakes receive less effective pressure than the right. The actuator's left-side hydraulic circuit must be inspected from the actuator outlet to the brake assemblies.

113. B — The TRU operated continuously and the return air sensor reads correctly, yet the cargo temperature rose 5°C. This suggests the refrigerated air is not reaching all cargo surfaces. Improper cargo stacking blocks the designed airflow channels — the cold air short-circuits from the evaporator back to the return air sensor without passing through the cargo mass. The sensor reads the return air temperature (which appears correct) while the cargo's core temperature rises from inadequate airflow contact.

114. C — The upper coupler plate and fifth wheel top plate must slide against each other during every turning movement, grade change, and backing maneuver. Without adequate grease, the two metal surfaces contact each other directly. The resulting metal-to-metal sliding under the trailer's full weight gouges both surfaces. The scoring increases friction, generates heat, accelerates further wear, and can cause binding during articulation that the driver may not notice until damage is severe.

115. A — Both right-side axle positions showing identical feathered wear on the inner ribs while the left side wears normally indicates the entire tandem group is shifted laterally. When the axle group is offset to the right of the trailer's centerline, all right-side tires are angled slightly outward (toe-out) relative to the direction of travel. This scrubbing angle produces the feathered wear pattern on the inside ribs of the right-side tires while the left-side tires track true.

116. D — When the supply gladhand is disconnected, the spring brake relay valve should close its inlet (to stop supply air from escaping) and open its exhaust (to vent the hold-off air from the spring brake chambers). If the relay valve's exhaust function has failed — the exhaust port is blocked, the internal exhaust valve is stuck closed, or the exhaust diaphragm has failed — the hold-off air remains trapped in the chambers and the power springs cannot extend to apply the brakes.

117. B — The system pressures are normal and the correct refrigerant charge is confirmed. The evaporator is functioning correctly from a refrigeration standpoint. The elevated vent temperature (15°C instead of 5-8°C) must be caused by insufficient airflow across the evaporator. A clogged cabin air filter, a blower motor running at reduced speed, or ice buildup on the evaporator from a blocked drain all reduce the volume of air passing through the cold evaporator, resulting in less total cooling of the airstream.

118. C — The HVAC mode door controls which duct outlets receive airflow. If the mode door is stuck in the floor position — from a failed actuator motor, a broken mechanical linkage, or a seized door pivot — all airflow is directed to the floor ducts regardless of the mode selected. The blower pushes air through the only available path. The defrost and dashboard ducts receive no air because the mode door physically blocks those pathways.

119. A — The rapid 2-second-on/1-second-off cycling with suction pressure dropping to 15 psi during each on cycle confirms a low refrigerant charge. The reduced volume of refrigerant is quickly compressed from the low side to the high side, dropping the suction pressure below the low-pressure switch's cut-out threshold within 2 seconds. The switch opens, the compressor stops, pressure equalizes above the cut-in threshold, and the cycle repeats. The system has a leak that must be located, repaired, and the charge restored.

120. D — The musty odor from the evaporator core is caused by microbial growth (mold and mildew) on the evaporator's surface. The evaporator operates at near-dew-point temperatures, and the continuous condensation creates a persistently moist environment ideal for microbial colonization. The growth produces the odor, which is strongest when the blower first activates because the initial air blast carries the highest concentration of microbial byproducts from the undisturbed colony. The evaporator must be treated with an antimicrobial agent.

121. B — The heated washer fluid contacts the cold windshield surface and some of the fluid evaporates on contact due to the temperature differential. The resulting water vapor temporarily condenses on the glass surface as a fog layer before being dispersed by the wiper blades. This is a normal, temporary phenomenon — the vapor dissipates within one or two wiper cycles. The effect is most pronounced in cold weather when the temperature differential between the heated fluid and the cold glass is greatest.

122. C — Visible mist from the evaporator vents during high-humidity conditions is normal. The evaporator cools the air below its dew point, causing the water vapor in the humid air to condense into fine droplets. These microscopic water droplets are carried out of the vent by the airflow as a visible mist. The mist is water vapor condensation, not refrigerant. This is the same phenomenon as seeing your breath on a cold day and is not a system fault.

123. A — Two identical expansion valve failures in rapid succession indicate a contamination source in the system that is reaching and blocking the valve. Common contamination sources include metallic debris from a failing compressor, decomposing desiccant from an old receiver-drier, sealant residue from a previous repair, or moisture that has formed ice crystals at the valve's orifice. The system must be flushed, the receiver-drier replaced, and the contamination source identified and corrected before installing another valve.

124. D — All other functions operate at full speed from the same pump, confirming the pump output is adequate. The slow telescope function with all other functions normal isolates the restriction to the telescope circuit's dedicated flow control or proportional valve. The valve is not opening fully — either from contamination on the spool, a worn spool bore, or an electrical fault on its control solenoid — limiting the flow reaching the telescope cylinder specifically.

125. B — A return filter element that is completely clean after 3 years of operation is not filtering — all return oil has been bypassing the element through the stuck-open bypass valve. The bypass valve should only open when the filter element reaches its maximum differential pressure (from contamination loading). A stuck-open bypass allows all return flow to pass directly to the reservoir unfiltered. The system has been operating without return filtration for the entire 3-year period.

126. A — Plugging the cylinder port isolated the cylinder from the directional valve. The drift stopped, proving the cylinder's piston seal is intact. The drift was caused by fluid crossing through the valve spool's internal clearance — from the cylinder's pressurized work port, through the worn spool-to-bore clearance, and out the tank return port. Isolating the cylinder eliminated this leak path. The valve must be rebuilt or replaced.

127. C — Hydraulic shock (water hammer) occurs when a column of moving fluid is suddenly stopped by a rapidly closing valve. The fluid's momentum creates a pressure spike at the valve face that reverberates through the system. The spike can reach several times the system's normal operating pressure, stressing hoses, fittings, and components. Operating the control lever slowly allows the flow to decelerate gradually, preventing the pressure spike.

128. C — The pump is rated at 15 GPM but delivers only 8 GPM at the correct engine RPM. The 7 GPM deficit is internal leakage — fluid bypassing through the pump's worn internal clearances instead of being pumped to the outlet. The pump can still build pressure (by compressing fluid against the relief valve), but it cannot deliver adequate volume for the cylinder to extend at normal speed. The pump must be rebuilt or replaced.

129. A — Air trapped in the rod end of the packer blade cylinder compresses during retraction. When the piston reaches the end of its stroke, the compressed air expands, pushing the piston back slightly before the air stabilizes. This bounce repeats with each cycle until the trapped air is purged. Incompressible hydraulic fluid would allow the piston to stop cleanly at end of stroke without any bounce-back.

130. B — The reservoir level drops during operation because the system's cylinders draw fluid from the reservoir when they extend. A properly designed reservoir accounts for the total volume displaced by all cylinders at maximum extension. If the reservoir is undersized (from an original design limitation or from cylinders added without increasing reservoir capacity), the level drops below minimum when the cylinders draw their combined volume from the reservoir.

131. D — The crimp passed a static pressure test but failed in service after 2 weeks. Static pressure testing subjects the fitting to a single, sustained pressure event. Operating conditions subject the fitting to thousands of pressure pulsations, vibration, thermal cycling, and mechanical flexing. An under-crimped fitting can pass the static test but gradually work loose under the cumulative effect of dynamic service conditions. The crimp dimensions must be verified with calipers against the manufacturer's specification.

132. C — Urban stop-and-go driving with heavy passenger loads consumes more energy per kilometer than suburban driving. Each acceleration from a stop requires high motor current proportional to the vehicle mass (including passengers). Frequent stops mean frequent high-current acceleration events that drain the battery faster. The heavy passenger load multiplies the energy needed for each acceleration. Additionally, the short distances between stops limit the energy recovered by regenerative braking because the braking events are brief.

133. A — The BMS monitors cell temperatures and starts the engine when thermal limits are exceeded. Even with adequate SOC and low power demand, elevated cell temperature triggers the engine start to power the vehicle's thermal management system (which typically uses the engine-driven A/C compressor to cool the battery coolant). Protecting the battery from thermal damage takes priority over fuel economy or emission considerations.

134. A — A 96-cell pack with 3.7V nominal per cell would read approximately 355V at nominal (50%) SOC. But cell voltage varies with SOC — at 100%, each cell reads approximately 4.2V (pack ~403V); at 0%, each cell reads approximately 2.5V (pack ~240V). The measured 348V corresponds to approximately 3.63V per cell, indicating the battery is at a moderate SOC below nominal. This is normal voltage variation, not a fault.

135. B — The truck charges normally on Level 2 AC (onboard charger circuit) but fails on DC fast charging (separate DC charging circuit). The two charging systems are independent — the onboard charger converts AC to DC and charges through one circuit, while DC fast charging bypasses the onboard charger entirely and uses a separate inlet, contactors, and communication protocol. A fault specific to the DC charging circuit (inlet, contactors, communication, or BMS DC-charge enable logic) prevents DC charging while the independent AC circuit functions normally.